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8th International Soil Science Congress on "Land Degradation and Challenges in Sustainable Soil Management"

May 15 - 17, 2012   Çeşme - İzmir / TURKEY

PROCEEDINGS

Volume-I

Deforestation, Overgrazing and Desertification
Land Degradation, Remediation and Reclamation
Wetland Soils and Climate Change

EDITORS
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Dr. M. Tolga ESETLİLİ
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PROCEEDINGS BOOK

http://www.soilcongress.ege.edu.tr

This book of proocedings has been prepared from different articles sent to the congress secretary only by making some changes in the format. Scientific committee regret for any language and/or aim-scope

Takım Numarası: 978-975-96629-6-7 (tk.)

ISBN: 978-975-96629-7-4 (1.c)

Printed by DEMFO Dijital Baskı ve Ofset +90 232 342 72 50

May 2012, İZMİR-TURKEY

PREFACE I

The 8th International Congress on Soil Science was held at the Altınyunus Hotel in Çeşme, Izmir, Turkey, from May 15th to 17th, 2012. The theme for this year was “Land Degradation and Challenges in Sustainable Soil Management”. The congress was organized by Ege University’s Department of Soil Science and Plant Nutrition, (Agricultural Faculty), and The Soil Science Society of Turkey (SSST). The congress also hosted the 6th International Conference on Land Degradation (ICLD).

The organization of International Soil Science Congresses is a long established custom for the SSST.
The 8 congresses held so far are listed below:

1998, Izmir:	1st International Congress on Soil Science
2000, Konya:	2nd International Congress on Soil Science
2002, Çanakkale:	3rd International Congress on Soil Science, organised by Onsekiz Mart University
2004, Erzurum:	4th International Congress on Soil Science, organised by Atatürk University
2006, Şanlıurfa:	5th International Congress on Soil Science, organised by Harran University
2008, Aydın:	6th International Congress on Soil Science, organised by Adnan Menderes University
2010, Samsun:	7th International Congress on Soil Science, organised by Ondokuz Mayis University
2012, Izmir:	8th International Congress on Soil Science, organised by Ege University

For this 8th International Congress we received more than one thousand abstracts from 54 countries worldwide. After a rigorous evaluation process, 655 of these were chosen for presentation either as seminars or posters during the congress.

There were two plenary lecturers: Prof. Richard Dick from Ohio State University, spoke on soil microbiology and Prof. Dr. Sergei Shoba from the Faculty of Soil Science, Lomonosov Moscow State University, talked about the challenges of soil degradation in arid areas.

The papers have been organized into five volumes according to topics for the Congress Proceedings Book The on-line version of these volumes is accessible at: http://www.soilcongress.ege.edu.tr.

We would like to take this opportunity to express our thanks to all the authors for their efforts in the preparation of these excellent contributions.

Yusuf KURUCU, Ph.D in Soil Science
Chair, The 8th ISSC 2012

PREFACE II

Today the world community has recognized the importance of sustainable use of soil, which is one of the key life-supporting components on the earth. As suggested in UN Conference on Environment and Development (UNCED) in 1992, soil degradation caused by over exploitation of fragile resources and misuse of marginal areas, degrease of potential agricultural areas by sealing, uneven distribution of potentially cultivable areas, declining trends in per capita food production, lack of adaptation of improved technologies by subsistence farmers, non-availability of essential off-farm input to resource poor farmers, and problems such as soil-mining should be considered in soil resources management plans.

Action programs are needed to protect and improve soil health by developing thematic strategies toward protecting soils from numerous of threads such as erosion, decline of organic matter content and biodiversity, sealing, soil salinizaiton, alkalinizitaion, flooding, and many others. Function of soils in environment in relation to human activates should be understood well to manage the soils without declining their quality. Unique role of a specific soil type for environment and human activities should be considered in managing soils to secure soil health, water quality, and food and fiber production for future generations. The evidence that we all depend on the thin layer of earth should be articulated to the people with no knowledge of soil and its importance. In addition, high quality technical information should be available and ready for growers, decision makers, government agencies, and so on for an effective use of science and technology in soil management.

This congress was organized to discuss issues in "land degradation and challenges in soil management". Interactions among soils, land degradation, and desertification were discussed and importance of soils for a better environmental quality and food security was stressed in the three-day congress. Poster and oral presentations covered a large spectrum of subject areas; including computer modeling, digital mapping, and new techniques and technologies used in data mining, decision making, and other related areas.

I trust that this proceeding will make a vigorous contribution to theoretical and practical soil science, and generate a prolific interest for appreciation of soil's importance to public well-being. I thank Organizing Committee and all worked and appreciate them for this high quality work.

Sabit ERŞAHIN, Ph.D in Soil Physics
President of Soil Sicence Society of Turkey
President of The Eurasian Federation of Soil Science Societies

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VOLUME I

Deforestation, Overgrazing and Desertification
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Plenary Lectures

Native Shrubs *Piliostigma reticulatum* and *Guiera senegalensis* as Companion Plants: Rhizosphere Hydrology and Microbiology in Relation to Crop Productivity in the Sahel

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[7]*World Bank, Washington, D.C. USA ;*
[8]*International Fertilizer Development Center, Accra, Ghana ;*
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The Sahel is experiencing landscape and soil degradation that reduces food and economic security of rural, underprivileged communities that depend on ecosystem services. The Parkland system of randomly distributed trees is an approach to address these challenges, but trees are slow growing and can compete with crops for water and nutrients. Conversely, two native shrubs, *Piliostigma reticulatum* and *Guiera senegalensis,* coexist in farmers' fields throughout the Sahel and until recently have largely been overlooked. It is well established that organic matter input to the soil is critical for improving soil quality and optimizing nutrient and water efficiencies, and ultimately crop productivity in the Sahel. Various non-indigenous vegetative systems have been proposed for the Sahel, but with limited adoption in cropped fields. Consequently, these two shrubs being indigenous and already found in farmers' fields to varying degrees, hold potential to meet these challenges. Unfortunately, the current management of spring coppicing and burning prior to cropping, is not utilizing this organic matter effectively. There has been very little research on how to ecologically or agronomically manage these shrubs. *Therefore, the global objective was to determine the unrecognized ecological function of these shrubs in agroecosystems of Senegal that are representative the Sahel*. To test these hypotheses, our team over the last 5 years, has conducted extensive field based investigations in the Peanut Basin of Senegal that included: ground surveys and remote sensing to determine the landscape levels of shrub C and biomass; hydrology and water relations between shrubs and crops; rhizosphere microbiology; residue decomposition; N and P cycling in relation to crops; and crop productivity. The project, funded by US National Science Foundation, graduated 4 PhD students and 3 post docs. The major findings in Senegal are that:

- shrubs are by far the largest source of organic matter on the landscape in cropped fields
- shrubs increase soil quality
- decomposition rates are rapid enough to allow non-thermal residue management
- shrub roots perform hydraulic lift by moving water from wet sub- to dry surface-soils that appears to drive microbial processes year around and assist crops through drought periods

- shrub roots recharge groundwater in the rainy season, reducing runoff and conserving water
- shrub rhizospheres promote microbial diversity and may harbour beneficial microbes
- intercropped shrubs do not compete with crops and actually stimulate yield by >50%
- repeated application of these low quality residues (in absence of live shrubs) begins increasing yields after 2 years.

Keywords: *Piliostigma reticulatum, Guiera senegalensis***,** soil remediation, Sahel, crop productivity

Soil Degradation Challenge in Arid Areas: The Role of Soil Databases and Soil Information Tools

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Abstract

Soil degradation is the biggest challenge to food security in the new millennium. Climatic change and increasing human pressure on ecosystems results in the extensive degradation of landscapes, especially in dry areas. Desertification is the major problem for agricultural development and for providing food for population in many regions of the world, including Eurasia. Both the south of Russia and neighboring suffer desertification, which consists of various complex processes, including the processes of soil degradation, such as salinization, compaction, organic matter loss etc.

In the context of soil conservation and protection we should develop scientific tools for effective prognosis of short-term and long-term soil degradation under scenarios of different land use and different paths of climatic changes. A reliable prediction is possible only on the basis of the most complete information on actual soil resources. The first component of soil information is the presence of soil databases, which allow spatial interpolation, data mining, and spatial and temporal modeling. The necessary feature of these databases should be a user-friendly format of data storage that allows multiple data management.

Our actual activities are aimed at the development of soil data storage system, the tools for effective soil data management, and the collection of legacy soil data. The main issues to be solved are poor compatibility of data in different regions, imprecise coordinates of soil pits in previous surveys, and low response from regional administrative bodies. However, with increasing desertification the attention to soil data should increase.

Keywords: land resources, sustainable development, risk evaluation, Russia, Central Asia.

Introduction

Despite of the impressive progress in technology, modern civilization is still completely based on agricultural production. The entire population of the Earth depends on the products obtained from soil either as crops or as forage. The development in agricultural technology is impressive, and now we can produce much more yields than few decades ago from the same area (Shoba, 2009). However, the population is growing rapidly, and we do not know, if the increase in productivity can compensate the increasing need in food and a loss of productive lands. The loss of productive arable lands is a widespread process that takes place all over the world due to various reasons, such as urbanization, soil erosion, desertification and many others. Some of these reasons are universal, and some of them are landscape-specific. One of the most vulnerable zones is the arid belt of Eurasia that is strongly affected by a complex of degradation processes associated with desertification.

Desertification is the major challenge for land management in many Eurasian countries. In the most severe cases we have to make difficult decisions on land use change and even change the whole strategy of the development of national economy. Soil degradation leads to food insecurity, poverty, and thus social instability. Even if a state has stable economy based on industrial production or mining industry, agriculture is a life-spring for millions of people who inhabit dry areas. For their sustainable living we should maintain a certain level of soil productivity, even taking into account progressing climatic changes.

For maintaining soil productivity and for successful planning of soil improvement and management we should have a complete set of data that characterize soil and water quality. In this short review we tried to show the state-of the art with soil resources information in Russia and neighboring Central Asian countries, and to outline the perspectives for future development.

Soil information in Russian drylands

Though Russia is traditionally considered to be a cold and humid country, its vast territory also possesses some areas with dry climates, where soils run the peril of drought (Fig. 1). These areas are localized mainly along the southern border of Russia, both in the European and Asian parts. The soils in these dry areas are affected by the degradation processes, which are common for most arid regions, such as salinization, alkalinization, wind erosion, and desertification (that is understood as a complex combined process). A comparison of the maps of drought probability and the distribution of the processes of soil degradation (Fig. 2) shows that there is a good agreement between dry soil regime and the distribution of the specific degradation processes mentioned above. Speaking more specifically, such process as salinization is widespread mostly in the southern part of European Russia, in Dagestan and Kalmyk Republics and in Volgograd region. In Asia most of saline soils are found in Novosibirsk, Omsk, and Altay regions. Alkaline soils are common in Kalmyk Republic and Volgograd region in European part of the country, and in Novosibirsk and Omsk regions in Siberia. Though desertification is not very common in Russia, being active only at 7% of the national territory, it strongly affects agricultural production. This negative process is especially dangerous in Kalmyk and Dagestan Republics, Astrakhan, Volgograd and Rostov regions (with lesser extent in Orenburg and Saratov regions) in European Russia, and in Altay and Omsk regions and Tuva, Khakassia, and Buryatia Republics in Siberia.

The processes of wind erosion are very active in dry areas. Totally 8.4% of the agricultural lands in Russia are affected by deflation; these are localized mainly in Stavropol and Krasnodar regions and in Kalmyk and Dagestan Republics (European part of Russia) and in Altay region and Khakassia Republic (Siberia).

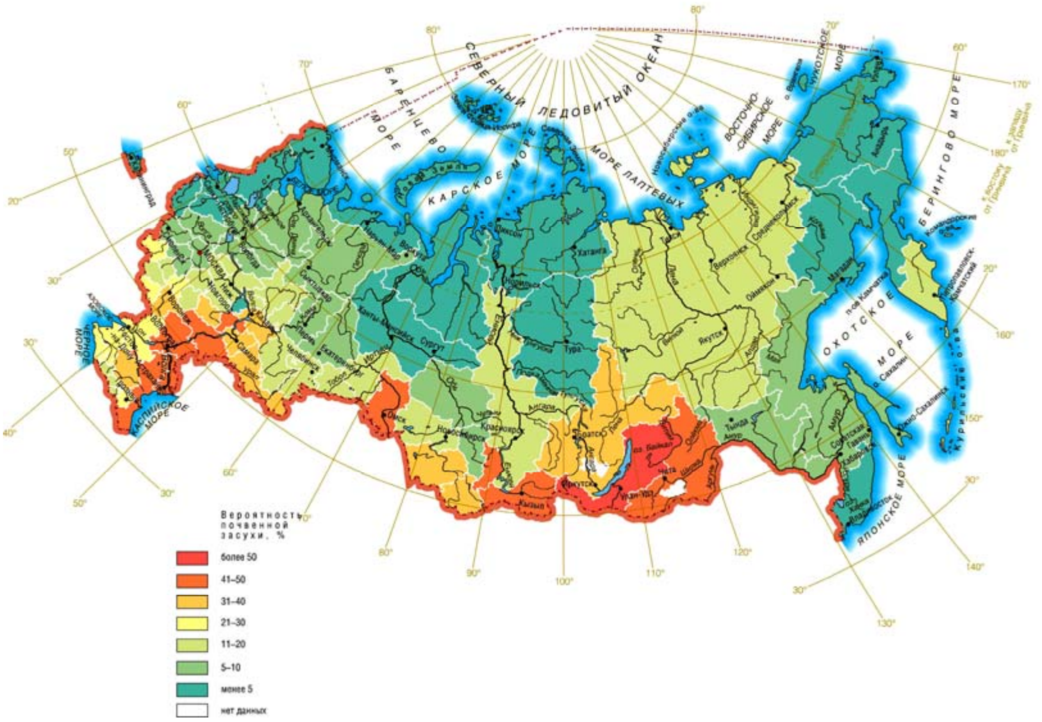

Fig.1. Schematic map of the probability of soil drought in Russian Federation. Red colour shows the probability of drought more than 50% (Shoba, 2011).

The other negative process usually associated with desertification is the loss of soil organic carbon. In the arid regions of Russia the balance of soil organic carbon is strongly negative that shows that the organic matter decomposes quickly in these soils (Fig. 3). Though arid soils usually have a positive balance of carbon from the point of view of global carbon cycling due to accumulation of carbonates, the loss of organic matter is a negative process resulting in the degradation of soil physical and chemical properties and in the decline of soil fertility.

In the context of soil conservation and protection we should develop scientific tools for effective prognosis of short-term and long-term soil degradation under scenarios of different land use and different paths of climatic changes. A reliable prediction is possible only on the basis of the most complete information on actual soil resources.

During the second part of the 20th century the soils of Russian drylands have been extensively studied, that allowed the development of soil and land evaluation maps of various scales, starting from the most detailed (1:10,000) to the most general (Shoba et al., 2010). These maps are valuable sources of information, but they have certain disadvantages. First, particular soil profiles seldom have exact coordinates. Second, some data are already outdated after several decades of anthropogenic transformation of soils. Third, the major part of this information existed only in paper form, and some important blocks of information are already lost.

Actually for successful soil data management, the first component of soil information is the presence of soil databases, which allow spatial interpolation, data mining, and spatial and temporal modeling (Panagos et al., 2012). Leaving apart an urgent need for updating soil data, the closest and the most reliable task is the development of soil database for Russia and possibly for neighboring countries. The necessary feature of this database should be a user-friendly format of data storage that allows multiple data management.

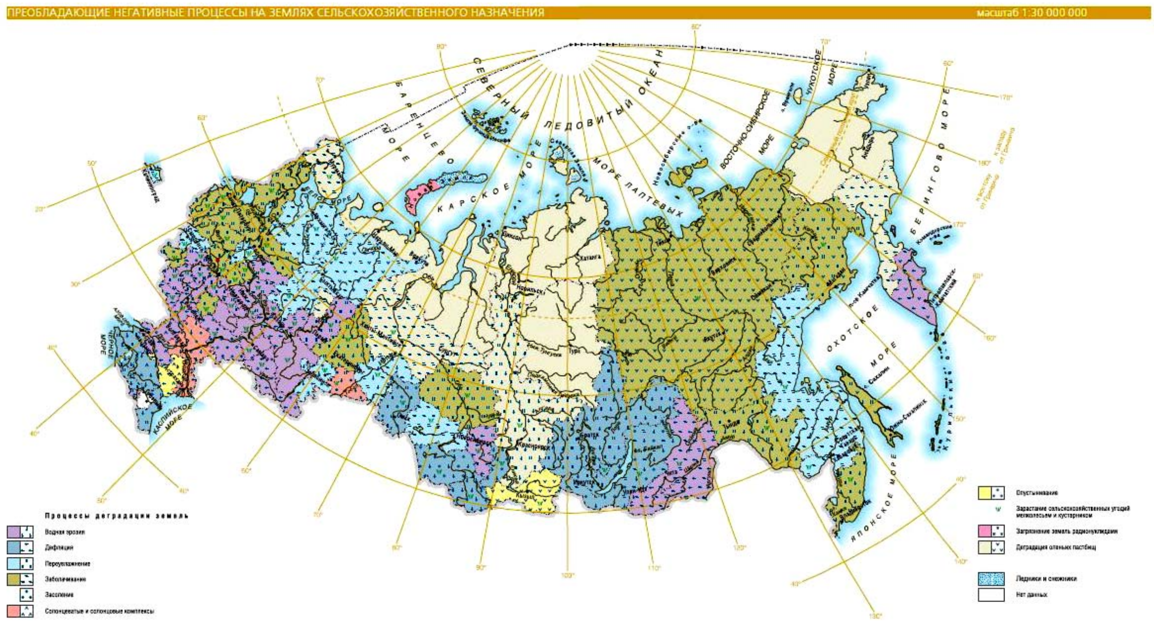

Fig.2. A schematic map of the processes of soil degradation in Russian Federation. Dark blue colour is for wind erosion, and yellow – for desertification (Shoba, 2011).

The development of such a soil geographical database started at the Faculty of Soil Science of Lomonosov Moscow State University several years ago (Shoba et al., 2008). The main blocks of the soil geographic database are the geographic database and the specialized attributive database (Rojkov et al., 2010). Relational Database Management (RDMS) System is used for data storage and processing. The Geographic Information Soil Database (GISD) forms the cartographic basis of the State Soil-Geographic Database of Russia. It consists of two digital coverages in MapInfo Professional. COVERAGE 1 is a digital map uniting the Soil Map of the RSFSR on a scale of 1: 2.5 M edited by Fridland (1988), and the digital map of the soil-ecological zoning of Russia. COVERAGE 2 is the digital map of the administrative division of Russia at a scale of 1:1 M. The soil profile (attributive) database of Russia is based on the concept of representative soil profiles (Kolesnikova et al., 2010). The database has a hierarchical structure ensuring soil description at several levels: SOIL–PIT–PROFILE–HORIZON–SAMPLE. The main object of the database is a specific soil profile with a set of soil horizons characterized by attributive data. The representative profiles should have an exact geographical location and be provided with a morphological description and a complete set of analytical data. The necessary conditions for the selection of representative profiles are: strict gridding of each soil profile, the most complete description of soil morphology, and the most extensive list of analytical soil characteristics (Shoba et al., 2011). The method of analysis, the units of measurement and the range of variation of each soil characteristic included in the database should be indispensably mentioned. For facilitating that, we developed uniform standards for soil information. The Program Soil-DB allows a provider of information to login in the site, to create and fill the soil description card, and to send it through Internet to the central server of the system (Anonimous, 2008). All necessary information on the properties and composition of soils is acquired by selecting representative soil profiles characterizing the main soil types in a generalized legend to the soil map on a scale of 1:2.5 M. Recently we started a joint project with neighboring countries for harmonizing the Russian, Ukrainian, and Belorussian soil databases.

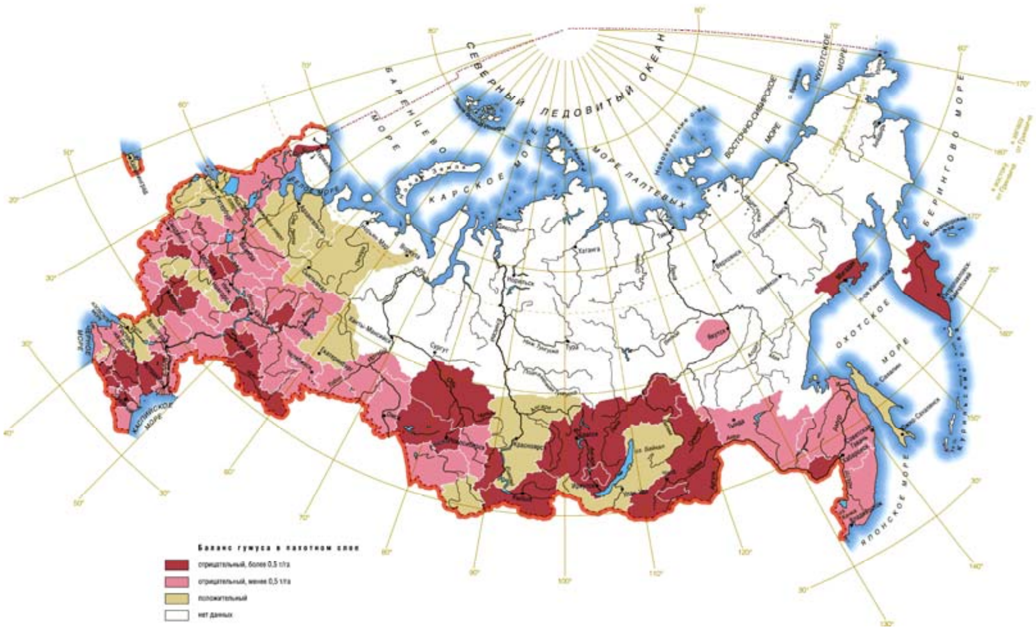

Fig.3. A schematic map of the balance of soil organic carbon in Russian Federation. Dark brown colour indicates strongly negative balance (Shoba, 2011).

Soil information in Central Asia

In the USSR the Central Asian region was always one of the most important centers of agriculture, because the climate allowed mellow-growing and especially extensive cotton production, which was impossible in other parts of the country. This epoch was both a time of great achievements in agriculture and a period of major negative impact on soils, especially related to secondary salinization. Several big state institutions and companies worked on the development of maps and explanatory notes on the land and water resources of Central Asia, with an emphasis on land improvement (irrigation, irrigation with drainage, chemical amelioration etc.). These data are important sources of information. Actually the Eurasian Center for Food Security of Lomonosov Moscow State University works on digitizing and publishing these materials on the web. Apart from this effort, we are discussing the possibility to include the information available on soil profiles of Central Asian countries in the joint Soil Database of Russia, Ukraine and Belorussia. We suggest using Soil DB tools for uploading the available soil information in Central Asia. The advantage of Russian Soil Database is that it can be easily converted to other soil database. Thus, the information would be integrated in the international data storage.

In Central Asia soil information obtained during the second part of the 20th century is of particular importance, because it can be used as a reference for soil monitoring, especially for irrigated areas suffering strong anthropogenic impact that have lead to soil salinization. The use of time series of remote sensing data may be also a good option for soil monitoring.

Perspectives of the use of soil databases

The perspectives for the future use and management of soil databases may be grouped in two main lines of research. Firstly, extensive soil information allows spatial modeling, and, secondly, it allows the prediction of the dynamics of soils on the basis of data mining, pedotransfer functions and dynamic models of the processes of soil degradation. These two lines are commonly interlinked, if we need to perform a spatial prediction of modeled variables.

The development of pedotransfer functions is of major importance for successful development of the guidelines for soil monitoring, land management planning and soil improvement. Usually the final user of soil information needs data in a format completely different from the primary soil data. The decision-makers do not care about pH values or electrical conductivity, they have to know, if the productivity of crops will be high enough to cover the investments to soil amelioration and management. This information may be produced only on the basis of pedotransfer functions, which, in their turn, can be obtained by data mining. For successful data mining we need thousands of soil profiler, otherwise any prediction and modeling would be baseless. Thus, both the development of information tools and filling the databases with reliable data are important components for information support of agriculture in dry areas.

Our task is to bring essential soil information to the decision-makers. Unfortunately, until now the response from regional administrative bodies is very low. However, now the situation changes slowly, because the governing bodies start to understand that soil degradation limits agricultural productivity, and, thus, the income of the population. Since increasing desertification leads to a drastic decrease in available soil resources and provides instability in agricultural production and food insecurity, the attention to soil data should increase.

Acknowledgements
We would like to express our gratitude to the Russian Foundation for Basic Research, which partly supported this research, project No. 11-04-90356-РБУ_а.

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ORAL PRESENTATIONS

WETLAND SOILS AND CLIMATE CHANGE
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DEFORESTATION, OVERGRAZING AND DESERTIFICATION

ORAL PRESENTATIONS

A New Approach on Combating Desertification and Erosion in TURKEY

Hanifi AVCI*

*General Director of Combating Desertification and Erosion

Abstract

The most important problems of our country's land are erosion and land degradation. According to surveys and assessments of Soil-Water Directorate (TOPRAKSU); 7% of the country's lands are mildly, 20% moderate, 36% severe, 22% very severely exposed to erosion. It's inevitable to conserve and improve the productivity of the lands that are sensitive to erosion and showing tendency to desertification because of different climate zones and very rugged topography. But for the last fifty years, only in about 8-10% of the eroded areas necessary erosion measures have been taken. Whereas to combat erosion and desertification which are the main reasons of rural poverty, all necessary soil conservation measures should be taken. Taking into account the vital importance of the subject, within the framework of restructuring, the General Directorate of Combating Desertification and Erosion (ÇEM)which is established within the Ministry of Forestry and Water Affairs, is aiming to combat desertification and erosion with a new approach by creating more efficient and solution-oriented strategies, as the owner of the subject.
To combat desertification and erosion actively and consciously, it aims to produce local and regional watershed-based solutions with the participation of the public, civil society organizations, the academics, practitioners and local people.
In this paper the dimensions of desertification and erosion in Turkey, and the solution-oriented works of the General Directorate of Combating Desertification and Erosion are described.

Keywords: Desertification, erosion, CDE, soil conservation.

Soil Resources and Problems in TURKEY

The first soil map of the entire country was prepared in 1954 by the American expert Harvey OAKES in 1/800.000 scale. In this exploratory mappings, the soil classifications applied in the U.S in 1938 was taken as the basis. In 1955, under the chairmanship of an American expert F.K.NUNNS, Çukurova lands were studied by the experts of Ankara Soil and Fertilizer Research Institute. Then at the end of the 1950s, Turkey's soil was examined in terms of soil erosion by Prof. Dr. Orhan YAMANLAR and a report was prepared on behalf of the General Directorate of EIEI. By the General Directorate of abolished TOPRAKSU (Soil Conservation and Agricultural Irrigation), comprehensive soil maps were created between the years 1966-1971 with 70 soil analysts' works throughout the country. By working on the 1/25.000 scaled topographic maps, 1/100.000 scaled soil maps on a provincial basis and 1/200.000 scaled soil maps on a basin basis were prepared and published. However, because of the rapid changes in land use, to correct some of the deficiencies and to be a basis for land use planning, the General Directorate of TOPRAKSU, revised the soil maps with the "Turkey's Soil Potential Studies and Non-Agricultural Land Use Planning" Project, between the years 1982-1984. Again in 1978 by TOPRAKSU, the "Turkey's Soil Productivity (TOVEP)" Project was implemented and for each province 1/100.000 scaled soil productivity maps were made. Also basin based soil studies were made by General Directorate of the abolished Rural Affairs and DSI, for irrigation and land-use planning. In all of these mapping studies, the soil classification which the U.S. adopted in 1938 was applied. These works have been completed with great sacrifice and effort under the terms of that time. However, because of the developmental dynamic nature of our country and the new models developed in the soil classifications, the soil maps that were done in the 1970s must be replaced. Mapping studies can't be done according to the new classifications to our country's land properties so we are forced to define them according to the 1938 U.S. principles of classification.

According to these soil maps which were done by this classification and collects the soils under 23 Large Soil Groups;
-Large Soil Group,
-The combination of soil properties (gradient- depth)
-Other soil properties (salinity, alkalinity, stoniness, drainage status)
-The present status of land use.

-Land capability class.
-Sub-class (main problem, second-degree problem)
-Important agricultural lands (with colors).
were defined.
As you can see our existing soil maps are based on a pathogenic system.
This classification which does not contain a lot of newly defined soils, has been abandoned by many world nations because of being inadequate.
Today, countries turned to new systems such as Soil Taxonomy, FAO, UNESCO and WRB 8 World Reference Base in their mapping studies. For this reason it's useful to do soil mappings in our country according to FAO/UNESCO soil classifications. Also it is not possible to say that existing soil erosion maps are reflecting the full facts exactly. Because the erosion classifications are not based on measurements, they are done according to the views and experience of the analyst. So, to make an erosion classification based on measurements and synthesizes soil properties, topoghraphy, vectors, vegetation cover and climate data, will be more realistic.
Until the studies that will be done according to these new approaches, the existing data were used while evaluating our land resources.
7% (5.6 million hectares) of Turkey's land is exposed to mild, 20% (15.6 million hectares) to medium, 36% (28.3 million hectares) to severe and 22% (17.4 million hectares) to very severe erosion.
According to the measurements and evaluations of the General Directorate of EIEI, 210 million tons of sediment (Dispersible + Bed load) is transported per year.
When sediment delivery ratio is taken 20%, a total of 840 million tons of soil throughout the country, is lost with erosion per year.

- According to the soil depth classification;
  - 15% deep or very deep +90 cm
  - 13% medium deep 51-90 cm
  - 32% shallow 21-50 cm
  - 40% very shallow < 20 cm

- According to the land inclination classification;
  - 12,5% flat or nearly flat less than 2%
  - 11,0% slightly inclined 2-6%
  - 14,5% medium inclined 6-12%
  - 16% steep inclined 12-20%
  - 46% very steep more than 20%

- The amount of saline soils;
  - Mildly saline 615 thousand hectares
  - Saline 505 thousand hectares
  - Sodic 9 thousand hectares
  - Mildly saline sodic 126 thousand hectares
  - Saline-sodic 265 thousand hectares

reaching a total of 1.520.000 hectares.

In addition to these data, 21,5% of agricultural land contains very low, 43,8% low, 22,6% medium, 12,2% good and high organic material.
According to analysts conducted by TOPRAKSU, 34,6% of country's land area is I.,II.,III. and IV. Class lands. These soils are suitable for cultivation-agriculture. However, the remaining 61.2% of the land area is mostly unsuitable for cultivation but have to be kept under continuous vegetation (rangeland and forest). For this reason, a land-use planning on a country wide or regional scale is inevitable. As can be seen, country lands have a lot of problems. Especially erosion and according to the UNCED 92 decisions, desertification; are our most important environmental problems. To eliminate rural poverty and meet the needs of the growing population, protecting the land resources and maintaining sustainability is essential for the future of our people. Therefore, the conscious management of natural resources is necessary.

The primary task of the **General Directorate of Combating Desertification and Erosion (CEM)** which is established within the framework of restructuring the Ministry of Forestry and Water Affairs, is to provide conscious management of our land resources, and to develop models and strategies in this matter.

As the General Directorate of Combating Desertification and Erosion, in the **Combating Desertification and Erosion subjects**;

- Determining policies and strategies,
- Helping the inventory of natural resources,
- Creating a data base in cooperation with relevant institutions and organizations, to determine the land resources,
- To do planning, monitoring an evaluation on national and regional level, for the protection of land resources,
- To create desertification and erosion prevention, avalanche, landslide and flood control, and integrated watershed management projects,
- To create action plans to combat desertification and erosion, and monitor the implementations,
- To ensure the preparation of the erosion mappings according to quantitative data,
- To contribute to the mapping of soil resources according to the new methods,

will be its main duties.

A lot of projects relevant to these subjects were implemented in 2011 and these works will continue with new projects in 2012.
There will be cooperations with national and international institutions and organizations while doing these works.
Also by creating sustainability providing projects for the benefit of the local people with relevant public institutions and organizations which will support these functions, as well as civil society organisations and local communities, we will develop mechanisms which provide the conscious use and protection of our most important assets- soil and water.
Also on every combating desertification and erosion based study, cooperation with international organizations on every level will be considered with a new approach.
Also national and international experts on the subject will be provided to help with the protection of our soil resources which are vital, and combating desertification and erosion.

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In-Situ Wind Erosion Measurement and Soil Loss Estimation: Karapınar Case Study

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Extended Abstract
Wind erosion is among the most significant reasons of desertification in arid and semi-arid regions. Although 450.000 ha land area is under the effect of wind erosion in Turkey, there aren't any detailed in-situ measurements and detailed research and estimation methods to evaluate the severity of the cases. Since direct measurements have not been available or not published in a study, reliable data about extend of wind erosion impacted lands and amount of soil loss are not also available. This research was carried out at Konya-Karapınar experimental station to evaluate the soil loss due to the wind erosion by case-based direct measurements and to evaluate the extent of the wind erosion. The research region is defined as the most arid part of Turkey and annual average rainfall is approximately 265 mm. An average wind speed in March can be higher 25 m s^{-1}. In the study, sediment flux rates (kg m^{-1} s^{-1}) for two different land uses (agricultural and pasture land uses) having different surface characteristics were measured with two replicate parcels. For that, a meteorology station and BEST type sediment traps were located in the experimental areas. A total of 12 measurements were performed from 4 plots at 3 cases from March until May in 2011. Grid sampling was carried out over agricultural lands and randomized sampling was performed over pasture lands at 20 different locations. Sediment fluxes for each case were modeled by the exponential model and 480 mathematical models were calculated for the total 8 wind erosion cases. The Case duration of each storm case was measured by a saltiphone, and sediment flux rates for each measured point in 1 meter height were calculated. Then, the spatial wind erosion maps were prepared by using geostatistical methods. The results indicated that wind velocities did not show significant variation, and durations were mostly varied for all cases. For example, in agricultural research area, the measured average wind velocities for 4 cases were 6.7, 7.0, 6.9 and 6.3 m s^{-1}, durations for measured cases in agricultural land uses were approximately 180, 480, 420 and 60 minutes. The highest sediment flux rate was obtained for agricultural land use as 0.191 kg m^{-1} h^{-1} and lowest was 0.077 kg m^{-1} h^{-1} for pasture use. The coefficient of variation for the sediment flux rates was changed between 39 and 68 per percent for all cases. Obtained variation in sediment flux rates is closely related to organic matter content, soil texture, aggregate size distribution, soil moisture, soil roughness, variation of plant cover by time and the measured wind velocities of experiment parcels.

Keywords: Wind erosion, Karapınar, BEST, spatial distribution, geostatistics

Deforestation Effects on Some Soil Properties in North of Iran

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Abstract

Forests are a valuable source which contributes significantly to economy and provides environmental stability, regional climate stability, regulate rainfall patterns, reduce sedimentation load. Deforestation has been recognized as one of the biggest environmental problems, main elements of land productivity changes and one of the biggest factors which threaten world's environmental variety. Due to high organic matter and strong structure, the forest soils in north of Iran are potentially productive. This study was conducted on 4 different sites to show the effects of land use converting on some soil properties. Soil samples were collected from adjacent natural forest and tea gardens. These were taken at upper 30 cm and use to measure soil total Nitrogen (N), available Phosphorous (P), and Potassium (K), Calcium (Ca) and Magnesium (Mg) contents, C/N ratio, soil reaction (pH), cation exchange capacity (CEC), electrical conductivity (EC) and soil organic carbon (OC). Results showed after 20–40 years of change forest to tea gardens caused that the soils in the natural forest lands had significantly different total Nitrogen, available P and K, and exchangeable Ca and Mg contents, compared to soils under tea gardens ($P>0.01$). Compared to tea gardens, the soils in the natural forest lands had significantly higher pH, CEC and OC compared to soils under tea gardens ($P>0.01$). In contrast changes of EC due to time of harvesting and use of fertilizer were irregular, and changes of C/N ratio didn't have significantly differed.

Keywords: Deforestation, Forest, Land Use, Nitrogen, Tea.

Evaluation of Soil Degradation in Different Rangeland Management Systems Via a Soil Quality Approach in Central Iran

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Abstract: A four-year investigation (1999-2002) was conducted to understand the changes of soil functions caused by different management systems in a semiarid rangeland of central Iran. In 1999, two sites, a reserved and a disturbed pasture, were analyzed for organic carbon (OC), total nitrogen (TN), microbial respiration (MR), aggregate mean weight diameter (MWD), and infiltration rate (IR) of the surface soil. Complete grazing exclusion of the rangeland has resulted in higher OC and MR with no effect on the amount of TN and IR. The apparently negative effect of this management system was a decrease in aggregate stability due to crust formation in bare surfaces between plant patches. However, MWD was significantly higher in samples taken under vegetation as compared to bare soil. In 2002, a third land use, a controlled (every four year) grazing management system, was added to the previous sites; and in addition to OC, MR, and TN, phosphatase activity (PA), saturated hydraulic conductivity (Ks), bulk density (BD) and the ratio of water dispersible clay to total clay (Cl_{WD}/Cl_T) of the three sites were measured. Among physical indices, only BD showed to be sensitive to different management practices. Disruption of the soil surface due to overgrazing followed by cultivation in the disturbed site has culminated in a significant decrease of BD compared to the other sites. OC and PA tend to be highest in reserved rangeland and lowest in disturbed rangeland. As for MR and TN, the highest values were observed in reserved rangeland and the lowest values in disturbed as well as controlled-grazing rangeland. Although it was suggested earlier that controlled grazing management may improve soil quality attributes compared to complete grazing exclusion, but our research did not support it, at least as far as selected biological indices are concerned.
Keywords: Soil Quality, Soil Degradation, Semiarid Rangeland, Sustainable Rangeland Management

Reforestation Possibilities in the Abandoned Boron Mine in Günevi, Bigadiç

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Abstract

This study was carried out at Günevi Open Pit Mine in Bigadiç, Balıkesir, Turkey by planting various plant species and sowing Turkish red pine (*Pinus brutia* Ten.) seeds in order to determine boron tolerant species suitable for reforestation of the former mine area.

The species that are already present in the vicinity were tested, such as Turkish red pine (*Pinus brutia* Ten.), sessile oak (*Quercus petraea* Mattuschka Liebl.), terebinth (*Pistacia terebinthus* L.), black locust (*Robinia pseudoacacia* L.), Italian cypress (*Cupressus sempervirens* L.), oleaster (*Elaeagnus angustifolia* L.), tamarisk (*Tamarix tetrandra* Palas ex Bieb.), Spanish broom (*Sparteum junceum* L.) and salvia cistus (*Cistus salviifolius* L.). Boron concentrations in the soil and in the plants were measured, condition of the plants, and indications of boron existence were recorded.

Boron concentration was very high in most of the area. Plants were not able to survive with very high boron concentrations (9.9-10.4 ppm), but survived with relatively low concentrations (< 3 ppm) by the end of the 4th year. Turkish red pine and tamarisk species were the most consistent to survive among the species planted in the area.

Keywords: Boron, open mine, plant species, reforestation

1. Introduction

The boron ore beds, located in northern Bigadiç in Balıkesir, were discovered in 1950. Bigadiç borate basin is situated in an area covered by an old neogenic tectonic lake. Colemanite and ulexite are dominant over other boron minerals in the two borate zones in the basin (Helvacı and Alaca, 1991; Helvacı, 2003).

The mining activity in the Günevi Open Mine, conducted by the Bigadiç Eti-Bor Operational Directorate, was terminated in 1998. Because the area was previously registered as a forest area and mining is finished in the area, according to the law, it is to be consigned to Bigadiç Forest Operational Directorate -after rehabilitation and reforestation by Eti-Bor, Inc.

Turkey holds 63% of the boron reserve in the world, that is, approximately 803,000,000 tons. 10% of the boron minerals produced is used in its original form. The rest is used to produce boron-based products. Boron is also used in glass, ceramic, cleaning and bleaching products, anti-flammable substances, agriculture, metallurgy and nuclear applications (Anonymous, 1995).

The average concentration of boron in the earth's crust is 10 ppm. In igneous-volcanic rock it is 5-15 ppm, and can be up to 100 ppm in sedimentary rocks (Kacar and Fox, 1967). The total boron concentration in most of the earth's soil is between 2-200 ppm, mostly ranging between 7-80 ppm. A concentration of less than 5% of boron content in soil is found to be favorable for plant growth. It has been determined that even a slight difference in boron concentrations in solution or solid form can result in boron deficiency or toxicity (Güzel et al., 1992). Kacar and Fox (1967) indicated the favorable level of boron content in Turkey's soil is 0.74-4.55 ppm.

Clay, lime, organic content and texture and pH levels of soil are the main factors affecting boron exchange and its availability for plants. Boron levels are higher in soils rich in clay and organic matter. By contrast, boron levels are typically low in sandy soils poor in organic matter. The available form of boron for plants is low in high lime and alkali soils (Güzel et al., 1992).

Boron is taken by plants from their growth media as boric acid, $B(OH)_3$ and $B(OH)_4$. It plays an important role in sugar transport, structural and functional properties of biomembranes, lignification, carbohydrate, ribonucleic acid (RNA) and indoleacetic acid (IAA) metabolisms, respiration, phenol metabolism and cell wall structure. It regulates transpiration in plants. It helps nitrogen fixation by inducing the tuber formation in the roots of legumes. It also provides plant resistance to viral and fungal diseases and insect damages (Kacar et al., 2002).

It is quite difficult to separate the indications of boron deficiency and toxicity from each other due to their similarities. The indications in young needles and leaves are in the growth tips when there is boron deficiency. The youngest leaves become deformed, thicken, and the color turns to dark

blue-green, internodes shorten and growth slows down. Plant looks bushy, and bud, flower and fruit formation is reduced. Inter-vein chlorosis occurs in mature leaves. There is a deformation seen in leaf blades, thickening petioles and stems, and root growth substantially deteriorates (Kacar et al., 2002). However, in the case of boron toxicity the indications are observed in mature needles and leaves. Tips of needles turn to red, while reddish-brown burns and inward curling are observed. Young plants try to get rid of the excessive boron by guttation (Mengel, 1984).
There have been various studies conducted on the vegetation of open coalmines in Turkey (Kantarcı, 1988; Kantarcı et al., 1998). However, reforestation of boron mines is more challenging than coalmines due to the remaining high boron content after the cessation of mining activities. It is important to determine the tolerance levels of native species in order to facilitate reforestation of inactive boron mines. This study is aimed at determining suitable species for the reforestation of these areas.

2. Materials And Methods

2.1. Materials

The materials of the study are the three trial fields that are chosen at the open mine at Günevi and the seedlings of the plant species which are considered suitable for reforestation of these fields.

2.1.1. Properties of the trial fields

The trial fields are located in the Günevi open mine, previously operated by Bigadiç Eti-bor, Inc., which closed in 1998(Figure 1, 2). Three fields in different locations in the mine were chosen to conduct the study. The first field is located on the hillside which is cleared as gradual terraces, the second field is located in the bottom of the mine, and the third one is located in the entrance of the mine. The second and the third fields are areas previously used for dumping the earthwork. The altitude of the mine is 370-415m.

Figure 1. General view of Günevi Open Mine

Figure 2. Planting in the field

2.1.2. Plant species

There are Turkish red pine, sessile oak, terebinth, sandalwood, juniper, Christ's thorn, salvia cistus, tamarisk, Spanish broom, blackberry, common reed and other gramineous species in the natural forest near the mine. These species and the other species (Italian cypress, black locust and oleaster) found near the mine were chosen as the species to be used in the study. The seedlings were provided by Balıkesir Seydan Forest Nursery. Table 2 illustrates the plant species used in the trial fields and their methods of planting.

Table 2. Plant species and their properties

Species	Age	Property
Sessile oak (*Quercus petraea* Mattuschka Liebl.)	1+0	bare root
Turkish red pine (*Pinus brutia* Ten.)	1+0	bare root
Turkish red pine (*Pinus brutia* Ten.)	1+0	containerized
Turkish red pine (*Pinus brutia* Ten.)	-	seed
Oleaster (*Elaeagnus angustifolia* L.)	1+0	bare root
Italian cypress (*Cupressus sempervirens* L.)	1+1	containerized
Spanish broom (*Sparteum junceum* L.)	1+0	bare root
Terebinth (*Pistacia terebinthus* L.)	2+0	bare root
Black locust (*Robinia pseudoacacia* L.)	1+0	bare root
Tamarisk (*Tamarix tetrandra* Palas ex Bieb.)	2+0	bare root
Salvia cistus (*Cistus salviifolius* L.)	uprooted from forest	bare root

2.2. Methods

2.2.1. Field preparation and planting

Soil processing in the fields was executed by a crawler tractor fitted with two rippers. Hole-planting method was used for planting. A total of 3000 seedlings were planted in the three trial fields without following the standard distance-interval for planting. Half of the seedlings were directly planted in the Mine field; the other half was planted by adding extra soil to the planting hole in order to mitigate the direct effect of boron residue on the roots. Turkish red pine seeds were sowed in the existing material and on the soil that was spread out on the existing material, and then covered with branches. Weed clearing and hoeing around the seedlings were conducted.

Seedling conditions were determined in the three fields at the end of the vegetation period. The condition of the seedlings was monitored regularly for the subsequent years and the condition of the living seedlings were recorded at the end of the first and fourth year.

2.2.2. Material analysis

The material samples (soil and plant) taken from the fields were brought to the soil laboratory at the Ege Forestry Research Institute. The soil samples were then air-dried, ground and sifted using a 2mm sieve and made ready for analysis as it is described in Kacar (1993). For the analysis of the needle and leave samples, the sample preparation procedures were carried out according to Wolf (1939).

Sample particle sizes were measured by using "Bouyoucos Hydrometer Method" (Gülçur, 1974). Total lime amounts were calculated using "Scheibler Calcimeter Method" and organic matter amounts were determined using "Walkley-Black Wet Incineration Method" (Kacar, 1993). Electrical conductivity (mS/cm) was measured by glass electrode EC-meter in soil/water (1:2.5) suspension and soil sample reactions (pH) were determined by glass electrode pH-meter in soil/water (1:2.5) suspension (Jackson, 1958). Total nitrogen contents were detected by "Kjeldahl Method" using full automatic Kjeltec-20 (Bremner, 1965). Favorable phosphorous amounts were determined according to "Olsen Method" regarding the soil pH and lime contents (Kacar, 1993). Soluble potassium, calcium, magnesium and sodium contents were measured by using flame photometer and atomic absorption spectrophotometer (AAS) according to "Neutral 1N Ammonium Acetate Method" (Jackson, 1958). Soil and plant boron contents were determined colorimetrically according to "Azomethine-H Method" (Wolf, 1939). Survival percentages were determined at the end of the 1st and 4th years, respectively, by counting the planted seedlings.

3. Results And Discussion

3.1. Material properties and boron contents

Table 3 and 4 show the analysis results of the material samples taken from the root parts of the seedlings in each trial fields at the end of the planting year. Because no seedlings survived in the second trial field, which was in the bottom of the mine, composite sampling was applied. According to the Table 3 and 4, it was determined that all of the trial fields displayed alkaline (low, medium or high), salt-free and low organic matter content characteristics. In the trial fields that were rich in lime, clay and boron, magnesium and calcium amounts were very high; however phosphorous levels were very low.

Table 3. Properties of the materials in the trial fields

		Sand %	Clay %	Silt %	Total $CaCO_3$ %	pH	EC mmhos/cm	Organic Matter %
1. Trial Field	Existing material	47.20-60.20	16.08-45.08	16.72-30.72	39.22-71.16	8.13-8.54	0.268-0.441	0.551-1.630
	Material + soil	35.84-58.84	13.16-42.16	22.00-38.00	24.78-78.56	8.02-8.40	0.271-0.551	0.218-0.950
2. Trial Field	Existing material Composite sample	39.20	60.08	0.72	47.63	8.94	1.322	0.394
3. Trial Field	Existing material	42.20-48.20	32.08-34.08	17.72-25.72	49.87-60.79	8.37-8.67	0.325-0.547	0.692-1.009
	Material + soil	41.20-49.20	30.08-41.08	20.72-32.72	33.62-59.11	8.34-8.48	0.291-0.435	0.462-1.072

Table 4. Nutrient condition in the trial fields

		N %	P ppm	K ppm	Ca ppm	Mg ppm	Na ppm	B ppm
1. Trial Field	Existing material	0.011-0.062	Trace-0.88	33-95	4100-6100	864-1760	10-37	1.454-8.667
	Existing material + soil	0.002-0.041	2.06-8.82	44-272	4200-11400	364-1200	10-24	1.546-5.816
2. Trial Field	Composite sample	0.011	1.03	44	6800	3020	710	10,403
3. Trial Field	Existing material	0.007-0.025	Trace	47-48	4400-4500	1440-1620	17-87	9.001-10.847
	Existing material + soil	0.015-0.032	Trace	40-70	4000-6000	1470-1680	13-28	7.506-9.866

3.2. Boron content of the seedlings

Table 5 illustrates the analysis results regarding the boron content of the seedlings at the end of the 4th year.

3.3. Seedling survival

The survival rates of the seedlings in the trial fields for the first and the last year of the study are shown in Table 6.

Table 5. Boron contents of the seedlings

Species	**Boron Content (ppm)**
Italian cypress	142-189
Oleaster	151-184
Sessile oak	199-202
Terebinth	195-200
Salvia cistus	154-184
Tamarisk	154-200
Spanish broom	184-202
Turkish red pine (seed)	177-179
Turkish red pine (bare root)	123-197
Turkish red pine (containerized)	142-200
Black locust	185-220

The number of the seedlings surviving in the three trial fields varied significantly. According to the totaling at the end of the 4th year, 362 seedlings out of 500 (72.4%) planted in the additional soil survived in the three trial fields; however the number of living seedlings that were planted without additional soil was 205 out of 500 (41%). None of the seedlings planted in the second trial field survived to the end of the 1st year. In the third trial field, the earthwork dumping area, 42/500 seedlings planted with additional soil survived (8.4%), while 12/500 seedlings directly planted in the existing soil survived (2.4%) through the end of the 4th year.

According to the averages of the three trial fields, the survival rate of the seedlings planted with additional soil was 26.9%, while the survival rate of the seedlings directly planted in the existing soil was 14.5%. In the first trial field, the survival rates of Turkish red pine (containerized) and tamarisk planted directly in the existing soil were highest, 100 and 96% respectively, at the end of the 4th year. These two species were the only species to survive in the third field by the end of the 4th year as well. Sessile oak did not survive in the same field at all. On the other hand, when planted using additional soil Italian cypress (100%) and sessile oak (90%) shared the first rank with Turkish red pine (88%) and tamarisk (92%) at the end of the 4th year in the first trial field. However, containerized Turkish red pine (18%) and tamarisk (62%) were the still the only species to survive in the third field.

Comparing the boron contents of the three trial fields, the lowest boron content was measured in the first trial field (average 4.12 ppm), while the highest boron content was measured in the second trial field (average 10.40 ppm). The average boron content of the third trial field was 9.18 ppm. This result shows that there might be a strong correlation between boron content and survival rates. However, other nutritional components and material properties of the field should also be considered together with the boron content.

It was observed that chlorosis occurred when the soil boron content was higher than 3 ppm, and intensified above 5 ppm. However, the tolerance to the high boron content of the species studied showed variety- 6.9 ppm for black locust, 8.7 ppm for Turkish red pine and 9.8 ppm for tamarisk.

Considering the boron content in the plant leaves and needles, 15-50 ppm is generally considered as normal level for boron (Bergman, 1992). However, the boron contents of the seedlings used in the study were significantly higher than the above mentioned amount (Table 5). The highest boron content was measured in the black locust seedlings (220 ppm), while the lowest boron content was measured in the bare rooted Turkish red pine seedlings (123 ppm). However, there were significant differences in boron contents of the bare rooted Turkish red pine, Italian cypress, tamarisk, oleaster, salvia cistus seedlings showing boron toxicity in their needles or leaves and these seedlings still looked green (Table 5). For example, the needles of the bare rooted Turkish red pine seedlings measuring 123 ppm boron were still green, while those with 197 ppm boron were reddish in color.

Table 6. Survival conditions of the species planted in the trial fields

Species	Trial Field	EXISTING MATERIAL					EXISTING MATERIAL + SOIL				
		Planted (no.)	Survival 1 (no.)	Survival 1 (%)	Survival 2 (no.)	Survival 2 (%)	Planted (no.)	Survival 1 (no.)	Survival 1 (%)	Survival 2 (no.)	Survival 2 (%)
Sessile oak	1	50	0	0	0	0	50	50	100	45	90
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Oleaster	1	50	5	10	4	8	50	36	72	30	60
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Black locust	1	50	36	72	20	40	50	33	66	24	48
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	5	10	2	4
Terebinth	1	50	20	40	18	36	50	28	56	28	56
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Tamarisk	1	50	50	100	48	96	50	49	98	46	92
	2	50	0	0	0	0	50	0	0	0	0
	3	50	9	18	9	18	50	37	74	31	62
Spanish broom	1	50	30	60	23	46	50	48	96	34	68
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Salvia cistus	1	50	24	48	16	32	50	30	60	24	48
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Italian cypress	1	50	20	40	19	38	50	50	100	50	100
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Turkish red pine (containerized)	1	50	50	100	50	100	50	46	92	44	88
	2	50	0	0	0	0	50	0	0	0	0
	3	50	5	10	3	6	50	14	28	9	18
Turkish red pine (bare root)	1	50	7	14	7	14	50	42	84	37	74
	2	50	0	0	0	0	50	0	0	0	0
	3	50	0	0	0	0	50	0	0	0	0
Turkish red pine (seed)	1	150 gr/m^2	-	-	125	-	150 gr/m^2	-	-	52	-
	2		0	0	0	0		0	0	0	0
	3		0	0	75	0		0	0	24	0

Since the boron content was highly variable in the fields, planting should be dense without considering the standard distance-interval applications and containerized seedlings should be used for planting in the field. However, seed sowing should also be considered as a viable application for reforestation of the mine. Seeds should be sowed in November-January and covered with branches. Turkish red pine and tamarisk species are more suitable for the reforestation of the mine. Due to the hardening of the material in the fields, the existing material should be cultivated using a ripper at least twice before planting. In order to increase the reforestation success in the mine, additional soil should also be spread out after processing the existing material. The second trial field- the most unsuccessful field- can be turned into a pond for recreational activities.

Acknowledgement We would like to thank Eti-Bor, Inc. Operational Directorate for supporting the study and Dean Cuming for editing the English translation.

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DEFORESTATION, OVERGRAZING AND DESERTIFICATION

POSTER PRESENTATIONS

Effect of grazing intensity on soil physical properties (case study: Miankale protected area in North of Iran)

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Abstract

The effect of different grazing intensities on some soil physical properties in the Miankale protected area was studied. In this study, three different grazing site of: reference (light grazing), key (medium grazing) and critical area (heavy grazing) were investigated. The results indicated that grazing intensity has significant effect on soil physical properties. Soil bulk density has increased but its porosity and stability [The soil mean weight diameter(mm)]were decreased significantly in critical area as compared to reference area

Key words: grazing, soil, physical properties, Miankale

Introduction

Intensive grazing and continues presence and movement of livestock in rangeland ecosystems can cause effects on soil and leading to soil degradation, thus in this research the impact of various grazing intensities on some soil properties including Bulk Density, Porosity and Soil stability in conditions such as reference area (no grazing), key area (moderate grazing), and intensive grazing areas (critical area) in Miankaleh protected area of Mazanderan province was studied.

Materials and methods

Study area

The study area located at Miankale protected area in North of Iran (36º 53' ″N, 53º 45' E), with a mean elevation of -28 meters of sea level. The mean annual rainfall of the area is 535mm and the mean annual temperature of this area is18.6 °C.

Methods

Surface soil samples (0-15cm) were taken in three sites via random-systematic strategy. Bulk density was measured by Black method (Black, 1986). Porosity of soil samples was determined by Water evaporation method (pore volume = (weight of saturated sample − weight of dried sample)/density of water). Stability of soil aggregates was determined by wet sieving method (Kemper and Rosenau; 1986).

Statistical analysis

After laboratorial measuring of parameters, one-way analysis of variance and Duncan test were used for testing of all parameter means equality and grouping of treatments respectively.

Results and Conclusion

Statistical analyses showed that because of livestock trampling intensity, bulk density of soil in critical area has significant deference in comparison with reference area and as consequence the porosity of soil in critical area has significantly decreased in comparison with reference area (Table.1).

Table 1. Influence of different grazing intensities on some soil physical properties

Grazing intensity	Aggregate stability [soil mean weight diameter (mm)]	Bulk density (gr/cm^2)	Porosity%
Reference area	0.62^a	1.54^a	$49\%^a$
Kay area	0.60^a	1.63^b	$42.33\%^b$
Critical area	0.50^b	1.73^c	$34.66\%^c$

Different letters mean significant difference at 0.01 level

The results showed that soil aggregate stability in reference area because of its good vegetation cover as compared with critical area and by consequence more soil protection, is significantly better.

We can conclude that the more grazing intensity, the more soil bulk density and instability.

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Influence of Shrubs on Some Chemical and Physical Soil Properties of Shrublands of Mediterranean Zone

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Abstract
Southern Marmara (Çanakkale), Turkey is a region in the Mediterranean spread with shrubs. Shrubs are the most important food source for goats and sheep, and also they play a significant role in soil conservation and sustainability of fertility. However, the region of southern Marmara has not been investigated for the effects of shrubs on soil. This study was conducted to determine the effects of shrub species in the Çıplak and Ağaköy rangelands on some chemical and physical properties of the soil. Shrubs common in the Çıplak rangelands, kermes oak, prickly juniper, and mock privet, and in the Ağaköy rangelands, jerusalem thorn and gall oak were used as plant materials. Analyses of pH, electrical conductivity (EC), total nitrogen (N), organic carbon (C), available phosphorus (P), lime ($CaCO_3$), cation exchange capacity (CEC), exchangeable cations (Ca^{2+}, Mg^{2+}, K^+, Na^+), texture, aggregate stability and bulk density were performed under canopy and open land. In the Çıplak land, available P, total N, organic C, CEC, exchangeable Ca, Mg, K and Na values under the canopies of the shrubs were found to be significantly higher (11–51% more), while the bulk densities were lower. Organic C, EC, total N, CEC, exchangeable Ca, Mg, K and Na under the canopy in the Ağaköy land were 16-39% higher than in the open area. However, in the Ağaköy rangeland, jerusalem thorn had higher levels of total N, available P, $CaCO_3$, exchangeable Mg, K, Na, clay, silt, sand and aggregate stability, while gall oak had higher levels of pH, EC, organic C, CEC, exchangeable Ca, and bulk density of enrichment ratio.
Keywords: Shrub species, soil characteristics, grazing, rangeland

Introduction

Mediterranean vegetation, commonly known by the French terms "maquis" (i.e., woody plants < 5 m tall) and "garrigue" (i.e., chaparral, dominated by $\leq$ 1 m tall shrubs), are two main types of shrubby vegetation on degraded soils in northern Mediterranean countries. Çanakkale, located in the Mediterranean climate belt, was 12.48% covered with shrubs (Anonymous, 2009). These shrubs are important with respect to forage, firewood, landscape and recreation, soil protection and water production.

Plants have intensive effects on soil formation and its characteristics. Many studies have been conducted to evaluate plant-soil interactions in the arid and semi-arid regions (Hirobe et al. 2001; Li et al., 2007). Researchers reported that plants induce the changes in chemical and physical properties of soil and microclimates. Plant species on maquis in the arid and semi-arid regions are very important for the sustainability of the ecosystem which is dependent on soil quality. Plants in arid and semi-arid regions have the capability of increasing organic matter, nutrient contents and cation exchange capacity under the canopy area, and of decreasing pH and lime content. Soil under the plant canopy generally contains low bulk density and high aggregate stability (Bochet et al., 1999). Changes in plant morphology (Li et al., 2007) results in a specific microclimate develops under vegetation with lower solar radiation, lighter wind speed, lower soil temperature and evaporation (Kidron, 2008). Plants indirectly affect infiltration by rainfall interception (Calder, 2001). Through the influence of infiltration, soil surface sealing and crust formation with raindrop impact cause diminished runoff, soil loss, splash erosion and soil compaction (Abrahams et al., 1995).

This research was conducted on common shrub species in Turkey (kermes oak, prickly juniper, mock privet, jerusalem thorn and gall oak), which cover 7 million ha (Atalay, 1994) and play a significant role in animal feeding, to determine their effects on the soil characteristics.

Materials and Methods

Study Area

Çanakkale province is located at 40° 09’ N latitude and 26° 24’ E longitude in the northwest part of Turkey. Çanakkale has a typical Mediterranean climate . The long term average precipitation in the region is 629 mm, and the annual mean temperature is 14.9°C (Anonymous, 2008).

The study area is within the Mediterranean plant geography region, in which kermes oak (*Quercus coccifera* L.), prickly juniper (*Juniperus oxycedrus* L.), mock privet (*Phillyrea latifolia* L.), gall oak (*Quercus infectoria*) and jerusalem thorn (*Paliurus spina christi* L.) are commonly found in the rangelands of the southern Marmara region. Evergreen species (kermes oak, prickly juniper and mock privet) were taken from the grazed ‘Çıplak’ rangeland, and deciduous jerusalem thorn and gall oak were from the ungrazed rangeland, ‘Biga Agaköy’. The grazed rangeland is in the southwest and 27 km away from the city center. The ungrazed rangeland is in the north and 85 km away from the city center. Parents materials of Çıplak and Ağaköy rangeland are sand stone. Slope of Çıplak and Ağaköy rangeland are 2% and 8%, respectively.

Soil Sampling

For each plant, two sampling areas were distinguished. In the area under the plant canopy, two soil samples at a distance of about 30 cm from the plant center were taken and mixed. In the open land, three soil samples were taken at least two meters away from the plant center. Soils were sampled in May 2007 at 0–10 cm depth, and 48 soil samples (1 depth x 2 places (under canopy and open land) x 3 plants x 8 replicates) were taken from the Çıplak rangeland. 32 soil samples (1 depth x 2 places (under canopy and open land) x 2 plants x 8 replicates) were taken from the Ağaköy rangeland. Plants with similar habitus were chosen during soil sampling. Samples were air dried and sieved through a 2-mm screen.

Laboratory Analysis

Soil pH and electrical conductivity (EC) were determined potentiometrically in a 1:2.5 ratio in H_2O (McLean, 1982; Rhoades, 1982b). Total carbonate content was measured volumetrically (calcimeter) after treating with HCl (Nelson 1982). Available phosphorus (P) was determined by 0.5 M Na-bicarbonate extraction at a nearly constant pH of 8.5 (Olsen and Sommers, 1982). Cation exchange capacity (CEC), using the method of Rhoades (1982a) for arid land soils after extraction with ammonium acetate, exchangeable Ca^{2+}, Mg^{2+}, K^{+} and Na^{+} were determined by ammonium acetate extraction(Thomas, 1982). Total C and total N concentrations were determined in duplicate by dry combustion on a Vario Max CN elemental analyzer (Elemental Vario El). All samples were free of carbonate so that the total C concentration equaled the organic carbon (C) concentration. Particle size distribution was determined by the pipette method, using sodium hexamethaphosphate as a dispersing agent, with silt and clay fractions being determined after sieving to remove sand particles (Gee and Bauder, 1986). Soil aggregate stability was assayed by wet sieving (Kemper and Rosenau, 1986). In addition, soil bulk density for the top 10 cm of soil at these two microhabitats (under canopy and open land) was determined by taking an undisturbed soil core with a knowm-volume stainless steel cylinder (Blake and Hartge, 1986).

Statistical Analysis

In order to decrease the effect of inter-site variability in the comparison of the two situations under shrubs (A) and the open area (B), the enrichment factor (E), where E=A/B, was used. It was calculated as the average of ratios for each pair of samples analyzed. The greater E differs from 1, the more the soil in A differs from the soil in B. Thus, E > 1 means a higher concentration for the characteristic analyzed in A (Wezel et al., 2000).

In order to compare the differences in the soil characteristics of Ağaköy rangeland, the paired-t test for normally distributed data and Mann-Whitney U test for abnormally distributed data were performed. In order to compare the differences in soil characteristics of Çıplak rangeland, ANOVA and the Kruskal-Wallis test, for normally and abnormally distributed data, respectively, were used if more than two variables were involved. Minitab Statistical Software (Version 13.0 for Windows) was used for statistical analyses.

Results

Soil Chemical and Physical Properties

Chemical properties of the soil in the Çıplak rangeland, except for pH and $CaCO_3$, were significantly different under the canopy and open land (Table 1). EC, total N, organic C, available P, CEC, exchangeable Ca, Mg, K and Na contents of the samples under the canopy were greater by 12, 24, 11, 26, 18, 16, 36, 47 and 51 %, respectively. E values of pH and $CaCO_3$ were respectively 1.02 and 0.95.

Table 1. Some chemical and physical soil properties under shrub (A) and nearby open area (B) in the Çıplak rangeland (n=48).

Property	Canopy	Open	Enrichment ratio (A/B)	Significance (p)
	Mean ± S.E.			
pH	7.38 ±0.06	7.25 ± 0.07	1.02	0.235 *
EC (dS m^{-1})	0.42 ± 0.02	0.38 ± 0.01	1.12	0.003 Э
Total N (g kg^{-1})	2.60 ± 0.20	2.20 ± 0.10	1.24	0.000 Э
Organic C (g kg^{-1})	27.40 ± 0.90	24.80 ± 0.50	1.11	0.014 Э
Available P (mg kg^{-1})	16.67 ± 0.54	13.46 ± 0.43	1.26	0.000 Э
$CaCO_3$ (g kg^{-1})	11.00 ± 0.60	11.90 ± 0.70	0.95	0.357 Э
CEC (cmol kg^{-1})	18.74 ± 0.18	15.82 ± 0.15	1.18	0.000 Э
Ca (cmol kg^{-1})	15.33 ± 0.16	13.26 ± 0.19	1.16	0.000 Э
Mg (cmol kg^{-1})	3.07 ± 0.09	2.31 ± 0.08	1.36	0.000 Э
K (cmol kg^{-1})	0.23 ± 0.01	0.17 ± 0.03	1.47	0.000 Э
Na (cmol kg^{-1})	0.11 ± 0.01	0.07 ± 0.00	1.51	0.000 *
Clay (g kg^{-1})	97.50 ± 7.20	110.80 ± 8.70	0.94	0.217Э
Silt (g kg^{-1})	216.40 ± 7.80	221.50 ± 5.30	0.98	0.340Э
Sand (g kg^{-1})	686.00 ±13.20	668.00 ±11.50	1.02	0.310Э
Aggregate stability (%)	75.81 ± 1.99	73.18 ± 1.67	1.04	0.401*
Bulk density (Mg m^{-3})	1.25 ± 0.01	1.43 ± 0.01	0.87	0.000Э

* Mann-Whitney U test, Э Paired-t test.

In the Çıplak rangeland, values for clay, silt, sand and aggregate stability under the canopy did not show any significant differences, while bulk density was significantly different ($p \leq 0.01$) compared to the open land (Table 1). Clay and silt contents of the soils were higher under the canopy. Bulk density increased from 1.25 Mg m^{-3} under the canopy to 1.43 Mg m^{-3} in the open land.

In the Ağaköy rangeland, soil properties under the canopy had higher EC (20 %), total N (17%), organic C (16 %), CEC (20 %), exchangeable cations of Ca (21 %), Mg (17 %), K (47 %) and Na (39%) compared to the open area (Table 2). Moreover, pH (E=1.01), available P (E=1.36) and $CaCO_3$ (E=1.20) did not show important differences in the open land compared with the canopy (Table 2). However, they were higher under the canopy. None of the investigated soil physical characteristics in the Ağaköy rangeland significantly differed between the canopy and compared the open land (Table 2).

Table 2. Some chemical and physical soil properties under shrub (A) and nearby open area (B) in Ağaköy rangeland (n=32).

Property	Canopy	Open		
	Mean ± S.E.		Enrichment ratio (A/B)	Significance (p)[Э]
pH	7.06 ± 0.05	6.98 ± 0.02	1.01	0.142
EC (dS m^{-1})	0.42 ± 0.01	0.35 ± 0.01	1.20	0.001
Total N (g kg^{-1})	2.80 ± 0.00	2.30 ± 0.10	1.17	0.000
Organic C (g kg^{-1})	28.40 ± 0.60	24.70 ± 0.70	1.16	0.001
Available P (mg kg^{-1})	24.20 ± 2.78	18.14 ± 1.52	1.36	0.076
$CaCO_3$ (g kg^{-1})	6.80 ± 0.60	6.30 ± 0.50	1.20	0.542
CEC (cmol kg^{-1})	19.64 ± 0.29	16.41 ± 0.18	1.20	0.000
Ca (cmol kg^{-1})	16.03 ± 0.28	13.32 ± 0.19	1.21	0.000
Mg (cmol kg^{-1})	3.26 ± 0.07	2.85 ± 0.11	1.17	0.007
K (cmol kg^{-1})	0.24 ± 0.02	0.17 ± 0.01	1.47	0.000
Na (cmol kg^{-1})	0.10 ± 0.01	0.07 ± 0.00	1.39	0.000
Clay (g kg^{-1})	135.90 ± 9.20	122.60 ± 12.00	1.11	0.387
Silt (g kg^{-1})	307.50 ± 7.10	301.20 ± 5.40	1.02	0.485
Sand (g kg^{-1})	556.60 ± 10.90	576.20 ± 11.70	0.97	0.230
Aggregate stability (%)	81.42 ± 1.16	81.21 ± 1.43	1.00	0.907
Bulk density (Mg m^{-3})	1.35 ± 0.01	1.34 ± 0.01	1.00	0.805

[Э] Paired-t test.

Effects of Plant Species

Effects of the plant species on the soil properties were similar in the Çıplak rangeland (Table 3), bearing no statistical importance. Mock privet had higher enrichment ratios of total N, available P, exchangeable Mg and bulk density, and lower enrichment ratios of $CaCO_3$, silt, sand, exchangeable Ca, K, Na and aggregate stability.

Table 3. Enrichment ratios (E) of the plant species in the Çıplak (n=48) and Ağaköy (n=32) rangelands.

Property	Çıplak E				Ağaköy E		
	Kermes oak	Prickly juniper	Mock privet	ANOVA (p)	Jerusalem thorn	Gall oak	Significance (p)
pH	1.01	1.02	1.02	0.992	1.00	1.02	0.713*
EC	1.15	1.10	1.12	0.882	1.17	1.22	0.083*
Total N	1.20	1.21	1.31	0.524[¤]	1.20	1.14	0.395[Э]
Organik C	1.09	1.12	1.12	0.946	1.14	1.18	0.563*
Available P	1.27	1.22	1.30	0.834	1.47	1.24	0.356[Э]
$CaCO_3$	1.00	0.96	0.91	0.732	1.34	1.05	0.342[Э]
CEC	1.17	1.20	1.18	0.756	1.16	1.23	0.111[Э]
Ca	1.16	1.19	1.15	0.715	1.15	1.26	0.049[Э]
Mg	1.28	1.37	1.43	0.600	1.23	1.10	0.127*
K	1.57	1.58	1.25	0.358	1.50	1.44	0.641[Э]
Na	1.61	1.54	1.38	0.635	1.42	1.35	0.758[Э]
Clay	1.04	0.84	0.94	0.745[¤]	1.24	1.21	0.885[Э]
Silt	0.99	0.98	0.96	0.947	1.02	1.01	0.807[Э]
Sand	1.02	1.03	1.01	0.924[¤]	0.98	0.95	0.417[Э]
Agregate Stability	1.06	1.04	1.03	0.929	1.03	0.97	0.204[Э]
Bulk Density	0.86	0.89	0.97	0.349	0.98	1.02	0.149[Э]

[¤] Kruskal-Wallis, * Mann Whitney U test, [Э] Paired-t test.

Two shrub species influenced soil parameters to varying extents in the Ağaköy rangeland. The difference between the jerusalem thorn and gall oak was only found significant for exchangeable Ca (p=0.049) (Table 3). The E value for exchangeable Ca was 1.15 in jerusalem thorn and 1.26 in gall oak. Although found to be insignificant, the enrichment ratios for total N, available P, $CaCO_3$, exchangeable Mg, K, Na, clay, silt, sand and aggregate stability were higher in jerusalem thorn.

The enrichment ratios for pH, EC, organic C, CEC, exchangeable Ca and bulk density were higher in the gall oak.

Discussion

Total N and organic C contents of the soils under the canopy in the Çıplak and Ağaköy rangelands were higher, although significant differences among the species were not observed. Both elements generally are dependent on the organic matter. A significant portion of organic matter in the soil (99%) is derived from the plant residue (Larcher, 1995). Dead roots and leaves of the shrubs caused an increase in the soil organic matter, leading to a rise in C and N contents under the canopy (Barth and Klemmedson, 1978). As organic matter is the basic food source for soil microorganisms, more nitrogen is produced by the microorganism activities that degrade organic matter under the canopy, resulting in thriving soil nitrogen (Aguilera et al., 1999). On the other hand, organic matter is also an important source for N, P, and S that play significant roles in plant development (Akalan, 1988). Thus, an increase in the content of organic matter under the canopy resulted in more rapid nutrient cycling. The higher cation exchange capacity of the soils under the canopy, as opposed to in the open land, is caused by the organic matter. Schnitzer (1965) reported that organic matter increased the cation exchange capacity of the soils by 30–60%. Incorporation of the organic matter under the canopy promotes inter-particle binding, aggregate stability and porosity (Oades, 1993). The infiltration rate is enhanced, and biogeochemical cycling speeds up. Higher aggregate stability means that the soils are resistant to erosion. Gökkuş (1994) stated that depending on the vegetative development and ratio of the plant to cover the soil, aggregate stability increased. The reason for electrical conductivity being higher under the canopy compared to the open land in the plant species of the study areas might be attributed to the results of litter accumulation (Rostagno et al., 1991). In addition, pH and lime values of the soils showed changes under the canopy compared to the open land. This supports the argument that some soil properties are influenced by the plant species (Li et al., 2007). Wezel et al., (2000) found that shrub species affected soil pH.

Intensive grazing decreases the number of plant and plant basal area and deposits dead plant material that acts as protective mulch (Da Silva et al., 2003). The thinning of mulch cover causes an increase in raindrop velocity and impact, along with soil loss, due to splash erosion and more runoff from the soil, resulting in more soil erosion (Smets et al., 2008). Vegetation and root development decreased in a heavily grazed site. Organic matter content is diminished and aggregate stability is destroyed (Evans, 1998) due to lower litter accumulation in the soil. In our study, an important decrease in exchangeable Mg and unimportant decreases in K and Na were observed. A similar situation was also reported by Binkley et al., (2003). Extractable K contains K in soil solution and K absorbed onto exchange sites on the clay surface. It is difficult to determine the interactive effects of grazing and plant species. Such processes as leaching, fixation by micaceous clays, weathering of feldspars and uptake by the plants might occur simultaneously, and they are known to influence exchangeable K (Tisdale et al., 1993).

Studies conducted in different rangeland ecosystems with different animals revealed that treading had negative impacts on physical, chemical and biological aspects of soils (Gökbulak, 1998; Steffens et al., 2008). The reason for the increase in bulk density in the open area is increased pressure of grazing (Abeye et al., 1997). Treading might result in 1) soil compaction, 2) destruction of soil structure, 3) decrease in infiltration, 4) displacement of soil on the steep slopes, 5) formation of animal trails, and 6) increase in erosion . Animal rarely step under the canopy area when they graze freely in the open land, leading to more treading in the open land. Over-treading leads to inadequate soil aeration, soil compaction, loss of structure, nutrient loss, reduced nutrient uptake efficiency, diminishing of microbial activity, and a decrease in earthworm population. These effects harden soil management, affect root development, and decrease pasture yield.

Conclusion

Plants change the chemical and physical properties of their surrounding soil, depending on their morphology and canopy. The shrubs species studied did not significantly affect the physical and chemical properties of the soils studied. However, the chemical properties of the soil changed significantly between the soil under canopy and the soil in the open land. Grazing caused an increase in bulk density.

Acknowledgements
This research was supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK) (Project No. 106O458).

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Dynamic of the active fraction of organic matter in some meadow soils

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Abstact
The microbial biomass (MB) as well as the light fraction of organic matter (LFOM) are often considered as active fraction of organic matter (AFOM) and as indices of soil fertility and activity in soils. This study was performed in order to measure the turnover of AFOM using long-term incubation (56 weeks) at 25 °C in 34 meadow soil representing a wide range textures, organic C and total N. The MB and the LF were respectively measured on eight and five occasions during the incubations using fumigation-extraction technique and densimetric flotation method. Among the soil properties, microbial-C was most strongly correlated to total N (R^2 = 0.72***), to organic C (R^2 = 0.66***) and to clay content (R^2 = 0.59**). Initial values of C and N of microbial biomass represent respectively 0.76 to 3.7% of organic C and 1.94 to 10.7% of total N. The C and N of LF represent respectively 2.9 to 25.6% of organic C and 1.7 to 17.5% of total N. At the end of incubations the loss of Biomass-C and N reach respectively about 71 and 82% of the initial MB. The LF-C displays a similar pattern and loss proportion. However, The LF-N denote increase to week 4 which represent between 6 to 43 mg N kg^{-1} immobilised during this period, followed by rapid decrease. During the incubation, we denote a relative proportionality between loss LF masse and the loss in LF-C; nevertheless, the LF-C and LF-N concentration increases during this period. These results indicated that LF could be considered as precursor of humic compounds. The two component first-order model offered the best description of the curves of turnover of AFOM. The labile-N compartment of both MB and FL represent respectively 54% of total N-MB and 61% of total LF-N. The resistant-and represents 2.4 years for LF-C and 1.4 years for C-MB. A negative relationship was found between labile-N of LF and C:N ratio of FL (C:N-LF = - 0.13 LF-N_L + 25.1; R^2 = 0.76***). Thus induced when C:N ratio of the FL increase and pass 25, labile fraction of LF immobilize N.

Introduction

The concept of the active organic matter (OM) has been proposed in first time by some authors and they suggest that non-humified OM should constitute the active fraction of OM. Two fractions can be distinguished in soil OM. A coarse mineral-free plant debris at different stages of decomposition known as LF. The other fraction, fine, colloidal and organised by the different humic acidic (Pochon and De Berjac, 1958; Spycher *et al.* 1983; Dalal and Mayer, 1987; Jenzen *et al.* 1992). Although the active fraction has not been fully described in terms of its composition, nor has it been successfully isolated (Wander *et al.*, 1994), it's why the concept of active fraction is not well defined. Indeed, several authors have suggested that active fraction is essentially composed by the LF (Henin *et al.* 1959; Jenzen *et al.* 1992; Wander *et al.* 1994; Wander and Traina, 1996). Others have defined the active fraction as the MB, LF, mineralizable C and N (Wood *et al.* 1988; Wood and Schuman, 1989; Biederbeck *et al.* 1994). However, Haynes (2000) defined the LF, MB and water-soluble organic matter as labile organic matter. We showed in our study (Sbih, 1999, Unpubl Ph.D.) that characteristics such as MB and LF are changing rapidly than do total soil OM. Our results support the funds that active fraction is functional description of OM, thus imply the greater proportion of active fraction suggested faster soil organic matter turnover. Several studies demonstrated that the active fraction respond more quickly to changes in crop management practices or environmental conditions than do the total MO (Dalal and Mayer, 1986a; Angers *et al.* 1993b; Biederbeck *et al.*1994). In addition, the active fraction can be influenced by rotations (Campbell *et al.* 1990, Biederbeck *et al.* 1994), tillage (Doran, 1980; Arshad *et al.* 1990; Angers *et al.* 1993a; Schjønning *et al.* 1995), mineral and manure fertilisation (Christensen, 1988; N'Dayegamiye and Angers, 1990; Paustian *et al.* 1992; Leinwebers *et al.*1994; N'Dayegamiye *et al.* 1997). Our principal objective was to determine the dynamic of active fraction (i) the size of the active fraction (LF and MB) as nutrients source; (ii) to determine a model describing adequately the two kinetics (iii) to assess the relationships between model parameters and soil properties.

Materials and Methods

Soil and sampling

Twelve dairy farms have been selected for this study is located in County of Lotbinière, near Quebec City at 53-km Southwest. Thirty-four sites were selected which represent a wide range of soil properties. The sites are essentially situated on 6 series soil (Tilley 7 soils, Bedford 11 soils, Orignaux Levard 11 soils, St-Jude 4 soils, Jolly 1 soil, and Raimbault 1 soil). The forage crop was red clover bromegrass mix and alfalfa bromegrass mix solid dairy cattle manure was applied in spring (20-Mg ha^{-1}).

Soil samples was collected after the growing season, in MI-September, in the top 15 cm and taken from 9 locations in each site. These sub-simples were pooled, homogenised and field-moist sieved (6 mm) (the apparent residues were discarded) and placed in polyethylene bags and stored at -20^{0}C for several weeks until the incubation.

Soil analysis

Total soil organic matter (SOM) was determined by oxidation method (Allison 1965), total-N was obtained by Kjeldahl procedure described by Bremner (1965). A particle size distribution was determined by hydrometer method (Gee and Bauder 1986).

Incubation methods

A week before incubation, soil samples have been thawed in a refrigerator to 4^{0}C then left during 24h in laboratory temperature. Hundred-gram of soil (on oven-dry basis) were incubated in 1-L polyethylene flasks, deionised water was added in order to adjust soil moisture content at 85% of the field capacity. However, to maintain the partial pressure in CO_2 near to zero a traps of NaOH 1N have been installed and have been renewed periodically (1, 2, 3, 4, 6, 8, 12, 16, 25, 32, 40, 48 and 56 weeks) (Sbih *et al.,* 2003). The soil was incubated at 25^{0}C for 56 weeks. The first microbial biomass (MB) and the light fraction (LF) (week 0) were respectively determined by fumigation-extraction technique (Vance *et al*., 1987) and density separation technique (Janzen *et al*. 1992). At each time the flasks were sampled in order to measure the MB and LF after 4, 16, 40 and 56 weeks of incubation. Losses of soil moisture during incubation were replaced by adding deionised water on a weight loss at each collection of alkaline traps. The MB and LF were determined by following methods and expressed in mg kg^{-1} and represent the average of two replicates.

Soil microbial biomass

At each time the flasks were sampled, for biomass determination fumigation-extraction was used (Vance *et al.,* 1987), The C and N of the MB was calculated according to Wu *et al*. (1990) method which multiplication factors are respectively 2.64 and 1.85. The MB was expressed in mg kg^{-1} dry soil and represents the average of two replicates.

Light fraction of soil organic matter

A modified density separation method of Janzen *et al*. (1992) has been used to extract the LF of OM. The yielded LF was analyzed for total C and N using humid oxidization (Allison, 1965), and the Kjeldhal digestion (Bremner 1965) respectively. The LF was expressed in mg C kg^{-1} and mg N kg^{-1} dry soil. The concentration of LF in C and N was expressed in mg g^{-1} of LF and represent the average of two replicates.

Table 1. Clay, C and N concentration in soil, in microbial biomass and light fraction of 34 meadow soil.

	Soil			Microbial Biomass (MB)				Light Fraction (LF)					C : N ratio		
				Initial		Final		Content in soil			Concentration		Soil	MB	LF
Site	Clay	C	N	N	C	N	C	dry matter	C	N* 10^{-3}	C	N			
	%			mg kg^{-1} soil				g kg^{-1} soil			mg g^{-1} LF				
1	8	2.31	0.188	119	374	26	99	11.86	2.38	72.3	200.9	6.1	12.2	3.13	32
2	15	2.55	0.201	132	546	12	189	9.00	2.41	72.5	268.6	8.1	12.6	4.13	33
3	19	2.94	0.292	97	383	13	90	10.75	1.45	88.5	135.1	8.2	10.1	3.94	16
4	17	6.13	0.320	87	496	16	123	12.00	1.79	86.5	159.5	7.2	18.7	5.68	22
5	33	4.08	0.321	62	515	21	147	10.00	1.33	54.9	133.3	5.5	12.7	8.29	24
6	17	2.96	0.254	105	687	23	234	9.89	1.81	73.2	183.7	7.4	11.6	5.37	24
7	29	333	0.254	121	519	33	196	6.72	2.13	58.7	317.7	8.7	13.1	4.26	36
8	31	3.38	0.249	97	514	22	62	6.04	2.53	64.1	419.2	10.6	13.6	5.26	39
9	15	3.31	0.243	148	513	20	92	12.41	2.84	79.7	229.3	6.4	13.6	3.46	25
10	18	2.34	0.219	84	378	21	125	8.65	2.71	62.8	313.5	7.3	10.7	4.48	42
11	9	2.26	0.189	91	405	19	81	8.80	1.81	107.1	206.8	12.2	11.9	4.41	17
12	29	2.50	0.162	114	348	24	76	11.15	3.65	94.4	327.5	8.5	15.4	3.03	38
13	23	2.88	0.216	108	498	23	107	9.51	1.48	62.1	156.3	6.5	13.3	4.60	24
14	28	3.01	0.222	93	494	27	86	12.89	1.64	94.4	127.7	7.3	13.5	5.25	17
15	18	2.63	0.234	71	443	18	145	10.65	1.14	51.1	107.2	4.7	11.2	6.21	22
16	14	2.55	0.170	54	301	10	87	12.34	1.36	77.2	110.6	6.2	15.0	5.54	17
17	14	1.86	0.202	49	325	15	109	12.18	1.32	48.1	108.8	3.9	9.2	6.62	27
18	11	2.94	0.126	127	436	13	172	13.33	2.19	77.9	164.4	5.8	23.3	3.41	28
19	20	3.87	0.210	81	353	14	102	17.95	2.63	169	146.9	9.4	18.4	4.32	15
20	27	4.00	0.264	86	427	13	111	13.10	2.09	75.1	159.6	5.7	15.1	4.95	27
21	9	1.67	0.109	30	277	ND	105	16.48	2.26	185.1	137.6	11.2	15.2	9.04	12
22	12	3.22	0.137	58	271	5	112	12.00	1.4	65.5	116.6	5.5	23.5	4.66	21
23	12	1.86	0.231	119	296	11	132	12.21	1.27	86.7	104.3	7.1	8.0	2.47	14
24	8	1.03	0.126	114	293	ND	97	4.92	2.64	102.5	537.1	20.8	8.2	2.55	25
25	9	1.77	0.066	45	266	ND	121	7.40	2.02	61.6	273.1	8.3	26.8	5.84	32
26	12	2.06	0.122	69	307	7	125	8.70	1.49	43.8	171.9	5	16.9	4.44	34
27	28	2.55	0.160	93	359	8	135	17.02	2.64	146.8	155.3	8.6	15.9	3.82	18
28	11	1.09	0.102	54	406	8	98	12.00	1.29	98.5	106.5	8.2	10.6	7.41	13
29	10	1.62	0.065	69	284	ND	76	14.89	2.2	112.5	148.1	7.6	16.2	4.06	19
30	9	1.93	0.108	95	263	14	94	5.05	1.19	39.9	236.7	7.9	17.8	2.75	29
31	9	1.31	0.122	120	185	ND	73	4.00	2.26	62.7	566.7	15.7	10.7	1.53	36
32	12	1.39	0.087	63	334	7	84	5.56	2.6	155.6	467.9	28	15.9	5.28	16
33	11	1.62	0.117	53	250	9	79	4.24	1.93	57.4	455.7	13.5	13.8	4.37	33
34	9	2.40	0.120	106	356	7		6.81	1.16	96.2	171.6	14.1	20.0	3.34	12

Calculation of the decomposition rate

The loss of MB and LF decomposition values were fitted into a two-compartment exponential decay model, assuming simultaneous exponential decrease of two components: a labile (B_L) and resistant (B_R). Accordingly, the model applied by non-linear regression as expressed by following equation (Murayama, 1984; Bonde *et al*. 1988; Nicolardot ,1988; Whitemore, 1996):

$$MB = MB_L\ e^{-kBt} + MB_R\ e^{-hBt} \qquad [1]$$

Where MB represent C or N of the remaining in soil microbial biomass at time t; MB_L and MB_R represent the proportion of C or N of labile and resistant of the MB with the rate constant respectively k_{CB} or k_{NB} and, h_{CB} or h_{NB}.

The same model was applied to LF decomposition:

$$LF = LF_L\ e^{-klf\,t} + LF_R\ e^{-hlft} \qquad [2]$$

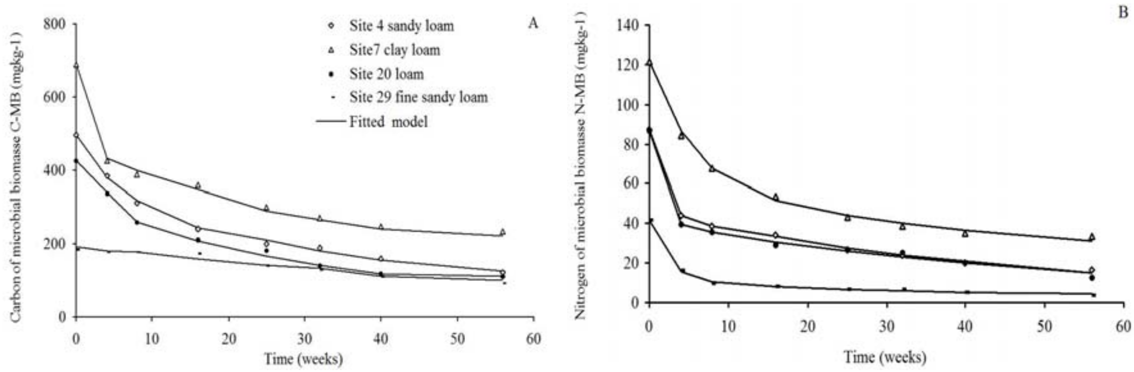
Where LF represent C or N of the remaining LF in soil at time t; LF_L and LF_R represent the proportion of C or N of labile and resistant of the LF with the rate constant respectively k_{Clf} or k_{Nlf} and, h_{Clf} or h_{Nlf}. (SYSTAT, 1992)

Results and Discussion

Evolution of C and N of the microbial biomass during the incubation

At the start of the incubation (t=0) the carbon microbial biomass (C-MB) contents vary of 185 to 687 $mgkg^{-1}$, which represent between 0.8 to 3.7% of total SOM. The amounts of nitrogen microbial biomass (N-MB) are between 41 to 148 mg kg^{-1} of soil, which represents proportion of 1.94 à10.7% of the total-N The C:N ratio of the MB range from 3.1 to 9.3 (mean 5) (Table 1). The initial values of MB were highest in clay loam soil and lowest in sandy loam soil, which had the highest and lowest total SOM contents respectively. Indeed, a strong positive relationship between the MB-C and clay content (R^2=0.59, P=0.001) and in silt (R^2=0.70, P=0.001). On another hand, the initial MB values was strongly correlated to the total SOM (R^2=0.66, P=0.001) and total-N (R^2 = 0.72, P = 0.001).

During the long-term incubation, patterns of C-MB and N-MB dynamic were identical in all soil (Fig. 1A). However, The N-MB were markedly declined (45% in mean) in the first four weeks of incubation comparatively to C-MB which amounted between 14 and 50% of the initial biomass (with a mean of 28%) (Fig. 1B). Thereafter, the decreases of the MB were attenuated. Indeed, during the week 16 and 32, the N-MB and C-MB decrease accounted in mean for 22 and 16% respectively. At end of the incubation the N-MB and C-MB was reduced to 2-11% (mean 6%) and to 2 to 11% (mean 10%) respectively of initial size. The total decrease in biomass N and C during the incubation reached in mean 84% of the initial N-MB and 71% of the initial C-MB (Fig. 1A, 1B).



This MB decrease probably corresponds to the predominance of mortality of microbial biomass on the growth. Indeed, soil microbial biomass maintained on long-term incubation without carbon input will have declined. The same dynamics pattern of the C-MB have been observed by many authors, notably Anderson and Domsch (1987) and Bonde et al. (1988) that recorded reduction of C-MB of 25 to 40% of the initial C-MB after 4 weeks of incubation at 28^0C. Nicolardot et al., (1986) found that the mineralization of the microbial ^{13}C reached 80% during the first week of incubation. The similar results were observed by Bonde *et al.,* (1988) which MB-N were reduced of 86 to 93% of initial N-MB after 47 weeks of incubation. Nevertheless, Brookes *et al*., (1985) and Robertson *et al*., (1988) observed only 20% of reduction of C-MB after 14 weeks of incubation. Whereas Lavahun *et al*., (1996) observed 17% of reduction of C-MB after an incubation of 24 weeks at 25^{o}C. Many authors attribute the reduction of MB to soil texture. Indeed, the fine texture seems to have a protective effect on the MB, as much that on the MO. This effect probably explains by the fact that water retention capacity of clay creates a favourable microhabitat for microorganisms in case of desiccation (Dommergues and Mangenot, 1970). Gregorich *et al*., 1991 found that clay stimulate the microbial respiration activity; finally play role of reserve of microbial nutrients (Weigand *et al*., 1995). Chaussod et al. (1986a), Martin and Haider (1986), Stotzky (1986), and Hassink (1994b) have reported some comparable results. These results appear in disagreement with suggestions of Anderson and Domsch (1987), according to which the texture of soils has no effect on the MB. This divergence could be owed to the fact that the C-MB has been determined by substrate induced respiration the method (SIR). However this method is a measure of the metabolically active biomass (Anderson and Domsch, 1987).

Dynamic of the light fraction of soil organic matter during the incubation

At the start of incubation the amount of light fraction dry matter (LF-DM) ranged between 4.0 to 17.9 g kg^{-1} of soil. The amount of LF-C and LF-N ranged respectively between 1.4 to 3.6 g kg^{-1} (mean 9.5% of the total soil C) and 0.033 to 0.185 g kg^{-1}. The C concentration of LF whether expressed on the basis LF-DM represents 106 to 566 mg C g^{-1} LF. The N concentration of LF ranged between 4 to 28 mg N g^{-1} LF. The C:N ratio of the FL range between 12 to 43 according to the soil (Table 1).

During the incubation LF-DM Losses are not constant. Indeed, during the first four weeks of incubation, the LF-DM was reduced in mean from 10.3 to 5.3 g kg^{-1} LF which represent in mean 46% of the initial FL-DM. After 16 weeks, the remained LF-DM were in mean 3.8 g kg^{-1} LF, thus involve that LF-DM losses reach in mean 60% of the initial DM. In the end of incubation only 2 g kg^{-1} LF (in mean) remained in soil, which represents 78% of LF-DM losses. These LF-DM losses are attributable to simultaneously physical fragmentation processes of the FL and mineralization. Indeed, the physical fragmentation of the FL provokes a considerable increase of the specific

surface of the FL, then the LF becomes more accessible to soil MB therefore mineralize (Catroux and Schnitzer, 1987).
The same tendency pattern were observed for LF-C, however, LF-C disappearance was less drastic during the first four weeks of incubation where the LF-C were reduced from 1.4 to 2g kg^{-1} which represent in mean 27% of initial LF-C (Fig.2A). At the different dates of extraction (16, 32 and 56 weeks) the LF-C remained in soil were respectively (1.1, 0.6 and 0.4 g kg^{-1} soil) thus represent losses 40, 67 and 73% of the initial FL-C. We observed that in soil containing between 17 and 33% of clay (loam and clay loam texture) the reduction of LF-C were more pronounced than in coarse textured soil. Thus involve that protected OM become inaccessible to soil MB, therefore, these microorganisms attack preferentially the no protected MO (LF).

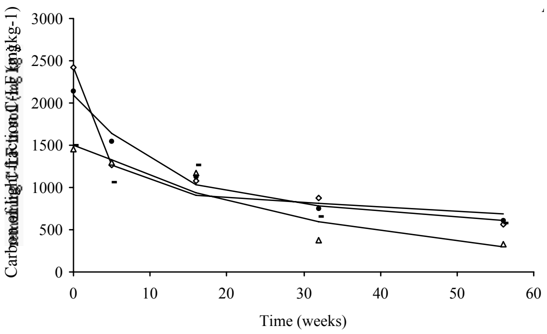


Figure 2A. Amounts of carbon found in the light fraction as measured with densimetric method during 56 week of incubation of soil at 25^{0}C Symbols represent experimental data, and line represent fitted model.

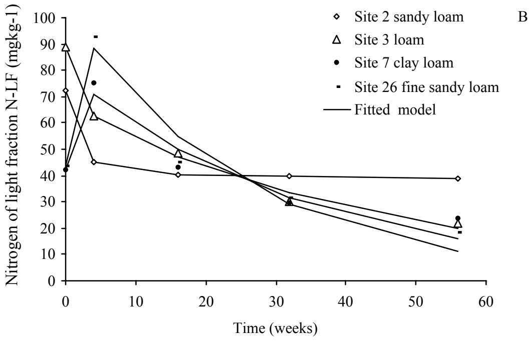


Figure 2B. Amounts of nitrogen found in the in the light fraction as measured with densimetric method during 56 week of incubation of soil at 25^{0}C Symbols represent experimental data, and line represent fitted model.

The evolutions of the FL-N content during incubation were different to LF-DM and LF-C. Indeed, during the first four weeks of incubation, we observe an increase of the FL-N content in 15 soils varying of 7 to 49 mg N kg^{-1} which represent in mean 34% of initial FL-N according to soils (Fig.2B). Nevertheless, the following date of extraction we observe LF-N decrease which reach 28 mg kg^{-1} LF (40% of initial LF-N) at 56 weeks of incubation. The total losses of LF-N during the incubation were 53 mg N kg^{-1}. Same reduction amplitude of the LF-C was observed by Sierra (1996). Dalal and Mayer (1986b) observed in the clay soils, that losses of LF-C were 2 to 11 folds more important than in the dense fraction.
In term of C and N concentration in LF, the data suggested an increase tendency pattern of the LF concentration which pass from 227 mg C g^{-1} FL at (t = 0) to 347 C mg g^{-1} FL and 8.9 to 14.4 mg N g^{-1} FL respectively after 16 weeks of incubation. Thereafter, a reduction of the concentration of C (268 C mg g^{-1} FL) and stayed steady for N followed by an increase of concentration C (289 mg C g^{-1} FL) and N (16 mg N g^{-1} FL) at end of incubation.
Our results are similar to those found in rotation system which including prairies (Janzen *et al.*, 1992; Biederbeck *et al.*, 1994). The same proportions are observed in soils under cereals (Dalal and Mayer, 1986a). Nevertheless, in prairie soil Greenland and Ford (1964), Gregorich and Ellert (1993) found that LF-DM represent between 3 to 10% of the total soil weight which contain 48% of the total C and 32% of the total N. However, under forest, LF-DM can reach 18% of soil DM which contain about 50% of the total soil C and N (Spycher *et al.*, 1983).
Microbial biomass kinetics description
The model [1] fit well the MB experimental data, the R^2 values range between 0.991 and 0.999 except for the site 21 and 22 where R^2 = 0.88. The labile compartment ($MB\text{-}C_L$) and ($MB\text{-}N_L$) of MB range between 35 to 287 mg kg^{-1} and 26 to 108 mg kg^{-1} respectively. The rate constant of this compartment (k_{CB}) varies between 0.012 to 9.27 wk^{-1}. This result suggested that labile compartment of $MB\text{-}C_L$ is mineralized between 0.1 to 8 weeks. The $MB\text{-}N_L$ compartment showed short time-life, which ranged between 1.4 to 29.2 days. This results suggested that, under non-immobilizing conditions and low humification processes regarding to the mineralization, the mineralization of labile compartment of the MB (50 to 83% of the total MB-N) and contributed

approximately 20-70% (mean 42%) of N mineralized during 56 weeks of incubation. Cochran *et al*. (1988) found two pools of biomass which one is deficient in C and the other in N. In the present survey biomass labile was rich in N (27 - 85 mg kg^{-1}) with C:N ratio <5. The resistant biomass was poor in N (5 - 65 mg kg^{-1}) with C:N ratio <10.

Our results are similar to those reported by Bondes *et al*. (1988), they found that N-MB could contribute between 55 to 89% of the N mineralized. Juma and Paul (1984) found only 15-25% of mineralized N are from MB. Robertson *et al*. (1988) brought back that 40% of the MB-N contributes to the total of N mineralized during 12 weeks of incubation to 37°C. Maramoto *et al.* (1982) found that 66% of the N mineralized come of N-MB. Nicolardot (1988) noted that about 80 to 100% of labelled cultured cells introduced into soil mineralized rapidly inside the first week of incubation.

The resistant compartment of the MB (MB-C_R) and (MB-N_L) showed a high time-life which ranged between 0.6 to 5.5 years and 1.3 to 1.9 years respectively. Despite the limit of life-time of this compartment it is so probable that soil microbial biomass tend to zero. Of this point of view, the MB-C_R compartment can be considered as active fraction of the microbial biomass fraction of the biomass not affected by the mineralization.

Evolution of the C:N ratio of the MB during the incubation

In general the ratio C:N of MB is gradually increased until week 32 which pass in mean of 4.6 to 10.3, after which it slightly decreased to 9.6 at 56 weeks of incubation. We have noted that C:N ratio of the MB during the first four weeks of incubation was similar to labile compartment of MB. Otherwise, the time of half-life of this compartment varied 1.4 to 29 days, which coincides with high soil MB loses. LeMaître (1992) and Hassink (1994a) have observed same evolution patterns. The C:N ratio of labile compartment of the MB varied between 1.2 to 4.5 (2.5 mean). However, the values of C:N of resistant compartment of MB varied between 6 to 17 (9.4 mean). This values are near of those of humified soil OM (Alexander 1977), what indicates that the resistant compartment of MB persist beyond 56 weeks of incubation.

These results indicate that the soil MB is heterogeneous; labile compartment source of C and N (Bondes and Rosswall, 1987; Nicolardot, 1988) and resistant compartment not sustained by availability of the carbon in soil become dormant. Thus involve that during the incubation the process of dormancy-activity of biomass is activated when the available soil OM becomes inaccessible to the soil microbial biomass. Bonde and Rosswall (1987) hypothesized that energy limitation would force a dormant population to decompose rapidly, and hence that remaining biomass could be considered active. Brookes *et al*. (1985), Wardle and Parkinson (1990) report that dormant soil MB can attain 50% of the total biomass.

Light fraction kinetics description

For soils 2, 3, 9, 14, 15, 19, 20, 22, 26, 28, 30 and 31, the model denotes same values of LF-C_L and LF-C_R and their rate constant. However, for LF-N model soils 4, 5, 6 and 25 denote same rate constant.

The labile carbon of the FL (LF-C_L) represent in mean 37% of total C-LF (8 - 50%) with rate constant varying between 0.078 to 6.64 wk^{-1}, this correspond to half-life between 0.1 to 8.8 weeks. These values of $k_{LF\text{-}C}$ show that in mean 37% of the LF is degraded inside the first 6 weeks of incubation very quickly. Otherwise, the time of half-life of the resistant fraction (LF-C_R) is lower and varied between 0.3 to 4.28 year, thus indicated that this compartment can not be the main source of energy for the MB. Nevertheless, it can constitute a precursor of humic compounds (free humus) (Dommergue and Mangenot, 1970). These two compartments (labile and resistant) of the FL correspond to compartments that McGill *et al*. (1981) and Parton *et al*. (1987) called metabolic and structural compartment; the first is metabolized by soil microorganisms, while the other is precursor of humic substances.

The rate constant of FL mineralization of the present survey are similar to those found by Dalal and Mayer (1986b), Hassink (1995) and Gregorich *et al*. (1997). However, Buyanovsky *et al*. (1994) found a very weak rate constant which account about 0.00086 wk^{-1}, which corresponds to 15 year of half-life time. They assign this weak constant of rate to the physical protection of the light fraction that gives back it inaccessible for the MB.

The nitrogen of the light fraction

As found some values of the N labile compartment of the LF (LF-N_L) are negative, this represent the amount of mineral N immobilized by the FL which varied between 3 to 60 mg N kg^{-1}. If we exclude the negative values of the LF-N_L, the amount of varied between 19 to 118 mg N kg^{-1} with rate constant between 0.061 to 7.21 $wk^{-1,}$ which represent half-life time of 0.1 to 11.3 weeks. Nevertheless, the rate constant corresponding to negative LF-N_L values which can be considered as N immobilization constant rate, the life time the immobilized N varied between 2 to 5.7 wk^{-1}. The immobilized N is from soil solution before the incubation. Besides, we noted a strong positive relationship between the initial mineral N and the N immobilized (R^2 = 0.70, P = 0.001). The amount of LF-N_R varies between 10 to 138 mg N kg^{-1} with the corresponding rate constant of 0.004 to 0.044 wk^{-1} the half-life time varied between 3 to 3.3 years. These results suggested that the microbial proliferation provoke the immobilization of the mineral-N mineralized from the dense fraction of the MO. The N immobilization is explained by the fact that the FL is a heterogeneous whole of MO having different stage of biodegradation and different levels of N therefore, microorganisms can immobilize the mineral N coming from the dense fraction of soil (Sollins *et al*.1984) in order to balancing the C:N ratio of the LF (Alexander, 1977). Other hypothesis can explain this phenomenon resides in the fact that the FL constitutes a privileged microhabitat to MB (Kanazawa and Filip, 1986; Gregorich and Janzen, 1996). These, after their death, the microbial biomass release N, which will be immobilized then in the LF. Besides, Adams (1980) observed an immobilization of N after incorporation of coarse MO. These values show the importance of this compartment of the MO that can contribute to the supplying of N to plants after mineralization. Besides, the FL can be considered as regulator which can in same time immobilized and mineralized N. This issue suggested that LF can decrease risks of nitrate losses in soil profile and can be synchronized the liberation of N with the growth of plants.

General attends were observed during the incubation which consist in a relative proportionality between loss of FL-DM and the loss of C and N of LF. Nevertheless, in term of C and N concentration in LF the results indicated that FL is more concentrated in C and N compared to the initial values. These results suggested that during the incubation two concomitant phenomena, which are taking, place mineralization and molecular condensation. The decomposition of LF remains in soil nutrients for plants and microbial biomass and part about 20% of initial LF-DM is converted into free stable humus (Duchaufour, 1983; Stevenson, 1994). Conti *et al*. (1997) affirm that the LF of the MO mineralize very quickly and cannot contribute to the formation of steady organic compounds. These hypotheses go in opposition to results of Gregorich *et al*. (1997) as well as those of Amalfitano *et al*. (1995) they concluded that the FL constitutes the humic precursor. In the present survey, we also noted that after 56 weeks of incubation a substantial amount of the FL (1-3.7 g LF kg^{-1}) remained in soil.

Otherwise, Dalal and Mayer (1986a) note that the carbon of the sandy fraction is lost quickly than clay fraction. Nevertheless, Catroux and Schnitzer (1987) find that N in sand and silt fractions was more resistant than in the clay fractions, they conclude that mineralizable N increased with decreasing particle size. We have noted that LF-C lost during 56 weeks corresponds exactly to mineralized C (Sbih 1999).

The C:N ratio of LF deceased during the first four weeks of incubation which pass in mean from 26 to 20, however, a slight increase of C:N ratio (21 mean) is noted between week 4 and 16. Thereafter, the C:N ratio decreased until attained value of 18 at the end of the incubation. This evolution pattern involved that LF tends toward to the more stable and humified OM. This hypothesis is supported by the fact that during the incubation the LF undergoes simultaneously loss of DM weight and increase C and N concentration in LF. In contrast, Greigorich and Jenzen (1996) suggested that an increase in the LF concentration generally signal enhanced levels of labile OM. They concluded that no adequately arguments which explain the eventual conversion of the transient C of LF to stable OM. However, Skjemstad *et al.* 1986 and Christensen (1992) suggested that LF is transitory pool of OM between fresh residues and humified, stable OM. We have also noted a negative effect of C:N ratio on available-N (labile compartment). Figure 3 showed when the C:N ratio of the FL is relatively raised; we observe N immobilization (negative LF-N_L values). While for C:N ratio equal to 25, the FL seems to reach a balance where the microbial immobilization of the N is stopped, whereas the mineralization of the LF-N turns from negative to positive. In the same order of idea, Sollins *et al*. (1984) found that the maximum of N mineralized of the LF and the dense fraction occurred at the C:N ratio between 20 and 30 respectively. They noted no FL mineralization for C:N between 50 and 60. Vong *et al.* (1990) found that FL mineralization turns negative at ratio between 20 and 25.

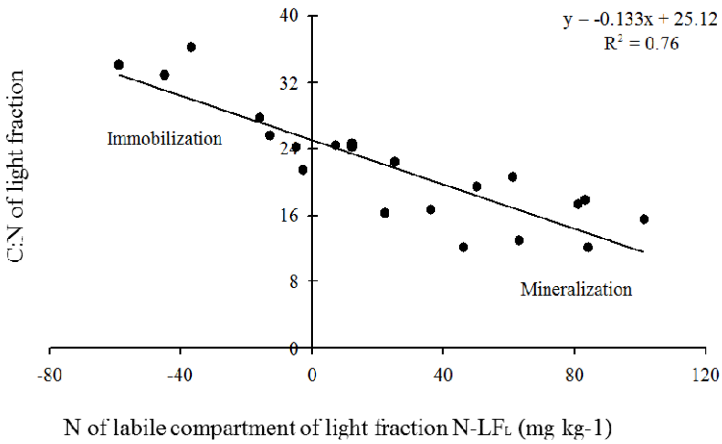


Figure 3. Relationship between the C:N ratio of the LF and the N of labile compartment ($LF\text{-}N_L$) of the light fraction of the MO as determined by fitted model.

Conclusion

The results reported in this paper show that during long-term incubation, the soil MB undergo high level decrease which can reaches 71% of initial C-MB and 82.8% of initial N-MB. In same time the decomposition of the LF reached the same proportions 73% of the LF-C and 77% of LF-N. So, the evolution of these two compartments of the soil MO revealed that the MB as well as the LF constitutes a no negligible source of N for plants nutrition. The loss of MB and LF followed a two-compartment pattern, labile compartment of both MB and LF constitutes variable but significant part of available C and N. The resistant compartment which half-life time can reach about 4.2 years. Thus suggested that this compartment will be considered as precursor of humic substance. In addition the model exhibited a significant amount of N (3 - 60 mg kg^{-1}) which is immobilized by the LF during the first four weeks of incubation.

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Afforestation Effects on Physical, Chemical and Biological Soil Properties

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Abstract
Land use change alters the soil ecosystem, leading to loss of biodiversity and depletion of soil carbon. In this study afforestation effects on physical, chemical and biological soil properties was investigated according to results from treeless area, 10 years old plantation, and 23 years old plantation in Kaymaz basin of the dam area of black pine plantation at Eskişehir which had been used like grassland. The results also evaluated for different aspects and for different soil dephts.

Afforestration increased electrical conductivity (from 0,264 *mS/cm* to 0,420 *mS/cm*), urease activity (from 0,187 $\mu gN.g^{-1}$ *soil* to 0,236 $\mu gN.g^{-1}$ *soil*) and CO_2 evaluation (from 1,396 $g\ C\ m^{-2}\ gün^{-1}$ to 1,574 $g\ C\ m^{-2}\ gün^{-1}$); and decreased organic matter (from 2,622% to 2,321%) and β-glucocidase activity (from 5,752 $mg\ pNP\ h^{-1}\ g^{-1}$ *soil* to 1,964 $mg\ pNP\ h^{-1}\ g^{-1}$ *soil*). There is no significant difference observed in phosphatase activity. Soil reaction, total lime, organic matter, β-glucosidase and CO_2 evaluation was affected from different aspects. It is founded that lime, pH, and CO_2 evaluation was higher in South; organic matter and β-glucosidase activity was higher in North. Depending on the depth of soil there was seen decrease at organic matter content and increase at phosphatase activity.

It was seen that β-glucosidase enzyme activity changed at the same aspect with organic matter's. Alcalin phosphatase activity increased with depth. It is considered that inorganic phosphorus' larger amounts at high depths were inhibited the phosphatase activity at high depths.

Enzyme activities and other microbial factors may widely vary under natural conditions typically. Therefore, soil enzyme activities investigations should be conducted with other chemical, physical and microbial measurements to evaluate soil health accurately and more comprehensive studies should be done.

Keywords: Afforestation, Soil Enzyme Activity, Soil Respiration

Environmental Evaluation of Residual Trees Damage Due to Recreational Activities in Fandoghlou Forest, Northwestern Iran

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Abstract
Forests are popular recreation areas in Iran. These temperate broad-leaved forests also have a high conservation value due to sustainable management. Recreational activities, particulary the use of fire places, can cause extensive damage to shrubs and trees. We develop a method to estimate damages to residual trees due to recreational activities in Fandoghlou forest of Ardabil, Iran. The method was tested in a coppice hazel forest with free access in northwestern Iran. Results showed that in the study area, 2 ha (3.3 %) of 59 ha were heavily impacted by recreational use, 6 ha (10.2 %) moderately and another 21 ha (35.6 %) slightly impacted by recreational activities. Heavily impact areas in most cases situated near the forest edge. The monetary benefits of forest recreation in these areas, however, by far exceed the damage to trees.
Keywords: forest recreation, multifunctionality, spatial distribution of damage.

Introduction
Today, forests have become multifunctional, fulfilling ecological, economical, and social services (FUHRER 2000, MATHER 2001). Forests are often the only freely accessible natural areas to spend some leisure time (JACSMAN 1998). Public interest in recreational activities has increased significantly around the world especially since the end of the nineteenth century (COALTER 1996). This is due mainly to increase in the amount of free time and welfare in nations among all the other complex inter-related factors (KARA AND DEMIRCI 2010). The amount of leisure time has increased with the spread of the weekends and holydays and reduction of working hours. Accompanying increase in income and living standard has provided many people with an opportunity to spend time on outdoor activities. Outdoor recreation in forests has become an important part of many people's lives. There has been a large increase in the recreational use of natural areas over the past few decades (LYNN AND BROWN 2003). Most outdoor recreational activities, however, can adversely affect the natural environment, and the increasing popularity of outdoor recreation has inevitably resulted in greater and more widespread ecological impacts on natural ecosystems (SUN AND WALSH 1998). Participating in different outdoor recreational activities became not only an interest but also a necessity for many people today because of its contributions to individuals and society in general (BEATON AND FUNK 2008, TINSLEY ET AL.2002). Today, one of the most serious problems facing managers of recreational resources is the paradox of protecting natural ecosystems while providing for their recreational use (KUSS AND GRAFE 1985). As the demand for recreational experiences in natural areas is growing, it has made the pressure of adhering to this dual mandate difficult (KLISKEY 1994, KEARSLEY 1990). Recreational use impacts are usually heavily concentrated on a small percentage of the total natural area along a few popular trails and destinations (HENDEE ET AL. 1990). Virtually all types of recreation alter some characteristics of soil, vegetation, or aquatic system (COLE AND LANDRES 1995). In this paper we present a method to estimate residual tree damages due to recreational-induced activities over forest area. The method presented can be easily adjusted to other forests influenced by intensive recreational activities.

Material and Methods
Study area
Field data for the present study were gathered in the hazel coppice forest of Fandoghlou, Ardabil (48° 40′E, 38° 32′N) in northwestern Iran. The forests of Fandoghlou (932 ha) are situated in the vicinity of the city of Ardabil. Approximately 1000000 individuals per year regulary visit its most popular areas for hiking and jogging with the area of 59 ha. The forest is dominated by hazel shrubs that give the forests a high recreational value in spring and summer.

Recording the tree damage and special distribution of tree damage

Grids of 50 x 50 m plots were set up in both areas in winter 2010, resulting in total of 86 circular plots in 59 ha of the Fandoghlou forests. Plots not containing hazel trees were excluded from the analysis. In each plot, all hazel shrubs with a diameter at collar area > 5 cm were examined for damage and assigned to one of three classes based on standard wood quality. Damages due to windstorms, lightning, or animal browsing were record but not considered in the data analysis as these damages were negligible. We focused on hazel shrubs and hornbeam trees because these two species are the only tree species in these forest. For illustrating the spatial distribution of tree damage, each plot was assigned to one of four categories based on the combined percentages of slightly and severely damaged trees (Table 1).

Table1. Definition of recreational-induced damage to hazel shrubs (DCA > 5cm) assessed at the level of single tree and plot

Level	Damage class	Definition
single tree	U	undamaged tree, no visible damage
	I	slightly damaged, few small scars
	II	severely damaged, extensively damaged
plot	Damage category	
	0	no damage trees
	1 (slightly impacted)	1 - 40 % trees with damage class I or II
	2 (moderately impacted)	41 - 90 % trees with damage class I or II
	3(severely impacted)	91 - 100% trees with damage class I or II

Method description

We developed a method to estimate damages to residual trees per year due to recreational activities. Recreation-induced damage to trees is not uniformly distributed over the entire forest area; damaged trees occur most frequently at picnic sites. The cumulative damage recorded in all plots gives an estimate for the entire forest area, which can also be expressed as mean damage per hectare forest area. The stand damages on trees were assessed by considering variable factors including location (root, 0 - 0.3 m, 0.31 – 1 m, and higher than 1 m), size (0 – 200 cm^2, 201 -500 cm^2, and >500cm^2), and intensity of damages (bark damaged, bark squeezed, wood visible not damaged and wood visible damaged). The highest risk for decay is given for trees with injuries in the stump area and the root collar. Damages on superficial roots or above the root collar (higher than 0.3 m) get less often infected by wood destroying fungi (LILIENAU 2003). Total of 912 residual trees with collar diameter of 5cm or greater were considered in data collection.

Results and discussion

Location of damage

The results indicated that the percentage of damages on root, 0 - 0.3 m, 0.31 – 1 m, and >1 m are 13 % (123 injuries), 27 % (255 injuries), 48 % (456 injuries), and 12 % (109 injuries), respectively. 40 % of the damages caused by skidding operation were on lower sections (root and 0-0.3m) of the trees. With regardin to outdoor recreational damages in most of cases occurred in root and stump level, biotic agents such as fungus and insets easily attack wood through injuries, especially which close to the ground (LILIENAU 2003). Therefore, injured trees infected by fungus and insects become subject to considerable amount of value loss in long run.

Table2. The summary of stand damages based on location of damage

location of damage	Root	0 - 0.3	0.31-1	>1
No. of injuries	123	255	456	109

Size of damage

The size of damages was evaluated by considering average width, length, and area of the injury. The damage size can be the most significant factor of deterioration. AHO ET AL. (1989) reported that the larger injuries results in more and rapid deterioration process. The studies indicated that wider and shorter injuries can cause more volume loss than that of thinned and longer injuries.

Besides, wider injuries can reduce the diameter growth. ISOMAKI AND KALLIO (1974) reported damage width 5 – 10 cm and 17 – 35 cm reduce the diameter growth by 10 % and 35 %, respectively. Furthermore, recovery from the wider injuries takes longer period of time than of time than of thinner and longer injuries.

Table2. The summary of stand damages based on size of damage

Size classes(cm^2)	0 - 200	201 - 500	> 500
No. of injuries	852	71	0

Intensity of damage

The results indicated that about 43 % (406 damages) of the injuries occurred on tree barks, resulted in cambium exposed. About 57 % (537 damages) of the damages was seen to be stem or wood injuries. Yilmaz and Akay (2008) stated that Residual trees with wood injuries become more vulnerable to insects and fungus attacks. ISOMAKI AND KALLIO (1974) indicated that the depth and size of the injuries on the wood greatly affect the diameter growth. They reported that diameter growth can be reduced by 10 % and 20 % due to surface injuries and deep wood injuries, respectively.

Table 2. The summary of stand damages based on intensity of damage

Intensity of damage	Bark damaged	Bark squeezed	Wood visible, not damaged	Wood visible, damaged
No. of injuries	117	289	131	406

Spatial pattern of recreational-induced tree damage

In the study area, 2 ha (3.3 %) of 59 ha were heavily impacted by recreational use, 6 ha (10.2 %) moderately and another 21ha (35.6 %) slightly impacted by recreational activities (Fig.1). Thus, 49.1 % of the total forest area contained trees with recreational-induced damage. Considering the heavily impacted areas, which in most cases contain picnic sites and fire places and were mostly situated near the forest edge (Fig.1).

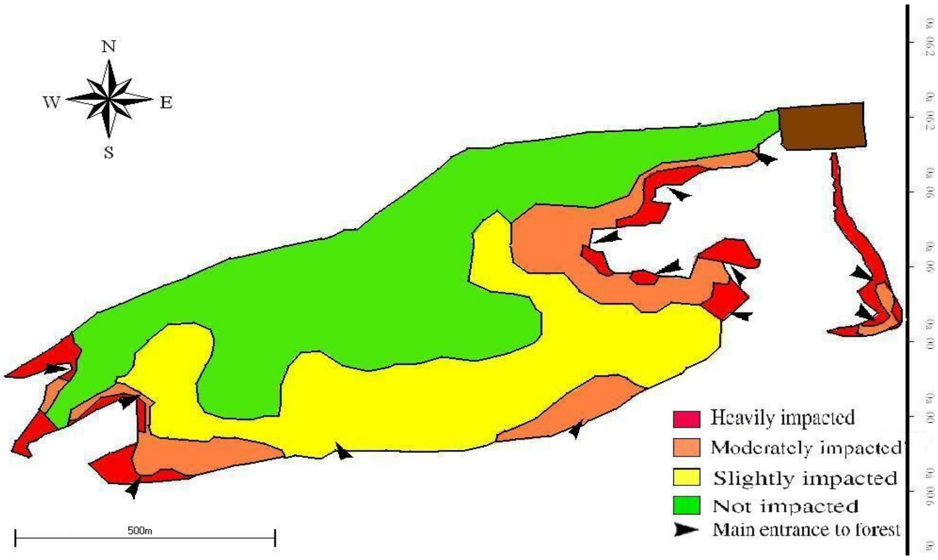

Fig. 1. Spatial distribution of recreational-induced damage to trees in the Fandoghlou forests in northwestern Iran

Conclusion

The recreational use of forests are kind of benefit obtained from forests (PAK AND TURKER 2006). Apart from the ecological consequences, frequently used sites become unattractive to forests visitors (HEGETSCHWEILER ET AL. 2009). Therefore, one aim of forest management must be to preserve recreational areas as attractive and diverse forests. The residual stand damage following recreational activities by visitors was studied in Fandoghlou forests in Ardabil to investigate the effects of various factors such as location, size, and type of damages. In Fandoghlou forests, recreational uses are generally performed by visitors which may cause serious stand damage during hiking and jogging. Therefore, the effects of specified factors on stand damage should be well understood to plan proper recreational operations with minimum damage. The forest managers should implement predetermines straight conservation strategies before visitor entering to the stand. In hiking and picnicking in the forest consisting of trees with thinner barks (i.e. beech), recreational operations should be carried out with extra precautions. In recreational operations, damage size should be kept as small as possible to minimize potential deterioration on wood due to attacks of biotic agents. The managers should be well educated about the important functions of even-aged coppice forests in sustainability of forest ecosystem. Then, adequately trained and supervised loggers should be employed in selection cutting operations to reduce stand damage.

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Construction and development of green landscapes in Arid regions of Iran

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Abstract

Green space development in arid regions is one of the important measures to stabilize the Earth life. Approximately, 80 percent of Iran is covered with deserts with fragile ecosystems. The present study investigates the importance of plantation management practices in combating desertification and achieving sustainable development specified for different regions of Iran. Iran is a country which about 80 percent of its area is covered with deserts with fragile ecosystems. Creating green space is beneficial for gentling air, preventing air pollution, attracting animal species (fauna), building aesthetic aspects and gaining thousands ecological and economic values. Suitable plant species used for planting areas located outside cities to prevent the spread of desertification are *caper beans*, *atriplex*, *haloxylon*, *tamarix*, *calligonum*, pasture and shrub species, different species of *pine*, *eucalyptus*, *mesquite*, *honeylocust*, *weighs cypress*, *almond* etc. In urban parks with more irrigation, some species such as *elm*, *sycamore*, *ash*, *ornamental* species such as *Italian cypress*, and *arbor-vitae* ..., can be used to increase biodiversity. Appropriate methods of irrigation are important factors in increasing plantation productivity in arid regions of the country which are going to be addressed in the present study. Provision of water primarily depends on the nature of species, the amount of water demanded, the extent of land allocated to plantation, the amount of precipitation, annual evapotranspiration, and the distance of seedlings from each other, soil type etc. an investigation of these factors in desert areas is of particular significance.

Key words: green space, plantation, resistant species, arid ecosystem.

Introduction

Green space with its various applications plays a significant role in soil control and stabilization (by preventing water and wind erosion) and prevention of waste water flows to form floods, controlling and reduction of abnormal and earsplitting sounds produced by different vehicles, factories, and workshops (i.e. these sounds are absorbed, reflected, refracted, distorted, or decreased by tree trunks, leaves, and branches). Green landscapes also act as an Oxygen making system to sustain human lives by oxygenating and diluting the air and controlling air pollution through absorbing Anhydride dioxide, as a pollutant harmful for humans' health. Plant leaves clean the air by absorbing dust, soot, steam, gases, and unpleasant odors. These particles will be washed down and removed from the surface of the leaves after each rainfall. Given that a large percentage of our country area is located in arid and semiarid regions, a need is strongly felt for planning and construction of park plantation. Today, the existence of cities without green landscapes in their various forms does not make sense. Urban development outcomes and complexity of environmental problems along with desertification have made the existence of green landscapes and their development as inevitable for ever. Therefore, the present study aims at introducing successful plant species and familiarity with the ecological needs of species used in desert areas.

Materials and Methods

Indigenous species of a region can be considered as the best guide for creating green landscapes. Parks and green landscapes play a major role in urban architecture, pollution control, mental health provision, fauna absorption, noise and traffic control, creating aesthetic elements and so on. When designing urban green landscapes, special significant must be given to possible applications of these landscapes and, therefore, the following points deserve attention:

1. Social Objectives
2. Gaining an awareness of cultural and geographical characteristics of the region (such as slope, drainage, and soil texture) and climatic conditions

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3. Conducting preliminary investigations when designing urban green landscapes: For instance, drawing maps and plots of the desired place for implementing green space projects (including accurate mapping and exact determination of the scale) and paying attention to changing socioeconomic factors related to the project (such as streets around the park, the entrance and exit, main and secondary outline of the constructed buildings) are essential.
4. Planning and selecting the project form: The project should be designed in a way that it includes all relevant issues. To do so, it is necessary to accurately assess the plot and analyze every single line or detail drawn on the plot by considering various associations between such details or minor points.
5. The existence of a harmony between the form and the type of the materials used: different lines and forms should be created homogeneously so that they do not lead to mental stress. It is likely to interfere with the quality of green landscapes by placing a statue in a place or not paying attention to harmony of the colors used and create a kind of natural and profound joy or grief. The use of hedges, fences, or scaffolds is influential in creating the effective quality of landscapes. As a result, a project is successful when it reflects all inducted events and positions.
6. Creating an association among different parts of the project: When developing the project, all points and the units should be coordinated so that to create a sort of communication between them. Communicative lines can be designed in the form of various steps, walls, etc. While creating aesthetic aspects, these lines serve as a communicative device between different parts of the project. In addition, the way various ornamental shrubs, trees, and other essential elements are combined and put together has a direct effect on the efficiency and environmental effects of the project. If in a plot of land located in the green space project site, the harmony among colors and aesthetic elements is created in a such way that there is no communicative line is established it is likely that a mental association is created in the observer's mind but objective and concrete relation is lost and the green space becomes like a useless forest. In some cases, given the psychological qualities and in order to create a social relationship between residents and buildings it is necessary to use florid fences as hedges or lees. At this stage of designing, selection of plants and shrubs play an important role in the representation of the project.
7. Cost estimation of a green space project will be applicable only if the resources allocated, in addition to design and technical considerations, are available. Therefore, the most important part of the project is related to the financial calculations as the first steps to carry out the project. As a result, it is necessary to estimate costs and prices with regard the operating space and its related purposes which include the following three parts: 1) Construction operations such as creation of waterfronts, pools, stairways, the design of streets, piping, cabling, along with calculation of wages and consideration of operational factors employed for construction. 2) Gardening and decoration issues: when planning for financial matters, it is necessary to estimate prices for different trees, shrubs, seeds, transplants, and types of fertilizers and pesticides employed. Price fluctuations should be also considered in the calculations. In determining the totals, the calculation of wages to be paid to the total number of technical and gardening employees is also of significance. Cost estimation of services: in this stage, calculation of prices includes: designing, implementation, and monitoring the good performance of operations. Besides, it is necessary that all items be included separately in the ledger (5).
The effects of implementation of green space projects on erosion control and soil stabilization in desert areas: Soil erosion will lead to the loss of surface soil (up to 20 to 30 cm) due to the lack of vegetation on the ground surface. Erosion intensity is dependent on the severity of wind, climatic conditions, soil properties, and the slope angle of the region. When the soil surface is dry and free of any vegetation and is exposed to wind, the surface soil will be blown as dust and will land and is deposited in the wrong place. Climatic factors affecting the erosion process are: the stability of the soil layer, the size of erodible particles, soil weight, and amount of soil moisture. When the wind is blowing on the soil surface with no plant coverage, smaller and lighter particles of the soil to dust and soil particles will be suspended in the air in the form of dust. Dense leaves will prevent the wind from blowing and dense branches control and

reduce the wind intensity. The most appropriate plants to prevent soil erosion by wind are short thick vegetations of very low height with comb-like roots. Leaves and branches existing in the green landscapes prevent rain drops hitting the soil surface, reduce the speed of water flow running down the slopes, and increase maximally water penetration into the soil. These processes are performed by increasing soil organic materials and mitigating the soil texture. This type of trees plantation includes planting trees in gardens, parks, streets, green belts around towns and villages, and the two sides of the roads with the aim of noise reduction and beautification of places and landscapes. In arid regions, beautification of views and landscapes usually means changing the brown color found in suburban areas into green or converting the color of landscapes into green (4). Green landscapes can be called breathing lungs of each city as plants are able to produce a great amount of oxygen through photosynthesis and absorb a significant part of toxic gases. Each acre of green space is capable of annually producing 22 tons of pure oxygen and, thus, plants can naturally be regarded as the best purifier of air pollution. On the other hand, the plant evapotranspiration mechanism causes a significant increase in air humidity. This makes breathing easier and reduces the effects of pollutant particles suspending in the air. Iran's arid regions are faced with many problems for the development of green space due to limited water resources and, as a result, the occurrence of successive drought periods has increased the vulnerability of the required planning. The allocation of green landscapes in terms of total area used for plantation of trees, lawn, permanent flowering, seasonal flowering, and landscaping is 76%, 13.8%, 1.9%, 2.8% and 5.1%, respectively. According to this classification, the highest amount of green space area is allocated to planting trees and lawn (8).

Discussion and conclusion

Several studies have investigated the role of ecological factors in the adaptation of different salt-resistant species and the recommended species through these studies can be used for the construction of parks and green landscapes in cities. Different species of *atriplex, alhagi*, *haloxylon*, *zygophyllum eurypterum*, *halanthium raiflorum*, *manna tree*, *Artemisia Siberia …* belonging to rangeland species and *eucalyptus*, *mesquite*, *gleditschia caspica*, *acacia*, *elm*, *pine*, *cedar*, and other tree species have been proposed to be used in green landscapes (7). *Sedlitzia* as a halophyte species is appropriate for arid areas (11). *Nitraria* is a species resistant to soil salinity and is planted in arid areas with high salinity and the playa (desert areas where the groundwater level is high) (1). For dry sandy soils, the following species are recommended: *ailanthus altissima*, *betula pendula*, *eucalyptus*, *niphophila*, *gleditsia triacanthos*, *acacia, robinia pseudoacacia*, *lote tree*, and sorbus aria (3). Proper irrigation and timely and balanced use of water are important for proper water management. The results of experimental studies indicate that the efficiency of drip irrigation systems is 2.5 times as much as that of flooding irrigation system. In addition, the use of pressurized sprinkler systems in for lawn irrigations yields high efficiency compared to usual irrigation systems (8). To increase the utility of water resources in arid regions the following points should be taken into account: 1) Irrigation at night to reduce evaporation 2) changing flooding irrigation method into drip irrigation systems, 3) transferring water by covered ducts/channels and using covered tanks for water storage (10). As the results of different studies indicate drought-friendly species are highly resistant to pests and diseases (6). Given the lack of water (dehydration) in dry systems and the need for development of green landscapes and forestation, a thorough and accurate investigation of plant species resistant to dehydration seems inevitable. Therefore, planting trees can result in more long-term economical savings than plantation of seasonal species as tree plants need sustained irrigation for the first 5 years after plantation but they can survive for a long time in future without any irrigation. Given the combined need of planting grass, flowers, and other ornamental plants next to trees, the optimal water management is highly recommended. At the present, grass lawn used usually in green landscapes belongs to a species with high water requirements. Considering the compatibility of various types of grass lawn to different conditions of dehydration, salinity, and resistant against stomping, heat, and coldness it is recommended that to use grass seeds that are resistant to heat and dehydration such as *festuca lawn* which is resistant against dry conditions. Other covering plants such as francinia whose maintenance cost is 0.8 times that of grass lawn and its water requirements are 0.2 times those of water grass and, therefore, it is a widely used species. Forestation with resistant tree species such as *eucalyptus*, *tamarix*, *atriplex aucheri*, *gleditsia triacanthos* and others is recommended to be used in parks outside cities and ring roads in dry suburban areas.

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Soil physical quality as influenced by man – made land uses and deforestation

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Abstract
Anthropogenic effects and changes in inherent soil properties have increased the need to assess impacts of land use change on soil quality. This study investigated the effects of land-use conversion on some soil physical properties in Western Azerbaijan, Iran. Some cultivated lands, garden and pastures, all with historical earlier use as forest, were compared with their adjacent natural forests. Penetration resistance was measured *in-situ* by a cone penetrometer and was used as an index for surface compaction. Undisturbed soil samples were collected from the sites and were applied to determine soil bulk density (BD) and total (n_t) and aeration (n_a) porosity. Garden and cultivation soils had Lower penetration resistance compared to the forest and pasture soils. Average values for BD were 0.99, 1.24, 1.32 and 1.29 g cm^{-3} for forest, pasture, garden and cultivated soils, respectively. Total porosity showed no significant change. However, n_a was of higher values in converted land-uses compared with forest soils.
Keywords: Soil quality; physical properties; Total porosity; Bulk density; Surface compaction.

Introduction
Soil properties can be affected by different land management systems (Sharma and Aggarwal, 1984). Inappropriate human-made conversions in land use are a widespread problem that results in land degradation (Celik, 2005; Li et al., 2007).
Almost 50% of the land surface has been significantly transformed by human and only ~5% remains untouched. The conversion of natural land into cropland decreases the rate of soil infiltration and affects soil physical properties that increase erosion (Li et al., 2007). The conversion of natural forest into cropland decreases the soil organic matter (SOM) leads to increased bulk density (BD) and decreased total porosity (n_t), thus decreasing soil infiltration (Wall and Heiskanen, 2003; Celik, 2005; Li et al., 2007). This conversion could leave the land more susceptible to soil degradation including higher soil BD, lower hydraulic conductivity, and higher soil erosion (Spaans, 1989). Deforestation and subsequent cultivation resulted in almost a 20% increase in soil BD (Hajabassi et al. 1997). Kizilkaya and Dengiz (2010) showed that after long term continuous cultivation of the natural forest soils resulted in change in soils both in physical and chemical characteristics. They also showed that land use change and subsequent tillage practices resulted in significant change in BD among cultivate, pasture, and natural forest soil. The aim of this study was to determine the effects of land use change on selected soil physical properties in a Western Azerbaijan, Iran

Materials and Methods
The experimental site is located in the Mirabad plain (36° 58 ‘N, 45° 00’ E), Western Azerbaijan, Iran. The area has about 1710 m of elevation above the sea level in the Western Azerbaijan.
The forest area is almost 2,000 hectares, and is totally covered with an average of 30 to 40 years age of Crataegus oxyacantha trees. Soil moisture and temperature regimes are mesic and xeric, respectively (with warm summers, cold winters and arid and semi arid climate). Most part of the natural forest has been fragmented and degraded by human activities such as clear cutting for agriculture, and rangeland. Forest has been cultivated for at least 50 years (1940 - 1990) with alfalfa, wheat and barley in a rational manner.
Soil sampling were taken randomly from three sites in each of four adjacent land use types which are native forest, pasture, garden and cultivated fields. 12 undisturbed and 96 disturbed soil samples were taken to investigated for their physical, chemical and biological properties at the laboratory. After disturbed soil samples were then air – dried and passed through a 2mm sieve, particle size distribution

was determined by the hydrometer method (Bouyoucos, 1962). Undisturbed soil samples were taken by using a steel core sampler of a 100 cm^3 volume. Bulk density and total porosity were determined with the undisturbed soil samples. Bulk density was determined by the core method (Blak and Hartge, 1986). Total porosity was calculated in undisturbed water – saturated samples of 100 cm^3 assuming no air trapped in the pores (Danielson, suther land, 1986).
The statistical analyses were conducted using the SAS program (SAS, 1985). An analysis of variance was performed using a randomized complete design with three replications model to compare the impact of land use on soil properties. Comparison of means was done by a Duncan test.

Results and Discussion

Conversion of the natural forest into cultivation had resulted significant difference of soil bulk density, penetration resistance and aeration (n_a) porosity. The greatest soil BD in was observed in garden and fallowed by cultivated land, pasture and forest lands. So that, the values of BD varied significantly from 0.99 g cm^{-3} to 1.32 g cm^{-3} (Table 1). This difference could be attributed to the compaction of the surface soil due to overgrazing and intensive field traffic and forest clearing and subsequent agricultural practices as well as the reduction of organic matter content (Ridvan et al., 2010). Bahrami et al (2010) have shown a significant difference between BD of natural forest and cultivated sites. Agricultural activities have a direct effect on the porosity of soil (Morgan, 2005; Blume et al. 2009). This has been indicated that deforestation has had a significant effect on the pore volume of the soils (Bahrami et al., 2010). Probably due to the traffic and overgrazing of livestock and trampling by humans forest soil is more compressed. Aeration porosity (n_a) increased in order of forest > pasture > cultivated land > garden and varied from 0.06 g cm^{-3} to 1.14 g cm^{-3} (Table 1). Groenevelt et al (2001) showed that have values more than of 2.5 MPa penetration resistances, root growth is considerably limited. Deforestation had a significant effect on the penetration resistances, so that, it decreased in the order of forest > pasture > cultivated land > garden and varied from 0.33 MPa to 0.122 MPa (Table 1).

Table 1. Comparison of the effects of changes in land use on total porosity (n_t), aeration porosity (n_a), bulk density (BD) and Penetration resistance (Pr) in soils of natural Forest, Pasture, Garden and Cultivated land.

Variations Source	nt (%)	na (%)	BD (g cm^{-3})	Pr (MPa)
Forest	0.52^{a}	0.06^{c}	0.99^{b}	0.33^{a}
Pasture	0.46^{a}	0.06^{c}	1.24^{a}	0.29^{ab}
Garden	0.44^{a}	0.14^{a}	1.32^{a}	0.122^{b}
Cultivated land	0.45^{a}	0.11^{b}	1.29^{a}	0.167^{ab}

Means in a column with the same letter are not significantly different at the 0.01 probability level.

Conclusions

The comparison between some soil physical properties in the different land use systems indicate that the transformation from forest to other land uses changed soil bulk density, penetration resistance and aeration porosity. The cultivated soils had bulk densities significantly higher than the forest soils. Results also showed that after 50 years of shifting from forest to other land uses the soils in the garden, pasture and cultivation land had significantly greater values of bulk density, penetration resistance and aeration porosity ($P<0.01$), compared to the soils under natural forests. Therefore the results confirm that long-term deforestation and subsequent cultivation had a significant influence on soil physical quality.

Table 2: Results of the statistical analysis of the soil properties

Variations Source	n_t			n_d			Bd			Cr		
	Cv	df	F	Cv	df	F	Cv	df	F	Cv	df	F
Land use	10.56	3	1.66^{ns}	13.84	3	28.7**	5.37	3	8.5**	41.72	3	3.4*
Error		8			8			7			8	
Total		11			11			10			11	

*: Significant (P<0.05), **: Significant (P<0.01), ns: None Significant

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LAND DEGRADATION, REMEDIATION AND RECLAMATION

ORAL PRESENTATIONS

Recent Consequences of Land Degradation on Farmland in the Peri-Urban Area of Kaduna Metropolis, Nigeria

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Abstract
This study identifies the recent consequences of land degradation in the peri-urban area of Kaduna metropolis with the aim to improve the environment and the socio-economic status of the inhabitant. Random sampling method was used to collect data from field observation and measurement while snow-ball sampling technique was adopted for the selection of farmers for semi-structured interviews, which are analysed using descriptive statistics. The result revealed that there are three new recent consequences of land degradation in the area; namely, one, socio-economic parameters which includes spending more time, energy and increase in cost of farming; two, the waste buried in the soil are non-biodegradable and contains poisonous chemicals while the third is the permanent resident of many non-degraded waste in the soil. Their implication has effect on the people's health, socio-economic pattern and quality and the environment which are all highly interrelated making the situation more complex. It is suggested that there should be proper and adequate waste management in place for the metropolis, improve conservation techniques to be employed by the farmers and where the land is assumed to be polluted beyond tolerance level the land use should be change from crop farming.
Keywords: Consequences, Conservation, Farmland, Degradation, Socio-Economic

Introduction
Land degradation is a long recognized environmental issue, which straddles both the physical and social sciences. Land degradation has been acknowledged in policy cycle through Agenda 21 and the signing of the United Nations Convention to Combat Desertification (UNCCD) in 1994. Land degradation is a contested term with various meanings, located as it is in various contexts. Historically, land degradation has been a contentious issue (Scoones and Toulmin, 1998; Niemeijer and Mazzucato, 2002 and Warren, 2002). The causes and consequences vary from region to region, mainly in terms of localized intensity, as well as programs to solve problems of land degradation, which also vary regionally as a function of ecosystem characteristics, culture, economics, and political will. However, some cases of similarities in causes and consequences have being reported to exist (Reynolds, 2001). The dual role of humanity in both contributing to the causes and experiencing the effects of global change processes emphasizes the need for better understanding of the interaction between human beings and the terrestrial environment. This need becomes more imperative as changes in land use become more rapid. As a result, understanding the driving forces behind land degradation in various ecological zones and developing models to stimulate these changes are essential to predicting the effects on global environment. Reynolds and Stafford Smith (2002) broadly classify into three groups, factors responsible for land degradation. These are: meteorological, ecological and human factors. The combination of the meteorological and ecological factors forms the biogeophysical factor while the human factors are the socio-economic factors. The causes of land degradation are as diverse as its consequences to man. Although they appear unlimited, in effect however they are basically grouped into environmental (ecosystem), economic, political, security, health, trade, education and the general well being of the people.
From the review of relevant literature, the most suitable conceptual framework for this study is the sustainability model. This model was arrived at because the essence of studies in land degradation is to determine the causes of land degradation, its rate and subsequently to use the findings for conservation of the land in particular and the environment in general for both current and future users. Therefore efforts are not just on what the current land users can get from the land but to ensure that future users even get better output. To this end, this study was designed on the model of sustainability, and as a result the methodology and discussion focus greatly on it with particular emphasis on conservation.

Peri – urban areas are transition zone between urban and rural areas. Consequently these areas are under intense pressure for change in their land use and land cover (Adewuyi, 2008). However, of recent these areas also begin to bear the burden of inadequate or lack of proper management of the resources of the city. A case in focus is Kaduna Metropolis, a city that is daily expanding due to several factors, among which are immigration from rural areas, proximity to Abuja, the federal capital territory and better job opportunity and standard of living. But, the available infrastructures are not increasing at the same rate. Thus, this expansion has its own consequences on the city and it peri-urban area.

The consequences emanate from the city centre first before creating both environmental and socio-economic problems at the peri-urban areas. Of concern to this study is the lack of adequate waste management in the metropolis which has led to dumping of refuse in drainages and streams (Nyeh, 2009). This leads to blockage of the channels and subsequently flooding takes place (Abdullahi, 2009). The effect of the flooding differs between the metropolis and out-skirt, strictly, because of differences in land use and cover. While it is easy to tackle it in the city because affected areas are usually the roads and adjacent buildings, where basic cleaning and application of disinfectants will easily solve the problems.

When this phenomenon occurs in the peri-urban area, it causes wide spread flooding of farmlands and dumping of waste materials on farms. Unlike in the metropolis, it is very difficult to handle the effects in the peri-urban area where land use is for crop farming mostly (Adewuyi, 2010) and surface soil is exposed and required tilling the soil before it is used. The main land degradation problem for such land use before now use to be erosion (Adewuyi, 2008), however, because of the dumping of waste on farmland during flooding and the mixing of waste such as nylon, polythene, rubber, plastic materials and light metal with the top soil which are not easily degraded, thereby introducing new problems. Since this is a new challenge to the farmers of this area, the research problem was to find out what the farmers goes through or experienced in order to put these lands to use for crop farming and more importantly to proposed conservation techniques for the area.

The general assumption for this study was that the earlier this problem is understand in detail and characterized, the quicker the conservation technique will be developed and the better the output from the farm which will subsequently bring higher yield to the land user and better socio-economic conditions for improved standard of living. Therefore the aim of this study is to identify the new consequences of land degradation in order to improve the environment and the socio-economic status of the inhabitant. To achieve this goal the following objectives are set: to map the river course, land use and cover adjacent to the river, examined the types of land degradation and their consequences and proposed ways of handling these new environmental problems.

Materials and Methods

The study area is a portion of the peri-urban area of Kaduna metropolis, Kaduna state, Nigeria. The main river in focus is River Mashi a tributary of River Kaduna. It flows roughly from the north to the south and has large portion of the metropolis as its catchment area. The river forms the natural boundary between Igabi, Kaduna north and south local Government areas. These areas lie within a 500m corridor from the outskirts of the city in some places while in other places developments have envelope the surrounding (Fig. 1). These zones are transition areas from rural to urban and they lack adequate infrastructure in comparison to the main city. It falls within latitudes $10^{\circ}\ 22^{I}\ 00^{II}$ – $10^{\circ}\ 26^{I}\ 00^{II}$ N and longitudes $7^{\circ}\ 29^{I}\ 00^{II}$ – $7^{\circ}\ 35^{I}\ 00^{II}$ E with the elevation ranging from 600 to 650m above mean sea level. The approximate size of the study area is 8,000m^2 (8km^2). It falls within Igabi and Kaduna north local government areas of Kaduna State, Nigeria (Fig. 1).

Kaduna experiences a tropical continental climate. This type of climate is characterized by two distinct seasons of dry and wet. The dry season sets in October and last till April of the following year while the wet season starts around late April and last till October. Kaduna temperature is high throughout the year with mean minimum temperature at 23^{o}C and mean maximum at about 34^{o}C.The diurnal range of temperature is sometimes as high as 12^{o}C which is good for crop growth throughout the year (Adeleke and Leong, 1981). The annual average rainfall is 1250mm with maximum rainfall between July and August (Kowal and Knabe, 1972).The land uses of the adjacent land to the river are mostly for agriculture while housing is also encroaching into the flood plain. The trees are generally moderate in size, ranging from 5 to 15m in height and 15 to 100cm in trunk diameter. The crops grown are mainly cereal (maize, guinea corn and millet) and vegetables (spinach, tomatoes, cabbage, onions etc). Cattle, goat and sheep grazed the vegetation from time to time.

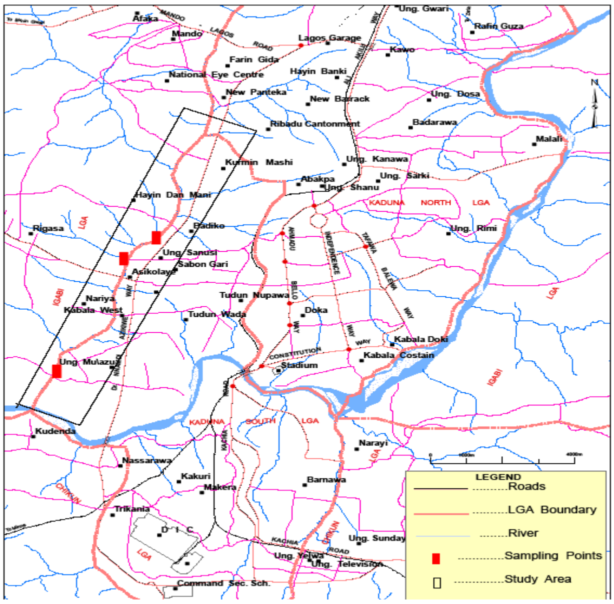

Figure 1. Study area

Studies on land degradation are both biophysical and socio-economic in nature. As a result the methodology of data collection was designed to reflect these two factors. Since the aim of the study is to examine the recent consequences of land degradation and its effects on crop farming in the area, first hand information was collected through observation, measurements and interviews after a thorough reconnaissance survey.

The reconnaissance survey was carried out to determine the size of the peri- urban area of Kaduna and the average size of the farm land in order to determine an adequate representative study size. This was used to determine the number of transects required and their dimensions. Satellite imagery was very useful during the survey. During the field work, field observation was carried out between 8.00am and 4.00pm daily. Under this section, one basic set of data is targeted. This was to observe as seen on the field and document the type of land use, land cover, farming system, type of degradation and local conservation techniques, type of erosion and major crops produced in each transect. The Observation was carried out by a thorough examination of each transect for each variable, and the result was documented on a recording sheet designed for the study transect. Each transect has a form and as a result at the end, 3 recording sheets was produced. The compilation was presented as Tables 1 and 2. The snow-ball sampling method was adopted to select 48 farmers out of an approximate 200. The summary of the result is presented in the appendix.

Result and Discussion

The peri-urban area of Kaduna metropolis has a distinct type of cover because the land use differs from that of the heart of the metropolis. Consequently, the major covers reflect the type of use and as a result, the covers for the area are houses, trees, crops, grasses, litters, shrubs and refuse (Fig. 2). This implies the area is not a complete built up area. The size and percentage of the area degraded, the character of the vegetation and the tree are documented in Table 1. On Table 2 are summary results from field observation which catalogue land use, land cover, soil type, texture and colour, type of degradation, erosion type and numbers, farming system, crop planted and existing conservation techniques.

Refuse dumping is common land degradation in the area (Fig. 2 and Table 2) and it occurs in two forms. First, human beings deliberately dump refuse on parcels of land due to proximity or availability of empty space. Second, refuse is dumped or scattered as a result of actions of wind and water. They are commonly found along drainage channels. However, refuse dumped by the action of water is by far the most important and they occur randomly. The refuse content range from domestic waste such as paper, polythene, food, animal carcass, cloths, saw dust, plastics and light weight objects that are not biodegradable. Year after year, these wastes are partially either cleared or are left to expand to swallow surrounding farmlands. The major type of waste creating problem in the area are non-biodegradable in the likes of nylon, polythene and plastic.

Table 1: Summary of land use and land cover characteristics

Transect	Area Degraded (m^2)	Percent of Area Degraded	SCI (%)	Tree Crown Fullness (%)	Area Cover By Litter (%)	Tree Density Per Transect	LCI (%)	Ratio of Indigenous to Exotic Trees	Types of Exotic Trees
TP 1	0	0	20.00	25	42	1	< 1	1 Palm	Palm
TP 2	195.70	0.78	52.60	75	4	121	10	1:12	Mango, Guava, Kola
TP 3	132.65	0.53	1.83	80	25	77	6.2	1:10	Mango

Table 2: Summary of results from field observation

Transect	Land use	Land cover	Soil Type	Soil texture	Soil colour	Type of degradation	Erosion type and number	Farming system	Major crop planted	Conservation techniques
TP 1	Crop farming	Trees and grasses	Silty clay	Fine	Fine brown	Deforestation	NIL	Crop and animal -rain fed	Maize and millet	Use of fertilizer
TP 2	Crop farming	Trees and crops	clay	Fine	Dark brown	Flooding, Gully, pollution and refuse dumping	One gully	Intensive crop farming-Irrigation	Maize, rice, cabbage, tomatoes and lectus	Use of fertilizer, manure, raised beds and construction of water channels
TP 3	Crop farming	Trees, crop and litters	silty	Fine	Brown	Gully, refuse dumping and excavation Pits	Two gully	Crop-rain fed	Maize	Use of fertilizer

Three new discoveries were made during the study. One, that farmers spend enormous energy and time to clear their farmland of waste such as cellophane, polythene and other light weight waste deposited by floods. This singular problem not only degraded the environment but also, much more, increase the hardship farmers along the river banks go through. As a result, more time and energy are spent on the farmland which was not the case in the past.

The first recent consequences is socio-economic in nature being that farmers now need to exalt more energy to produce less than what they use to get in the past. One of the farmers interviewed revealed that he spent at least two weeks of hard labour in the last five years at the beginning of every farming season just to gather and sort out waste from his farm of about 1000m^2 (Fig. 3). This further reduced the time available to 25% of the farmers who have other economic activities for their survival and for socialization of all the farmers. Therefore by implication, in the long run it could also create poor health conditions and other social problems for the farmers. Grazing animals for both private and commercial consumption can also consume poisoned vegetation which in turn can create safety and health problems in the food chain.

The second dimension to it is time. Following the popular adage that “time is money”, the time spent to clear the waste and sort it before preparing the land for farming is indirectly adding to the time spent for farming. Increase in the time spent on the farm invariable leads to the third dimension of the first new recent consequences of land degradation in the peri-urban area of Kaduna metropolis which is high cost of farming. Also, part of the cost implication is from the money spent on their health and for hiring of additional hands and the conservation that is employed which Adewuyi (2010) already found to be inadequate in many areas. From this study, the three socio-economic characters of the first new consequences are inter-related and one leads to

the other making the whole situation more complicated. The second new consequence is that the kinds of waste emanating from the metropolis have changed and is now introducing new problems at the peri-urban areas. Before farmers are used to easily decompose waste materials such as dead animals, human faeces, bad fruits and food which many of the farmers even used as manure to enrich the soil. But recent discovery revealed that the type of waste now include chemicals from battery, electronics and household equipments which invariably pollute the soil. This demand for a better waste management system within the metropolis because once the soil is polluted it is more difficult and costly to eradicate and which in this case it is even beyond the ability of the farmers. The biggest fear and concern is the problem it can introduce in the food chain and the health consequences since most of the produce are consumed by the larger population of the metropolis.
The third new consequence is that based on the available conservation techniques that the farmers are using, they are only able to reduce the amount of waste, and many are still left in the soil. This is so because they employed physical removal of big sized waste from the surface soil while the smaller size and the ones buried in the soil are left untouched (Fig. 4). At the long run, the soil will suffer from the effects of this waste. This is likely the reason for the trend experienced in crop yield and the years since when it as being observed particularly in areas with declining productivity. Also this likely explains why 90% of the changes in crop yield and changes in vegetation occurred in the last 15 years and 50% of it occurs in the last 5 years.



Fig 1.Refuse dumping in artificial pond Fig. 2 Sorted waste on farmland. Fig.3. Farmland dotted with waste after sorting

Most of the farmers in the area are below 50 years of age, with fairly large family to look after, further implying that the impact of the new consequences of land degradation in the area is enormous and should not be waved aside but rather the policy maker should begin to find lasting solution to it as it has health, socio-economic and environmental implications. It also requires urgent attention because the area is underdeveloped with a lot of projects chasing little revenue.
In conclusion, our investigation identifies three new recent consequences of land degradation in the peri-urban area of Kaduna metropolis. All of these are traced directly and indirectly to lack of adequate waste management within the metropolis. In our opinion, this is a time bomb that can go on anytime; therefore the earlier there are alleviation steps the better for the environment and the socio-economic well being of the people at large, since crops grow there are sold in open market for all. The steps on one hand should focus on better waste management for the metropolis while on the other hand areas already polluted should be conserved and the people affected be given support both in the short and long run. Therefore, in order to improve the environment and the well being of the inhabitants, these three discoveries are recommended research areas for further studies.

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Effect of salinity on germination and early seedling emergence of canola

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Abstract

In order to investigate of effects of salinity on germination and canola seedling growth, five canola cultivars (Hyola401, Hyola308, Hyola330, RGS003 and PP308/3) were induced to germinate under five salinity levels (0, 4, 8, 10 and 12 mmhos/cm). The germinated seeds were be counting daily for 8 days, then germination rate, mean of germination time, coleoptyle weight and coleorhizae weight were measured. The results showed that salinity had significant effect on all of measured traits and response of all of cultivars to salinity was unique. In addition, all of cultivars maintained 60 % of ability to germination and produce complete seedling. In basis of results, RGS cultivar was best cultivar and cultivars Hyola401 and Hyola330 were in lower levels in term of measured traits.

Keywords: Salinity, germination, seedling growth, canola

Introduction

Canola is one of the most important annual oil and protein crops in temperate climates. Seed provides both for industrial and culinary purposes to manufacture margarine, or serves as source to produce bio-diesel fuel (Francois,1994).

Salinity is one of the important restriction factors for germination and growth in arid and semi arid areas such as Iran. The production of large areas of canola will certainly reduce imports of plant oil and therefore save on foreign revenue (Mohammadi 2009). The expansion of canola is however hampered by low yields per hectare. Low yields may be the result of various factors such as poorly adapted cultivars, production techniques (Bybordi et al 2009), biotic stresses (weed management, pest control) (Farhoudi, 2006) climates constraints (Gul et al 2006), and soil factors (Gutierrez et al 1996).

In spite of above mentioned, crop growth and yield is largely dependent on the success of germination and seedling establishment which are largely affected by seed quality (Hanekom et al 2005), pest and diseases, climatic constraints, (Steppuhn et al 2001) as well as soil factors such as soil pH, soil temperature, soil moisture and soil salinity (Hanekom et al 2005). Salinity affect the germination of seeds, by creating an osmotic potential to prevent water uptake and/or by providing conditions for the entry of ions which may be toxic to the embryo or developing seedling (Hanekom et al 2005). Different growth stages of plant species may have variable tolerances to salt in soils and the effects on different parts of a plant may also vary (Hanekom et al 2005). Salts are usually most damaging to young plants (Francois, 2007). Although plants are more tolerant to saline conditions during germination in general, high concentrations of salts may reduce the rate of germination or even inhibit seed germination altogether (Ali, et al 2003).

South regions in Iran are often patches with high salt contents. These saline patches may therefore also be a reason for the high variability and generally low canola yields obtained in these areas. It will therefore be important to quantify the effect of such saline conditions on the germination and seedling establishment of canola in an effort to improve yields. The aim of this study is to determine the response of five cultivars of canola to salinity with regard to germination and growth response of different cultivars in different concentration of NaCl salinity.

Responses to salinity may vary between *Brassica* Spp/canola cultivars (Valadiyani, 2006 ,Puppala et al., 1999). Brassica napus and *B. carinata* seemed to be more tolerant to salinity compared to *B. compestris* and *B. juncae*, but the germination and vegetative growth of Brassica napus and *B. juncae* responded more positively than others did when both NaCl and $CaCl_2$ instead of only NaCl did used in the Hoagland nutrition solution in germination experiments (Hanekom et al 2005). In addition to this it was shown that the germination of five different cultivars of B.

napus not only differs in their response to salinity, but that response also showed an interaction with germination temperature (Puppala et al., 1999).

Material and Methods

The aim of this study was to evaluate the germination and early growth of canola cultivars in response to different salinity levels in Petri dishes. The experiments were conduced in Petri dishes in the dark and with a constant temperature of 20^{oC} in germinator. One hundred seeds of canola (*Brassica napus*) cultivars (H330, H308, *RGS003*, PP308/3, and H401) after sterilization with Hypochlorite sodium were sown in Petri dishes, lined with filter paper and wetted with 10 ml of solutions with the following EC's (the solutions salinated with NaCl):

0 mmos/cm: distilled water; 4 mmos/cm; 8 mmos/cm; 10 mmos/cm and 12 mmos/cm.

The number of germinated seed counted on a daily basis for a period of eight days. Seeds regarded as germinated as soon as the coleoptiles appeared. The traits such as percentage, rate, and time mean germination evaluated by following formula:

1) Germination rate: (No. of germinated seeds in 2^{th} day)/2 + …...+ (No. of germinated seeds in 8th day/8)

2) Rapidity of germination: $\sum n \times 100 / \sum (nt)$

3) Time mean germination: $\sum (nt) / \sum n$

Where n is No. of germinated seeds in day and t is referred to day (days after incubation).

In addition to, the length, dry and fresh weight of seedling rootlet and stemlet measured, also. The experiment carried out as a complete randomized block and three replicates. The data analyzed by using the statistic 7 statistical package. The Duncan's test used to compare treatment means.

Results and Discussion

1. Germination percentage

The first seeds germinated one day after planting and no seeds germinated later than six days of incubation. From Fig 1, it is clear that percentage of germination was affected by salinity from first day to 5^{th} days of incubation, while significant differences were found between cultivars for period of 8 days of incubation but not significant differences observed in interaction cultivar with salinity. In respect to germination percentage the cultivar *RGS003*, H308 and PP308/3 is excellent and H401 is weakest (Fig. 1).

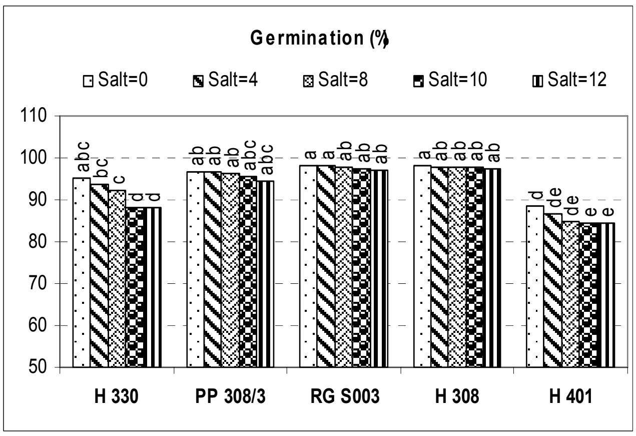

Fig. 1 Interaction effect of cultivars and salinity levels on % of germination

2. Rootlet and root length

The results indicated that rootlet and root length significantly affected by cultivar and salinity levels (Table 1). The *RGS003* had the most root and rootlet length (Table 1), but the least root, and rootlet length observed in 12 mmos/cm saline treatments. The interaction mean comparisons indicated that highest root and rootlet length was obtained in c.v *RGS003* and 4 mmos/cm salinity level, but the weakest found in the c.v *H401* at 12 mmos/cm (Fig. 2). This obtained results are in agreement with that reported by shekari et al. (2000) and Keshta et al. (1999).

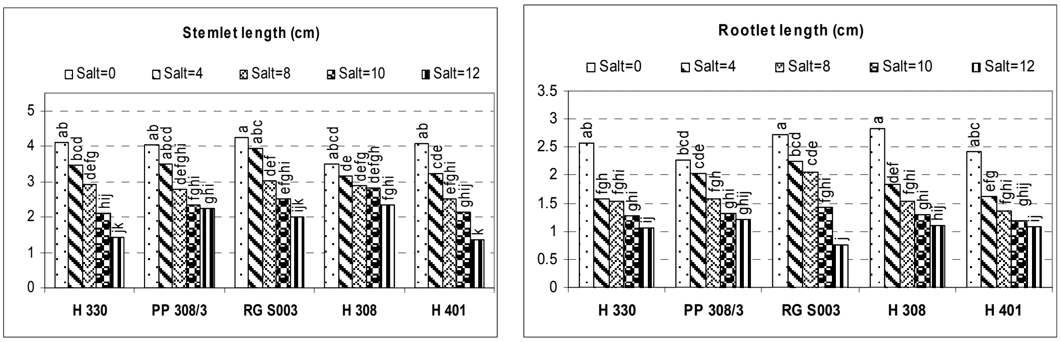

Fig. 1 Interaction effects of cultivars and salinity levels on stemlet and Rootlet length

Table 1: Analysis of variance (ANOVA) of Total fresh weight, Rootlet and stemlet dry weight, Rootlet length and Stemlet length.

Source of variation	df	Total fresh weight	Rootlet dry weight	Stemlet dry weight	Rootlet length	Stemlet length
Repeat	2	61.247	0.00028	0.0140	0.1306	0.2134
Cultivar	4	1033.1589**	0.0015**	7.658**	0.2069**	0.4898*
Salinity	4	170.931**	0.0199**	40.15**	5.10921**	10.6055**
Cultivar×Salinity	16	45.201	0.00827**	0.0638	0.1242*	0.2543
Error	48	36.5044	0.00015	0.0558	0.0619	0.1655
CV	-	15.06	11.59	10.22	14.85	14.03

Table 2: Analysis of variance (ANOVA) of % germination, Germination rate index, Germination time mean and Germination rate.

Source of variation	df	Germination rate index	Germination time mean	Germination rate	Germination percentage
Repeat	2	6.934	0.0192	2.316	1.013
Cultivar	4	101.532**	0.2485**	210.502**	386.386**
Salinity	4	16.977**	0.0416**	50.009**	23.553**
Cultivar×Salinity	16	1.977	0.00516	3.975**	4.695
Error	48	3.947	0.0088	1.519	4.471
CV	-	3.79	4.319	2.72	2.256

3. Stemlet dry and total fresh weight

The results showed that dry mass and fresh weight significantly affected by cultivars and salinity levels and showed a significant interaction between cultivar and salinity level (Table 1). From Table 2 the c.v *RGS003* had the most dry weight and total fresh weight. From Fig. 3, 4 and 5 observed that 4 and 12 mmos/cm treatment resulted in the most and least the total fresh weight and dry weight, respectively. The most and least of rootlet dry weight was observed in control (Distilled water) and 12 mmos/cm salinity, respectively. In severely saline conditions, dry mass for all cultivars were very low and no dry mass produced at very severely saline conditions (Fig. 3). This results was same as that reported by Valdiani et al (2005) and Ali et al. (2003).

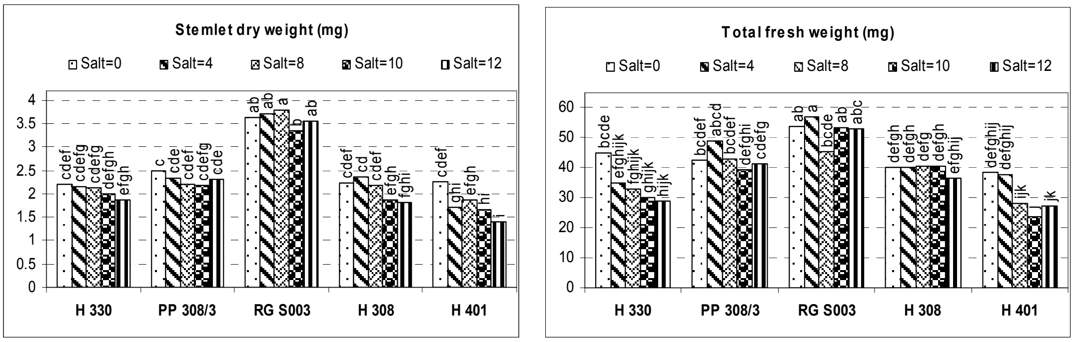

Fig.3 Interaction effect of cultivars and salinity levels on dry weight of stemlet and total fresh weight

4. Germination rate, time mean germination, and Germination rate index

Rate and rapidity of Germination in seeds of cultivars showed a significant interaction for cultivar and salinity levels after 2 days of incubation. After this time of incubation, Germination rate and rapidity for c.v *RGS003* was significantly higher than for others cultivars (Fig. 4). At 0 mmos/cm, 80% canola seeds germinated, and %, rate and rapidity of germination decreased with increasing salinity level for all cultivars (Fig. 4). Adverse effects of salinity on seedling germination, early emergence, and plant growth may also be due to ion cytotoxicity and/or osmotic stress, which cause ionic imbalances, oxidative and osmotic stress and nutritional deficiencies (Gul et al 2006). In this study, with increase in salinity, stemlet and rootlet's growth of all cultivars decreased. These results therefore clearly support the finding of (Jalali, 2006)which showed that although the rate of germination is still reduced at high levels of salinity.

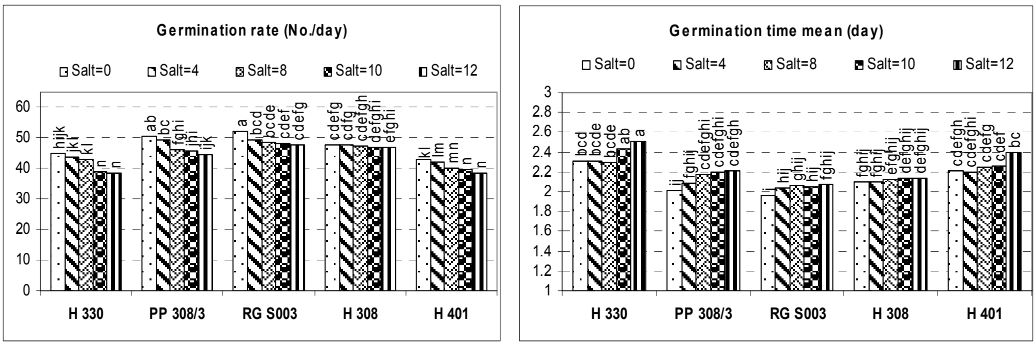

Fig. 4: Interaction effect of cultivars and salinity levels on Germination rate and Germination time mean.

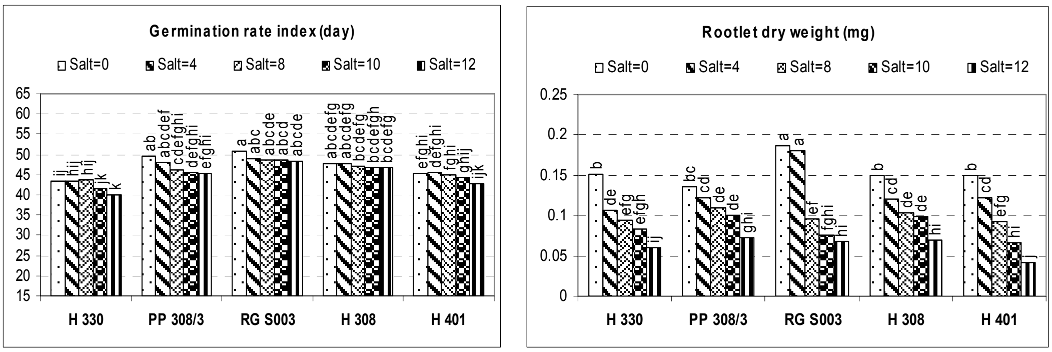

Fig. 5: Comparison of Interaction effect of cultivars and salinity levels on Germination rate index

Conclusions

The results showed that NaCl induced salinity are more harmful to canola germination. Results also showed that the seedling growth (fresh and dry weight) of canola is more tolerant to salinity than the germination phase. From the incubation studies it become clear that canola germination significantly affected by cultivar and salinity level. With regard to percentage of germination, rate, and rapidity of germination, stemlet and rootlet length significantly decreased with increasing of salinity. Among all of cultivars, c.v *RGS003* had the highest resistance to different levels of salinity. Therefore, in order to cultivation of canola in Khuzestan Province fields, this is the suitable cultivar.

Because the response of plant to salinity may be affected by growth stage and soil conditions, it will be important to evaluate both the germination and growth response of canola cultivars to salinity in germinator and soil conditions.

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Evaluation of Environmental Problems of Urmia Lake in the North West of Iran

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Abstract

Urmia lake has been recognized as a national park in Iran and of MAB (man & biosphere).It almost has 30 satellite fresh water and brine wetlands which some of them have globally great importance because of their biodiversity. Having a research done because of environmental problems of Urmia lake was our purpose of this study. Urmia lake with 5000 km² area is a lake with high saline which is located in north west of Iran between west & east Azerbaijan provinces. Regarding the droughts happened in its basin; water level of lake Urmia comparing with 1995 has decreased to its lowest level of 7.2 meters so that presently 1270.4 meters from sea level. This crisis has caused loss of biological and non-biological characteristics and rapid change in more than 60 percent of its area to salt marshes& swamps therefore threatening its living beings. Despite recent droughts and construction of intermittent dams, saline rate has dramatically risen from 166 g/lit in 1994 to 340 g/lit in 2008. All in all lake Urmia is encountering critical dramatic decrease of water, loss of many satellite wetlands around it because of implementation of infrastructure projects, land use changes, pollution and water flows reduction. If a serious attention for solving its biological problems is not paid, in near future biological crisis will break out in region.
Keywords: Lake Urmia national park, biological crisis, international wetland

Introduction

Lake Urmia (or Orumiyeh), which is situated between East and West Azerbaijan provinces in Iran and it is one of the largest permanent hyper saline lakes in the world (Fig.1). The biggest natural Artemia habitat in the world and resembles the Great Salt Lake in the western USA in many respects of morphology, chemistry and sediments (kelts and Shahrabi, 1986) Registered under the convention on wetlands of international importance as waterfowl habitat (Environmental campaign, 2010). More than 211 species of birds such as flamingos, pelicans, spoonbills, and gulls, 41 species of reptiles, 7 species of amphibians, and 27 species of mammals such as yellow deer inhabit the lake. The terrestrial ecosystem is comprised of 102 islands with total area of 33486 ha and surrounding shorelines of the Lake. Besides the lake and rivers, several wetlands around the lake are the main habitats of wide diversity of aquatic species (Sadra, 2005). In a recent drought of the Urmia basin, which started in 1999, the water level of Lake Urmia dropped from 1278 m to 1271 m. Investigations show that water level will decrease further to 1270 m above sea level and water volume will decrease from 25 km^3 to 11 km^3 in a few years. In recent years, human population growth has increased the need for agricultural and drinking water, which is supplied from surface and groundwater sources in the area. The last decade drought episodes and recent dam construction programs have simultaneously caused more evaporation of the lake water and thus considerable variations of water surface levels. These circumstances have accompanied with a hyper-saline condition in the lake which imposes a critical effects on the existing vulnerable ecosystems. The drought is threatening the lake's biodiversity and ecology. Reduction of water depth by 6 meters, increasing water salinity to saturation level which is main restricting factor to the bio-ecology and living space of *Artemia Urmiana* and dependent fauna and flora population, appearance of huge salt fields around the lake, and huge reduction in Artemia population, is alarming indications of gradual total desiccation of the beautiful and unique ecosystem, the Urmia Lake. West Azarbaijan rivers are the most important water resources of lake urmia around 22 permanent (perennial) and seasonal (ephemeral) rivers provide the water of Urmia Lake. Among them Zarinehrud, Siminehrud, Talkhehrud, Gadarchai, Barandoozchai, Nazlochai and Mahabadchai are the main streams of the region (Sadra, 2003).In this investigation an attempt is made to analysis the present situation and discovers Lake Urmia.

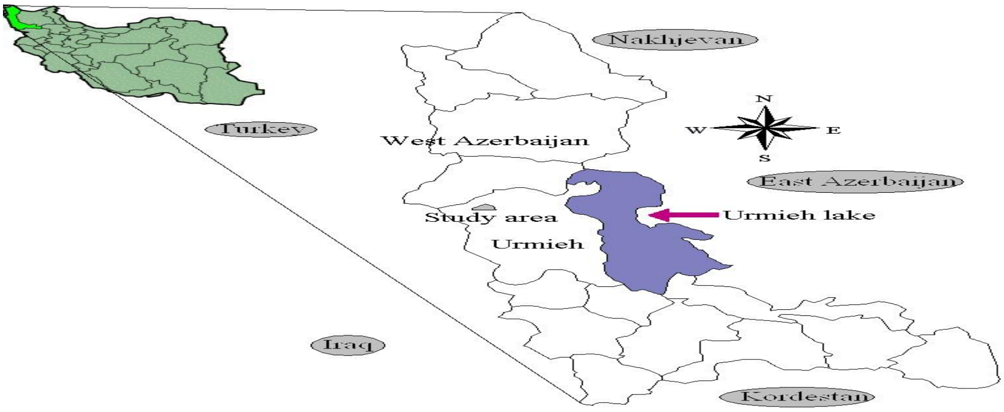

Fig 1. Location of Urmia Lake

Problems of Lake Urmia
1. Salinity

Due to a decrease in water inflow and volume, the salinity of Urmia Lake has reached to more than 300 g.l since 2001. The increased salinity has greatly influenced biological aspects of the lake, and caused the lake undergoes at critical conduction (fig. 2) and it is changed the climate and ecological situation of region. Analysis of ecological conditions of region required to control climatic parameters such as precipitation, temperature and evaporation. From 1995 to 2005 its average salinity increased from 169 ppt in 1995 to 267 ppt, and in 2010 its salinity reaches to 338 ppt (Fig. 3).

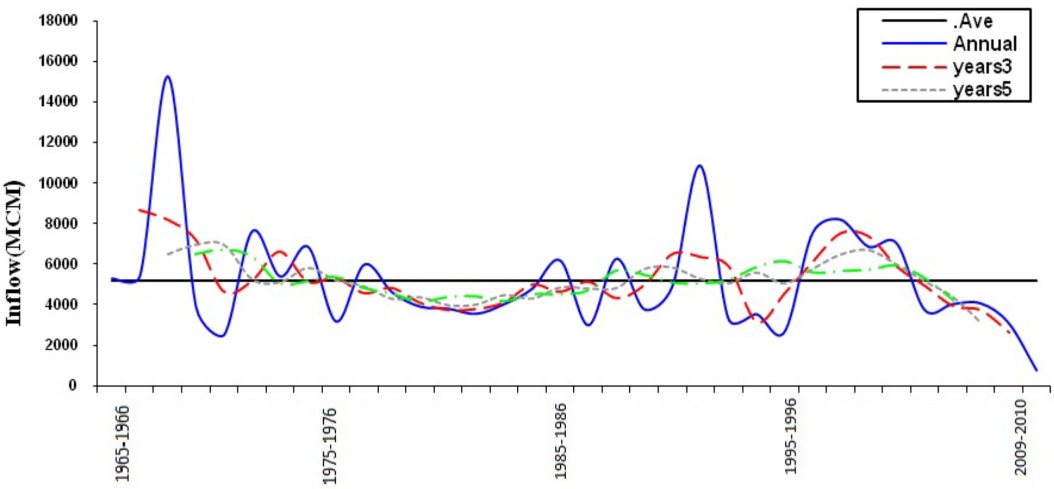

Fig. 2. Mean annual inflows into Lake Urmia.

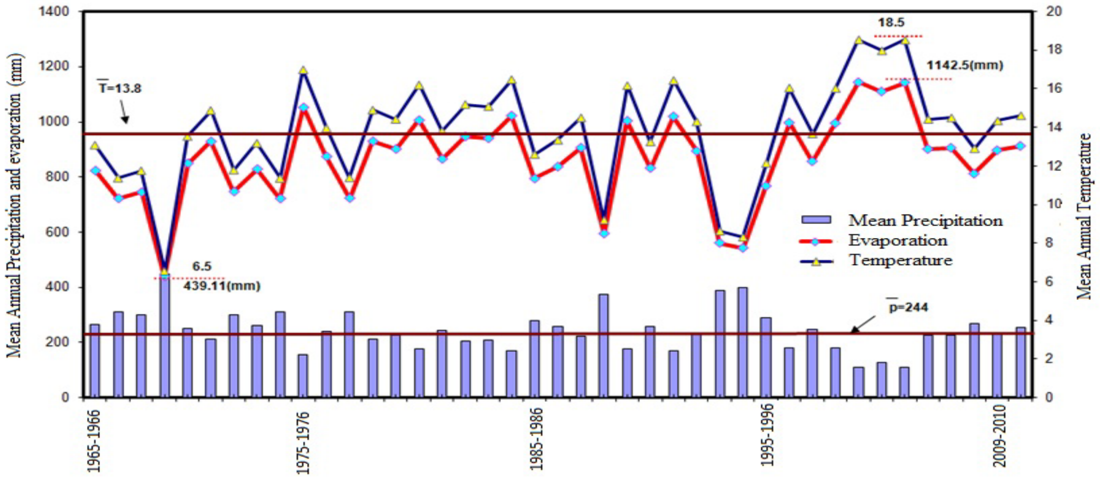

Fig. 3. Mean annual temperature, evaporation and precipitation from surface of lake Urmia

In summer 2010, the Urmia Lake water was changed to a pinkish-purple color in several areas such as two sides of the causeway. The phytoplankton population of Urmia lake has mainly composed of a unicellular green alga namely Dunaliella which included about more than 90% of the whole and when water salinity exceeds saturation levels, the density of halophilic bacteria increases By decreasing inflow to the lake, the salinity exceeded the tolerance level of the Artemia in the water, so it almost completely died out, surviving in small pockets around the inlets of the large rivers, and salt crystallization occurred on the shores, which is decline the number of migratory birds, e.g., flamingos, that is a preventing to more than 108 cells.ml^{-1}.Since the bacterioroberin are distributed evenly on the cell membranes in these prokaryotic cells, so can absorbed light more efficiently than pigments of eukaryotic Dunaliella .phytoplankton density of the lake, this is the color changes of Urmia lake (Mohebbi, 2011).

2. Shahid Kalantary highway construction

A project to construct a highway across Lake Urmia was initiated in 1979 to facilitate communication between Tabriz in East Azerbaijan and Urmia City in West Azerbaijan. This highway divides the lake into south and north arms and significantly alters circulation of water. Barzegar and Sadeghian (1991) used MSS, RBV and SPOT image data to investigate the effect of the causeway on the general circulation of the water body between 1972 and 1986. They concluded that the Highway had caused changes in the natural water circulation and hence the process of sedimentation will lead to possible blocking of the gap by deposition of sediments in the opening. There is also a significant difference between two sides of the causeway having increased spatial variability. Thus, it can be concluded that the observed differences of two sections in under study parameters could be attributed to the blocking effect of the causeway and inefficiency of the gap in preserving the link. Because of that 16 percentages of entrance inflows from south of highway, the physical and chemical characteristics of water especially sedimentation properties had a significant different with north division of highway. Plus that increasing of vehicle traffic depletes pollution to lake and terminates the safety of birds' inhabitation in lake.

3. Change in water quality and sedimentation process

Urmia Lake has a unique condition due to its high-concentration of salt, variety of sediments and especial ecological characteristics. Based on available data, the recorded lake salinity (chloride) varies from 87 to 275 gr/lit (Sadra, 2003) while TDS varies between 180 to 420 gr/L. Also average pH of the lake is reported 8.6 (Warwa, 2006). But, in the recent years growing of population and human activities in the region and consequently increase in water consumption reduced the average of direct inflow to the lake considerably. All rivers entering the lake receive more or less untreated wastes from urban settlements along them which are increased pollution of the lake. Bacteriological tests of the lake sediments proved that population of bacteria are decreased.

Presumably such bacteria, if present in the inflows, do not survive in the highly saline lake waters. The only positive results were for green and purple sulpho- bacteria, together with ferrous bacteria and one type of Gram positive bacterium on Artemia remains which none of those are pathogenic.

4. Construction of Dams

In recent years, human population growth has increased the need for agricultural and drinking water, which is supplied from surface and groundwater sources in the area. Dam's construction has changed water volume and flow regime in many of rives that has caused wide negative results on natural ecosystems, qualities and their use. Dam constructions and devoting water sources to agricultural, industrial and domestic uses are the most important factors for water surface slump. In 2010 the capacity of water reservoirs of dams in the basin was 1.62 milliard m^3 which will rise to 3.56 milliard m^3 and it is obvious that the process will make the situation more critical. Studies showed that average consumption rate of Urmia Lake Basin is 7.84 milliard m^3 which 94% is dedicated to agricultural activities. Continues of this process will lead to more consumption of water storage of the basin and soles amount of water will enter the lake every year. Fast water surface diminishing, water quality changes (fig.4), increase salinity of Lake Urmia and coastlines changes could be corresponded with the rapid development of more than 20 dam construction projects. In addition, driving deep water wells operated by electrical pumps, and increasing population which require more water resources negatively affects the water levels in the lake.

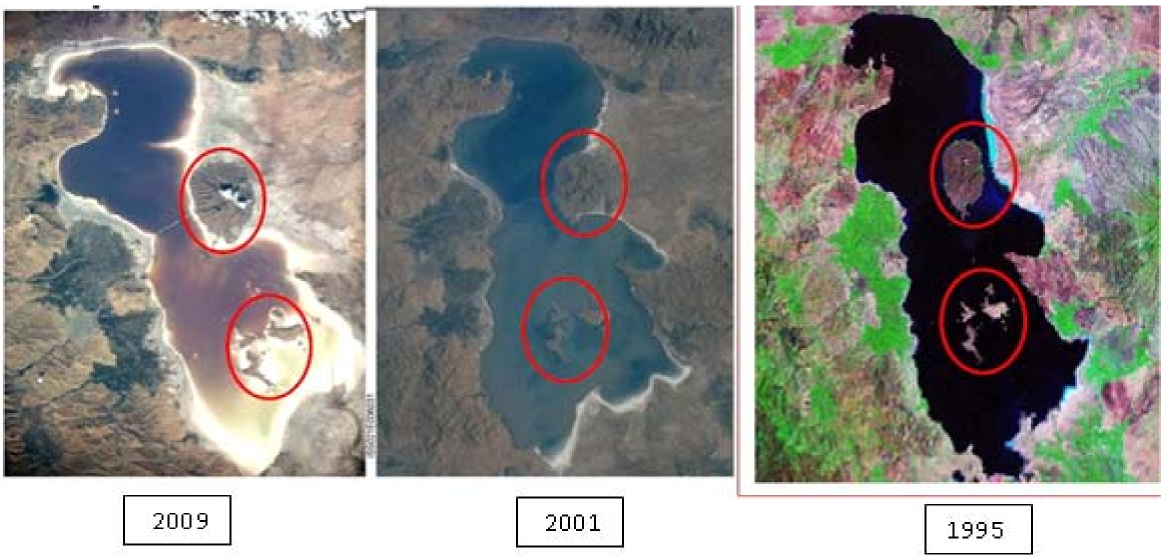

Fig 4. Water quality changes of Urmia Lake

5. Climate Changes

Global warming triggers a change in global precipitation pattern. This change occurs as a result of a change in evaporation, and consequently, in water circulation patterns, which causes some regions to be more humid and some others drier. The process of precipitation and temperature is not the same throughout the whole planet. Climate change does not necessarily result in consequent changes in precipitation and temperature. In this case, precipitation may concentrate more on higher altitudes (Clark, 2003).The climate regime is Mediterranean seasonal-continental in the Global Bioclimatic Classification System (Rivas-Martinez et al., 1999). Many studies showed that lake water depth variations are depend on the climate change. Reversible and sequentially world climate systems variations which are occur in different periods of times have direct impact on hydrologic system of regions. It's suggested that water head decreasing in Lake Urmia could be the result of a long period of arid climate that exist in region. Then each study to find out the reasons of decreasing water head of Lake Urmia should primarily analysis the impact of local, regional and worldwide climate on the Lake.

Conclusion

Lake Urmia is the second great salty Lake in the world. Unfortunately in the recent years water level and area of the lake show a great decrease and this lake in threatened by the risk of drying. Climate changes and dam constructing are the most important reasons for this disaster. Continuously we studied the wide variety of problems which this drying may cause and used the information of worldwide lake which are extinguished or are going to die soon. Investigations show that if this environmental disaster takes place we will encounter a wide area of problems like extinct of most of animal types and creation of a huge salt desert. The causeway had restricted hydraulic connections between north and south parts of the lake. Transported suspended load is mostly depositing on the south edge of the western section of the causeway. Many migrant birds which are used the lake during their migrations, particularly flamingoes and pelicans which feed mainly on the brine shrimp, Artemia *sp*. stopped migration and reproduction in the lake. all rivers entering the lake receive more or less untreated wastes from urban settlements along them and bacteriological tests of the lake sediments presented evidences indicate that the water inflow to the lake is also substantially decreased and will be decreased more in the near future due to dams and irrigation networks construction. Furthermore, the construction of the causeway, introduction of industrial wastes into the lake and the increase in the area of the farmlands have led to a drastic reduction in the surface water quality. Unsustainable development of water resources in region decreased entrance inflow to Lake and increased salinity of water. In fact the present development plans do not considered water requirements of the Lake. Agricultural, industrial, and municipal waste water contained lots of pollution depletes in Lake and because of that the Lake is a close system then contamination in lake system increased each year .The only available/accessible/reliable/sustainable source of clean or cleanable water to be dependent on as permanent solution to the problem of repeating drought in Urumia Lake is Caspian Sea in a 320 km long distance. The water quality of Caspian Sea is suitable for this purpose: its salinity range is just 1.2% (one third of the free ocean waters) and therefore would not increase the salinity of Lake Urmia.

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Decontamination of Potential Toxic Elements in Sewaged Soils by inorganic Amendments

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Abstract
This study investigated the feasibility of using some natural clay minerals available in Egypt like kaolinite, bentonite, also using of iron oxide, rock phosphate and mixture of these types to minimize the rate of some potential toxic elements (PTE's) such as Ni, Cu, Zn and Mn desorption from sewage soils and to evaluate the effect of these mixtures on Zn equivalent constant values before and after remediation. The obtained results indicated that all mixtures used were minimizing the rate of PTE's release from sewage soils compared to control treatment. According to the decreasing order of different treatments and SD, data indicated that application the mixture treatment of Bentonite, kaolinite and rock phosphate (RP) in sewage soils become the best treatment compared to other treatments used. However, the lowest and save Zn equivalent constant value, the constant of contamination in sewage soils, was observed in sewage soil treated with the mixture of bentonite and RP. The rate constant of PTE's desorption of Elovich, modified Freundlich and Hoerl equations, the best fitted models, were significantly decreased compared to control treatments with different percent of minimization according to type of pollutants and remediation material used. To understand the mechanisms of PTE's retained in treated sewage soil, distribution study was applied which showed that different pollutants studied were removed to hardly available form. Different mechanisms of PTE's undergo in treated sewage soils were discussed in the study.
Keywords: PTE's, sewage soils, kinetics, desorption, remediation.

Introduction
Since antiquaty man used sewage effluent in agricultural purposes at a limited scale. Planned reuse of sewage effluent gained its worth only two or three decades ago, when the demands for water dramatically increased due to technological advancement, population growth, and urbanization, which put great stress on the natural water resources (Saber, 1991).
There are two main types of sewage effluent in Egypt, the first is sole domestic effluent, and the second is mixed domestic and industrial effluent. In most cases, the industrial effluent contains PTE's along side with POPs together with many pathogenic microorganisms such as parasites, bacteria, fungi and viruses. If raw sewage effluent was used in irrigation with only primary treatment, and this is most dominant case in Egypt, the agricultural products will be contaminated with the above mentioned hazardous contaminants which enter the food chain causing several adverse consequences.
Heavy metal contamination of some soils applying through sewage effluents used, poses serious problems to both human health and agriculture in different sites of Egypt as well as aboard. Current technologies used to remediate soils (e.g., removal of topsoil for storage at land- fills) are quite costly, and often dramatically disturb the landscape. Control of heavy metals emission from soils combustor/waste incinerators has been in the limelight for many years. Different experiments applied revealed that single or multi stages sorption systems can significantly reduce heavy metals effluent concentrations for the same total amount of sorbent or, alternately dramatically lower total sorbent consumption for the same effluent concentration.
Although of the advantages of those local clay minerals, the utilization of such materials in remediation of heavy metals contaminated soils is limited. Therefore, the main targets of this research on in situ immobilization of metals were: (1) To evaluate the use of inexpensive, abundant materials naturally found under Egyptian conditions as stabilizing agents in metal-contaminated soils; (2) To determine the influence of stabilizing agents on the mobility, bioavailability, and toxicity of metals in soil using kinetic approach; (3) Developing soil quality indices as tools in evaluating the efficacy of remediation techniques and for monitoring purposes.

Materials and Methods
A sewaged soil sample collected from Abu-Rawash sewage farm irrigated with sewage effluent for 30 years and was cultivated with artichoke was used In a completely randomized pot experiment with four replicates. Single and combined mixtures of varied remediative in-organic amendments

were tried to retain PTEs were from the contaminated sewaged soil. The soil was mixed with either 2% Bentonite, 2% kaolinite, 1% Bentonite+1% Kaolinite, 1% bentonite +1% rock phosphate (RP), 1%kaolinite + 1%RP, 1% Bentonite + 0.5% kaolinite + 0.5% rock phosphate (RP), 2% iron oxide or 1% iron oxide + 1% RP. Treated and control soils were moistened to 60% of the soil water holding capacity and incubated for 60 days at 25^{o}C. A kinetic study, after incubation was carried out on treated and un-treated soils followed by a distribution study of PTEs.

Total potential toxic elements were determined according to Cottonie et al. (1982). PTEs were fractionated to water soluble, exchangeable, carbonate-bound, Fe-Mn oxides-bound, organic-bound and residual fraction as described by Zaghloul (2002). The soil quality criterion index (Zn equivalent model) was numerically expressed for the levels of PTEs toxicity according to Chumbley (1971). A quality criterion index over 250 units indicated a risky situation. Kinetic studies were carried out using the Electrical Stirred Flow Unit (ESFU) method. The concentrations of PTEs were determined using atomic absorption (Cottenie et. al 1982). The diagram of ESFU used was drawn according to Zaghloul (2002). Four kinetic equations (Elovich equation, Parabolic diffusion equation, modified Freundlich equation and Hoerl equation) representing both empirical and theoretical equations were used to test data conformity of PTEs release from contaminated sewaged soils (Zaghloul 1998). Statistical analysis was done using SAS software (1985).

Results

Barrier to represents the data, it should be mention that results showed that all treatments minimized desorption of PTE's from the sewaged soil in terms of the standard division values. But there were noticeable variation in the response of PTEs to the tried in-organic amendments. For example, in case of Cu desorption, 2% kaolinite, 1% bentonite + 1% kaolinite or 2% iron oxide were respectively the most effective materials in minimizing the hazardous level of Cu to a save margin. Bentonite (1%) + Rock phosphate (1%), however, were the best in-organic amendment in reducing Zn desorption from the sewaged soil. More or less the same trend was observed for both Ni and Mn.

Data graphically drawn in Fig (1) represents the rate of PTE's desorption from sewage soil as affected by application the mixture of Bentonite and PR at 1% for each remediation material. Generally, treated soils significantly decrease the rate of PTE's compared to control treatment of each pollutant.

As shown in the same Figure, the rate of PTE's processes might be divided into three steps, the first started at a high rate trend of desorption during the first 0.5 hrs of the reaction, the second exhibited a moderate decreasing rate trend of desorption within the following 0.5 to 2 hrs followed by almost steady state condition during the rest of reaction time. Such trend holds true for control treatment. It should also mentioned that different mechanisms took place in desorption of PTE's from both treated and untreated soils.

Data represented in Tables (1) shows the effect of the best remediative amendments on the rate constant of MFE, for PTE's desorption from treated and un-treated sewage soils. It is worthy to mention that the succession of other models also in describing the rate data means that more than one mechanism controlled desorption of this element from treated sewaged soils.

The comparison between kinetic constants of the used models related with different in-organic remediative amendments indicated that 1% Bentonite+1% Kaolinite followed by 1% Bentonite + 1% rock phosphate (RP) were the best treatments in minimizing the hazardous effect of Cu desorption. The same trend of results was apparent in case of 2% Bentonite, 2% kaolinite and 1% Bentonite+1% Kaolinite.

Data in the same Table indicated again that the in-organic remediative amendments 1% Bentonite+1% Kaolinite, 1% Bentonite +1% rock phosphate (RP) and 1% kaolinite + 1% RP were the best treatment in minimizing the hazardous effect of Zn in sewage soils. The rate of Zn release in treatment with 1% Bentonite+1% Kaolinite, was the best one reaching 0.04 $mgkg^{-1}hrs^{-1}$ according to MFE model, while in the control treatment it was only 0.09 mg $kg^{-1}hrs^{-1}$ with a decrease of 400% or more The decreasing order was more pronounced in the constants of Elovich equation. Data given in Table 5 showed the **a** constant values of Elovich model, where the rate of Zn desorption decreased from 24.88 in control to 0.26 in 1% Bentonite + 1% rock phosphate (RP). Data in the same table showed a significant decreasing in treated soils compared to control in their capacity factor represented by b constant values. The highest decreasing order observed in 1% Bentonite + 1% rock phosphate (RP) seemed to be the best between all in-organic remedators. The observed decrease in this factor means the transferring of Zn from the readily available form to hardly available one. Cao et al (2004) studied the solid/liquid interface reaction between rock phosphate (RP) and zinc and found that rock phosphate had the highest affinity for zinc, with sorption capacities of 138 in the zinc ternary system, competitive PTEs sorption occurred with sorption capacity reduction of 75.6% for zinc, compared to the mono-PTE systems. Desorption of zinc was sensitive to pH change, increasing with pH decline.

The rate constants of used models describing Ni desorption from used sewage soil. In all cases the treatment applied significantly decreased the rate of release. The maximum decrease in Ni desorption was observed in 1% Bentonite + 1% rock phosphate (RP) treatment. In Horel's model, the ***a*** constant value was the highest (0.57 mg $kg^{-1}hrs^{-1}$) compared to other values, which means that the change of Ni form to a hardly available form through the reactions with tried clay minerals in this treatment was faster compared to other treatments.

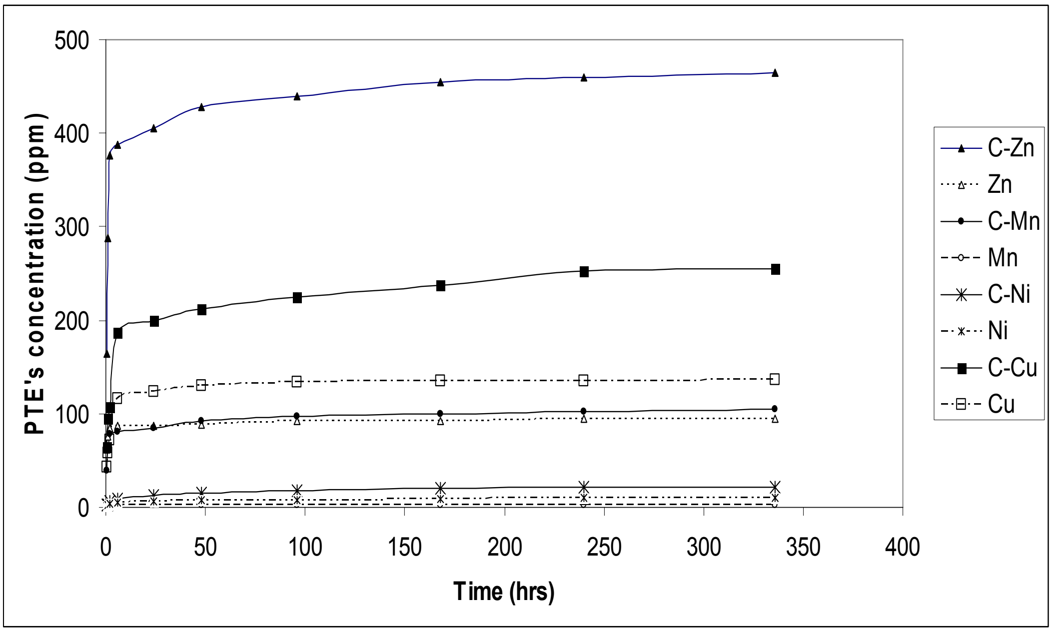

Figure (1) Kinetics of PTE's desorption from sewaged soils as affected by application the mixture of Bentonite and RP.
C-PTE's: the control treatment of the pollutant studied.

In Zn, however, the application of multiphase decreased the rate of Zn desorption by about more than 70% which led to significant decrease of Zn equivalent values to save level as shown in figure 2. The geochemical behavior of PTE's indicates that phosphate, when present in sufficient amounts, reduces these pollutants solubility (Ma et al., 1993). Thus phosphate minerals have the potential to immobilize pollutants in contaminated soils.

Table (1) Rate constants of PTE's desorption from sewaged soils described by MFE model, the best fitted model.

Cu				
Treatments	R2	SE	a	b
Control	0.92**	0.08	0.20	1.96
soil+2% Bentonite	0.92**	0.07	0.17	1.44
Soil+2% kaolinite	0.89**	0.09	0.16	1.42
Soil+1% Bentonite+1% Kaolinite	0.91**	0.08	0.16	1.41
Soil +1% bentonite +1% rock phosphate (RP)	0.96**	0.03	0.16	1.69
Soil + 1%kaolinite + 1%RP	0.88**	0.09	0.16	1.63
Soil + 1% Bentonite + 0.5% kaolinite + 0.5% rock phosphate (RP)	0.89**	0.09	0.17	1.78
Soil + 2% iron oxide	0.89**	0.09	0.17	1.51
Soil + 1% iron oxide + 1% RP.	0.88**	0.08	0.16	1.66
Zn				
Control	0.91**	0.03	0.09	2.51
soil+2% Bentonite	0.88**	0.05	0.06	1.99
Soil+2% kaolinite	0.88**	0.02	0.04	1.97
Soil+1% Bentonite+1% Kaolinite	0.88**	0.02	0.03	1.78
Soil +1% bentonite +1% rock phosphate (RP)	0.88**	0.02	0.04	0.70
Soil + 1%kaolinite + 1%RP	0.96**	0.02	0.07	1.84
Soil + 1% Bentonite + 0.5% kaolinite + 0.5% rock phosphate (RP)	0.94**	0.01	0.03	1.90
Soil + 2% iron oxide	0.89**	0.04	0.06	1.82
Soil + 1% iron oxide + 1% RP.	0.90**	0.03	0.07	2.20
Ni				
Control	0.97	0.08	0.31	0.62
soil+2% Bentonite	0.98	0.06	0.32	0.41
Soil+2% kaolinite	0.96	0.05	0.18	0.79
Soil+1% Bentonite+1% Kaolinite	0.99	0.04	0.24	0.37
Soil +1% bentonite +1% rock phosphate (RP)	0.94	0.07	0.20	0.03
Soil + 1%kaolinite + 1%RP	0.98	0.06	0.31	0.10
Soil + 1% Bentonite + 0.5% kaolinite + 0.5% rock phosphate (RP)	0.92	0.07	0.24	0.44
Soil + 2% iron oxide	0.96	0.08	0.28	0.41
Mn				
Control	0.96**	0.02	0.08	1.84
soil+2% Bentonite	0.96**	0.01	0.06	1.68
Soil+2% kaolinite	0.91**	0.03	0.07	1.55
Soil+1% Bentonite+1% Kaolinite	0.97**	0.01	0.06	1.42
Soil +1% bentonite +1% rock phosphate (RP)	0.94**	0.02	0.04	1.39
Soil + 1%kaolinite + 1%RP	0.93**	0.02	0.06	0.69
Soil + 1% Bentonite + 0.5% kaolinite + 0.5% rock phosphate (RP)	0.89**	0.03	0.06	1.65
Soil + 2% iron oxide	0.90**	0.03	0.06	1.52

a: Rate constant represent the intensity factor
b: The capacity factor
R^2: Coefficient of determination
SE: Standard error

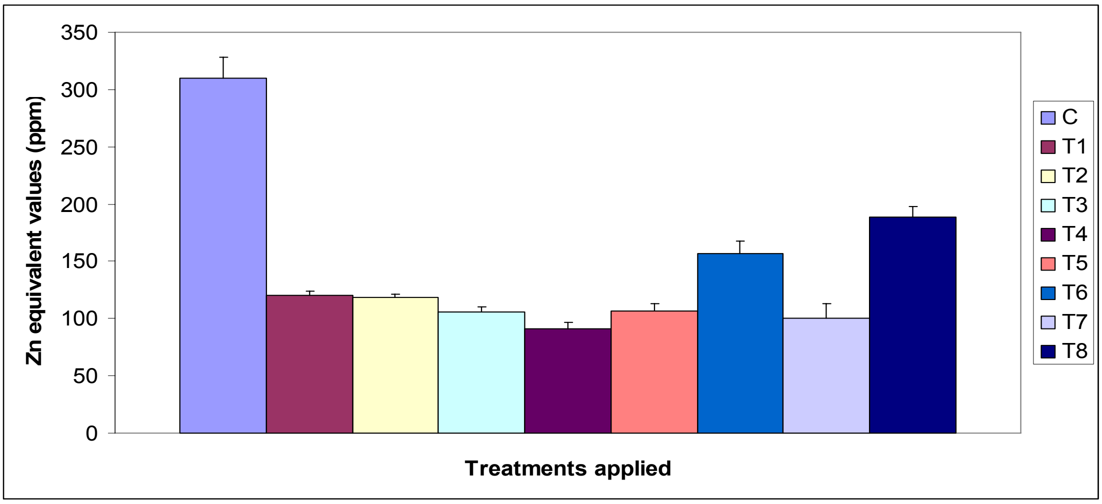

Figure (2): Zn equivalent data as affected by applied treatments

Data given in Tables 2 indicated that application of the bentonite and RP at 1% to sewaged soils, led to decreasing the concentrations of readily available forms and some of hardly available forms like the organic ones. In contrast the application of the in-organic remediative amendments led to an increase the residual form. Badawy and Helal (2002) ranked Ni fractions nickel in soil irrigated with sewage effluent as follow; organic> residual> oxides> carbonate> exchangeable in the polluted soils.

Table (2) PTE's distribution in sewaged soil (ppm) as affected by the best remediation treatment and time of soil incubation.

Treatments	Water soluble	Exch. form	Carbonate form	Fe-Mn Oxide form	Organic form	Residual form
Ni						
Control	0.5	0.95	2.6	3	4	6
Soil + bentonite + RP	nd	nd	1.2	0.5	2	14
Cu						
Control	2.5	3	3.5	6	7	13.5
Soil + bentonite + RP	nd	nd	0.5	2	1.25	31.25
Zn						
Control	15	22	41	48	130	150
Soil + bentonite +RP	3	5	15	18	24	341

nd: Non detected

Discussion

In this context the present paper had been planed, to test the efficiency of some remediative in-organic amendments in decontaminating sewaged soils from PTEs. Although, numerous remediators had been proposed for that, yet they might be generally ineffective in practical applications due to high cost, operational difficulties, and low efficiency (Tyagi et al., 1988; Sreekrishnan and Tyagi, 1996).

Application of clay or modified clay minerals is a promising and widely applied technique in remediation of contaminated soils (Wahba and Zaghloul, 2007). The results obtained in this study showed that all treatments applied significantly decrease PTE's desorption from sewage soil. In general, the mode of action of such natural amendments represents in sorption phenomena takes place with different specification according to 1. Electronegativity of ions studied i.e. Ni, Cu and Zn and its concentration in soil system; 2. Specific and non-specific sites of natural or modified natural amendments and 3. The affinity of ions to be retained by studied clay minerals.

In this study, we applied single phase of remediated materials represented in Bentonite, kaolinite, and iron oxide; double phase represented in combination of Bentonite and kaolinite, each of those

materials with RP and iron oxide treated with RP; multiphase represented in Bentonite, kaolinite and RP. We supposed that application of double and multiphase could be more beneficial in minimizing the hazards of PTE's in sewage soil. The kinetic study represented by MFE, the best fitted equation, showed that application of double phase represented by Bentonite and PR could be the best in minimizing the release of Ni in sewage soil. This result could be related to the CEC of Bentonite used and ability of phosphate to react with Ni to form complex compound.
Barrier to discuss the mode of actions of remediation materials it should be mention that as it will known that PTE's exist in the soil in five in-organic pools, soluble, exchangeable, adsorbed, and organically chelated or complexes. Aboulroos et al (1991) stated that the PTEs applied with sewage effluent tended to be accumulated in organic complexes and to a lesser extent as in-organic precipitates. However, the organically complexed fraction always represents the main reservoir.
In conclusion, PTEs are not degraded biologically and might persist in the environment indefinitely. Sewage effluent quality control requirements for PTEs are stringent and their control is complex and difficult and they must be periodically assessed on a case-by-case basis.

Acknowledgment
The authors would like to express their appreciations and gratitude to the authorities of Science and Technology Development Fund (STDF) for financing the present work through the project number 1425 contracted with the National Research Center on Bioremediation of Sewaged Soils.

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Geochemical Evolution of the soil solution in contact with water with a residual Alkalinity calcite positive in Controlled Conditions Application at the lower –Cheliff

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Abstract: In Algeria, more than 20% of irrigated land are affected by the problem of salinity. In the north-western Algeria, the plain of Lower Cheliff is in the area most affected objective of this work is to study the geochemical evolution of the soil solution in contact with water has a positive calcite residual alkalinity and risks of land degradation in the plain of Lower Cheliff. Water at positive calcite residual alkalinity is brought to the laboratory in which two were irrigated soil textures distributed pots. We brought two states: steady-state ground water, non-equilibrium state. It was found that as far as the waters are concentrated in the soil, there will be precipitation of calcite and an increase in sodium is probably due to desorption of the soil exchange complex. The SAR of a significantly increased which leads to a sodification soil. This will not be without consequences on the physical degradation of soil texture, especially clay.
Key words: groundwater, calcite residual alkalinity, salinity, steady-state, geochemical.

Introduction

The development of irrigation systems has enabled the development of arable land in arid zones. Thus for a hundred years, large areas were constructed developing the agricultural sector in the countries concerned. However, these practices of large scale irrigation changed the soil functioning sometimes leading to the decline in fertility in the process of salinization. Over 20% of cultivated lands on the globe are now assigned to variable degrees of degradation by salinization (Tyagi, 1996). Soil salinity is an environmental problem that affects large areas in the world.In Algeria, the area of saline soils increases more and more each year, 3.2 million hectares at a rate of 15 to 20% with the majority of irrigated land (Douaoui and Hartani, 2007). The figure of 4% of the agricultural area (UAA) affected by the salt is made by the services of the Ministry of Agriculture and Fisheries (MAP, 1998), it seems well below the true extent salinization in the country, as shown in the figure of 1490 ha of UAA affected by salinity, significantly underestimated, which is advanced to the plains of Cheliff the areas currently affected by salinity are around 80% this salinization continues to grow spatially and temporally increase (Douaoui et *al*. 2006). The objective of this work is to study the geochemical evolution of the soil solution in contact with water has a positive calcite residual alkalinity controlled condition. The study applies the requirements of the plain of Lower Cheliff that soil salinity increased steadily especially for irrigated land. The only question to ask is: The path of soil salinization in an irrigated water calcite residual alkalinity positive way neutral or alkaline?

Materials and Methods

Presentation of the soil

Two types of soil textures are used: the first is a clay texture (S1) from a plot of Hmadna, the second texture is balanced (S2) from the perimeter of a parcel of Ouarizane. Chemical analysis of the two soils are presented in the following table

Table 1. Chemical composition of S1 and S2

Soil	Texture	pH	CE	Cl	SO4	Alc.	Ca	Mg	Na	K
			dS/m	mmolc/L						
S1	Clay	8	1,76	12	4,16	3,14	8	8	11,3	0,47
S2	Equilibrium	8,08	2,23	16	5,91	3	3	1	11,9	0,39

Introduction of irrigation water

The water used (E1) comes directly from a drill normally used for irrigation in the command area of Lower Cheliff. This choice is based primarily on the sign of calcite residual alkalinity is positive. The chemical characteristics of water used are presented in (Table 2).

Table 2: Chemical composition of used water (E1)

water	CE dS/m	PH	Na	Ca	Mg	K	Cl	SO4	Alc.	RA.Ca*	SAR	RIVERSIDE Class
			mmolc/L									
E1	1,85	7,17	8,6	2,5	1,5	0,49	8,1	1,59	3,67	1,17	7,03	C3S1

* *RA. Ca = Alc. – Ca (mmol$_c$/L)*

Presentation of the device

The pots used had a diameter of 5 cm and a height of 12 cm, a volume of about 230 cm3 (Fig. 2). These pots were made from piece of PVC with a lower bet is obstructed by a canvas. They are filled with 200 g of soil after putting a few grains of gravel at the bottom to prevent clogging at the exit.

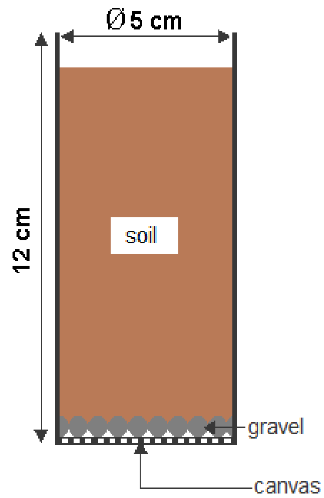


Figure2: Experimental setup

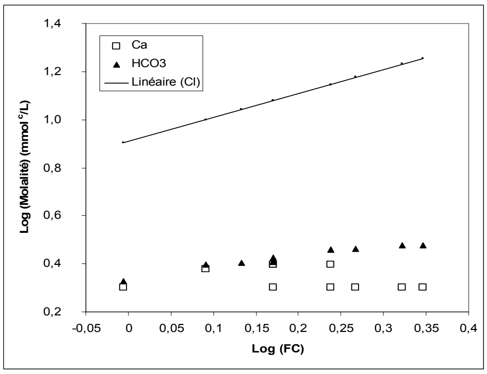
Results and discussion

Geochemical evolution of soils under the effect of water RA.Ca> 0

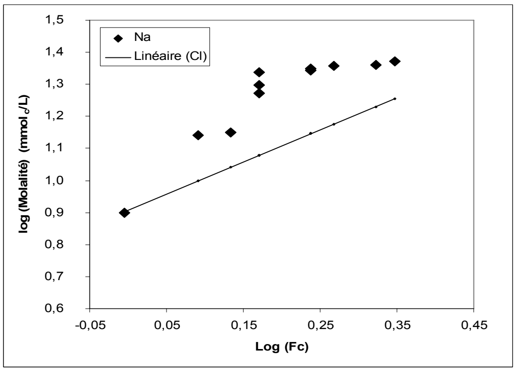
As a reminder here that the concentration of water over time strongly influences their relationships with the ground. This concentration was monitored by studying changes in ion concentrations based on a supposedly inert ion (or precipitation / dissolution or reaction with the soluble phase) and used as a chemical tracer: the chloride ion is ideal the construction of the concentration factor is determined by dividing the chloride content of the soil treated with the chloride content of water E1. The chloride ion and selected as an indicator of concentration factor (CF) and chemical tracer because of its conservative character. The construction of diagrams with logarithmic y-axis value molality of the ion studied and the logarithm of the concentration factor (Valles, 1985; Barberio and Valles, 1992).

Clay textured soil (S1)

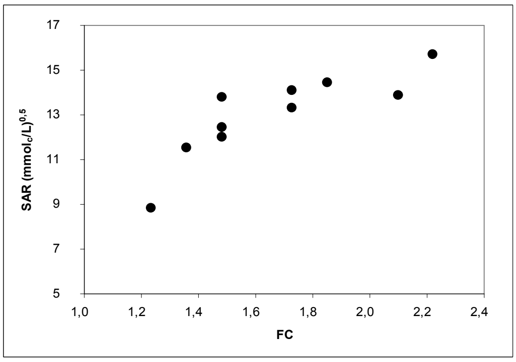
A. Steady state



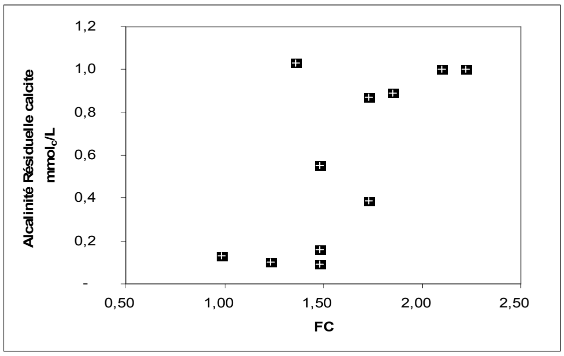
a. Precipitation of calcium



b. Precipitation of sodium



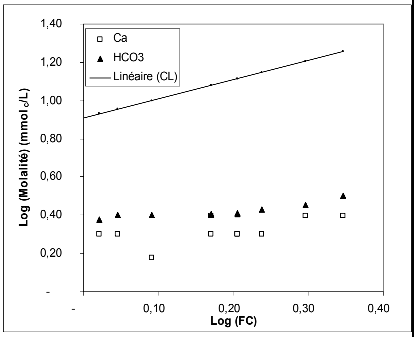
c. SAR evolution



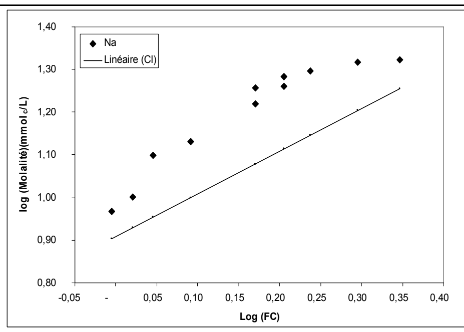
d. RA.Ca evolution

Figure3: Variation of some parameters of the soil solution S1 under the influence of water on E1 steady-state ground water.

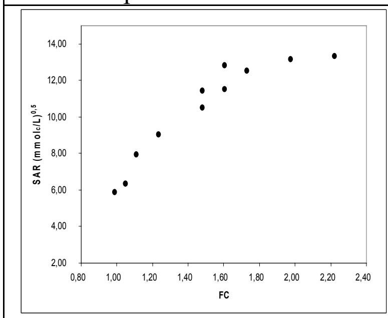
B. No-equilibrium state



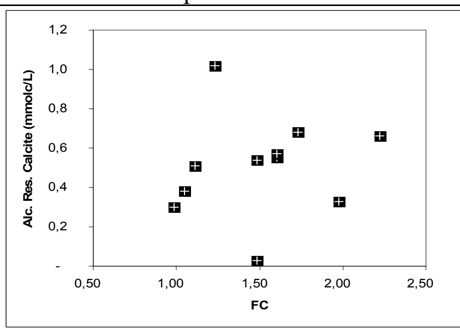
a. Precipitation of Ca and HCO3



b. Precipitation of Sodium



c. SAR evolution

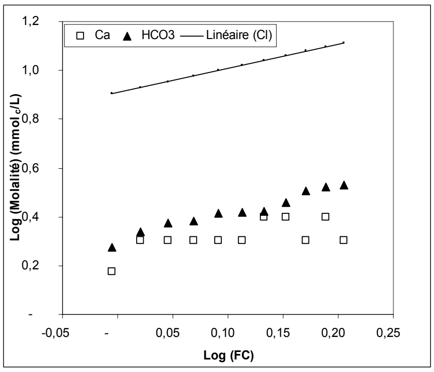


d. RA.Ca evolution

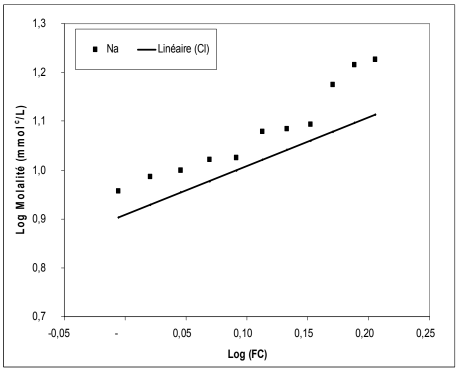
Figure4: Variation of some parameters of the soil solution S1 under the influence of water E1 in the state of no-equilibrium.

Equilibrium textured soil (S2)

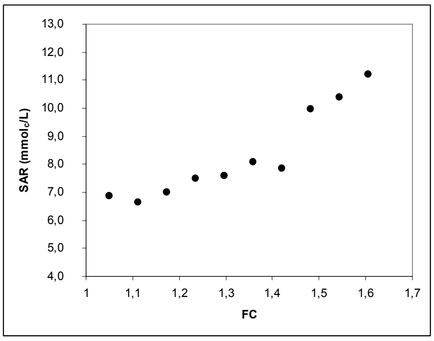
A. Steady state



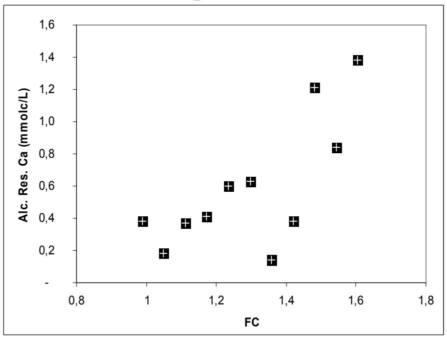
a. Precipitation of Ca and HCO3



b. Precipitation of Sodium



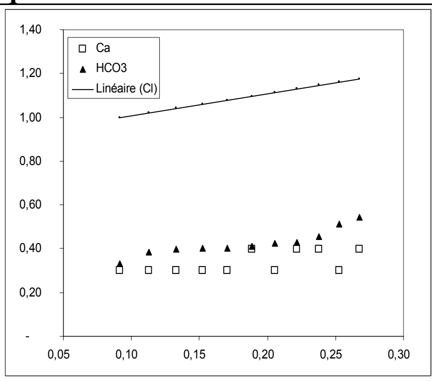
c. SAR evolution



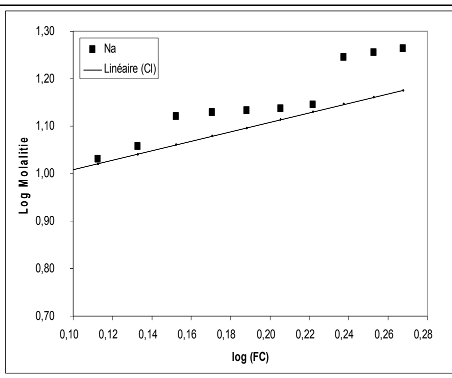
d. RA.Ca evolution

Figure5: Variation of some parameters of the soil solution S2 in the steady state under the influence of water E1

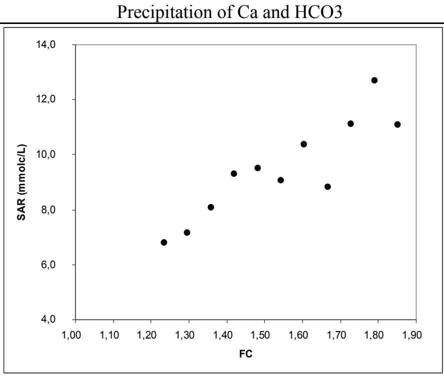
B. No-equilibrium state



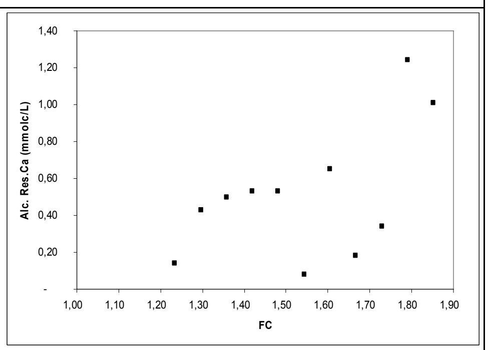
a. Precipitation of Ca and HCO3



b. Precipitation of Sodium



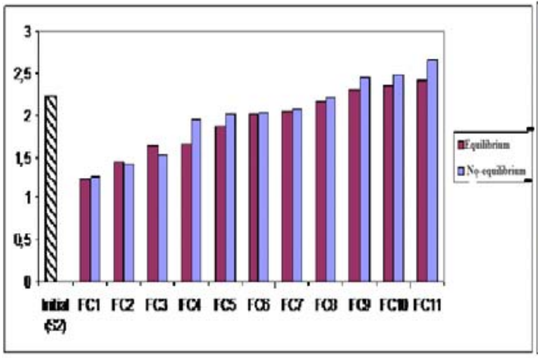
c. SAR evolution



d. RA.Ca evolution

Figure6: Variation of some parameters of the soil solution S2 under the influence of water E1 in the state of no-equilibrium.

Evolution of the electrical conductivity of soils treated



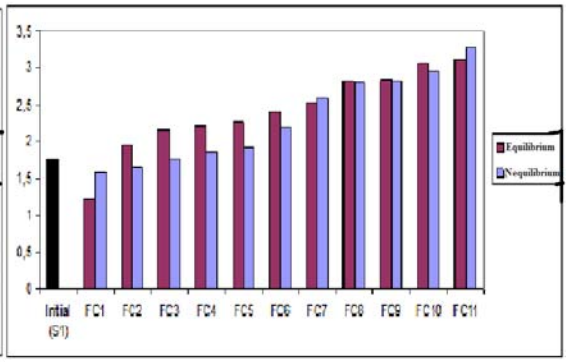
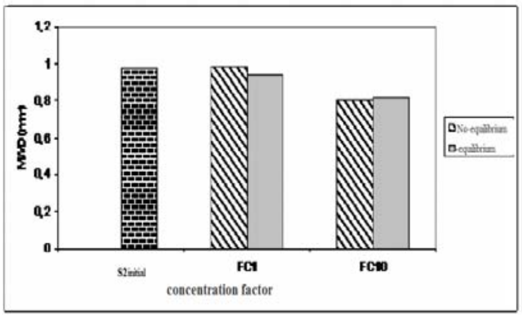


Figure8: Evolution of the EC soil S2 **Figure7:** Evolution of the EC soil S1

as a result of water E1

Evolution of soil structure



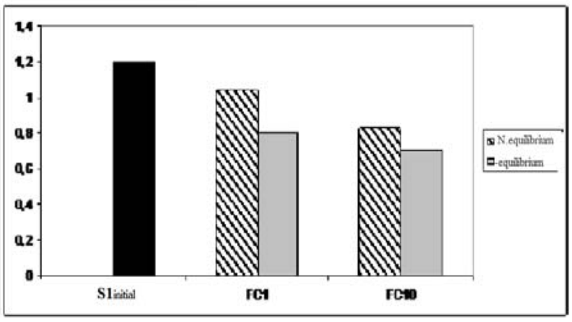


Figure10: structural evolution of the soil S2 **Figure9:** structural evolution of the soil S1 under the effect of E1

Discussions

The effect of this type of water (E1) is similar for both treated soils and even for the four states except that the high rate of SAR for the clay texture brings us back to say that the effect is stronger on these soils. For steady state, the effect of chemical composition greatly influenced the increase in the SAR for the state to balance; we have reduced the soil solution in equilibrium with water E1. The variation of the EC can score, because the texture of the two EC remains below 4DS / m which limit soil salty. Even with that, the destruction of soil is shown by the value of MWD which decreases at the end of treatment. This brings us back to say that the precipitation of Ca as calcite promoted the enrichment of the exchange complex with sodium causing a destruction of the soil in particular the clay soil. Waters calcite residual alkalinity (Alc.Rés.Ca> 0) to induce a sodification soil. The SODIS is more pronounced on clay-textured soils that store a value of SAR large (> 16 (mmolc / L) $^{0.5.}$

Conclusion

The objective of this work is to study the geochemical evolution of the soil solution in contact with water has a positive calcite residual alkalinity in controlled conditions. To reach our goal, a system was developed in the laboratory. This device consists of a set of pots made from PVC pipes 5 cm in diameter. A distribution of two types of soil texture, one of the other balanced texture and clay were divided each type of soil in two-state equilibrium and a no equilibrium state. Only one type of water is then used for irrigation. The water used for irrigation is marked by a positive calcite residual alkalinity. The results have shown that water use causes an increase in SAR and EC when it is safe to start by referring to the method of classification namely those of Richards (1954).

Waters calcite residual alkalinity positive affect on increasing the SAR over the ground mark on clay texture. The SAR recorded in these soils, very high values compared to the textured soil balanced. The observation made is that the clay-textured soils have a higher sodium levels on the exchange complex. The precipitation of Ca Na causes the desorption of the complex, which will increase the concentration of the latter in the soil solution and increased the SAR. Finally, the water in calcite residual alkalinity positive result in a deterioration of soil physical properties. Monitoring the structural evolution of the two types of texture has proven this fact. The action of the water to have positive calcite residual alkalinity a very marked effect on steady state soil texture clay. This effect is due to the very high value of SAR recorded for this texture as a result of the used water .

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Assessment and Mapping of Degraded Lands in the Desert Environment of Abu Dhabi using Geoinformation Technologies

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Abstract

The need to maintain sustainable use of land resources in Abu Dhabi Emirate requires assessing and analysis of degradation stresses and risks so that problems may be addressed and dealt with in the initial stage, which is the aim of the present study. The study was conducted as part of a comprehensive inventory of soil resources of Abu Dhabi, United Arab Emirate. Data collection and management were designed to take advantage of the latest technologies such as remote sensing (RS), geographic information systems (GIS), and Soil Information Systems (SIS). Fieldwork activities were undertaken through investigating 22,000 observation sites across the study area, on average one site for every 250ha. Each site was fully described for site characteristics and an in-depth soil morphological description. Representative soil samples were collected and analyzed for standard parameters. All collected data were stored in the Abu Dhabi Soil Information System (ADSIS), which was used for data management, interpretations, and analyses. ArcGIS was used for compiling and manipulating collected data and executing all interpretations and production of maps. Different criteria were considered for mapping degradation status including surface and subsurface salinity, hardpan (rock depth), water table depth, surface gravel, and surface texture. The procedure used for allocating ratings to each soil components and ultimately each map unit is described. The resulted degradation map showed that an area of 1296,000 ha (23%) are categorized as highly degraded, 4000 ha (less than 1%) as moderately degraded, and 4424,000 ha (77%) as slightly degraded. The study concludes that areas along the coastal sabkha are considered highly degraded due to high levels of salinity. Deflation plains are also degraded by a shallow depth to hardpan or bedrock. The greater part of the emirate, where sandy soils and dunes occur and where erosion by wind is a current hazard, are evaluated as having a slight degradation risk.

Keywords: Degradation, Mapping, Abu Dhabi, Geoinformation, RS, GIS, ADSIS.

Introduction

Major drivers of land degradation in the United Arab Emirates (UAE) are: drought, evaporation exceeding rainfall, uncontrolled overgrazing, irrigation with saline/brackish water, intensive use of ground water, wind erosion and sand encroachment, excavation for construction material, off-road vehicular maneuvering, and urbanization. These problems result in soil features that are indicators of land degradation: salinization, loss of biodiversity, sand encroachment, waterlogging, loss of productive top soil, exposure of hard pan, surface gravel lag, land filling, and compaction (Shahid, 2007 and Abdelfattah, 2009). In Abu Dhabi Emirate, degradation produces pressures that results in the current state of land resources, with a negative impact on society and the environment (Shahid and Abdelfattah, 2008). Forces of degradation can either be natural or man-induced. Anthropogenic activities (human-induced land degradation) ultimately lead to very poor wildlife habitat and ecosystem destruction via salinization, soil compaction by off-road vehicles, loss of vegetation through uncontrolled overgrazing and land clearing. Whereas, the natural causes of land degradation in the Emirate are drought (evaporation exceeds rainfall), wind erosion, and sand encroachment (Abdelfattah 2009). As the increasing world population places more demands on land for food production, many marginal arid and semiarid lands are at risk of degradation and require sustainable use of land resources. This requirement is best understood by first mapping of degradation so that the problems may be addressed and dealt with in its early stages (Al-Quraishi et al., 2004). The objective of this study was to assess and map degraded lands in Abu Dhabi using geoinformation technologies such as remote sensing, GIS, and databases.

The study area

The United Arab Emirates is located between 22°50' and 26° N latitude and 51° and 56°25' E longitude at the southeastern tip of the Arabian Peninsula. Abu Dhabi (Fig. 1) is the largest Emirate of the United Arab Emirates occupying 84% (77,000 km^2) area of the country. Abu Dhabi's major ecosystems are comprised of the coast, numerous islands, mountainous areas, gravel plains, and the sand desert (Boer, 1998). Nearly 80% of the Abu Dhabi Emirate is desert, and on the north and west side of the emirate is an extensive area of coastal salt flats, locally known as ''sabkha".

Isolated interdunal sabkha exists in the desert away from the coastline. The sandy desert begins behind the coastal sabkha, with small white dune ripples eventually forming an expanse of large orange-red dunes in the southwest. About 100 kilometers inland, towering dunes rising to 200 meters (mega dunes) are common. These form part of the Empty Quarter or "Rub Al-Khali", a vast desert which stretches beyond the UAE's southern border (UAE Yearbook, 2008). Gravelly plains also cover wide areas in both the far west and east of the Emirate. Mountains are absent, a notable exception being the impressive Jebel Hafit near Al Ain, an outlier of the Hajar mountain range (Brown, 2008). Abu Dhabi Emirate experiences extremely high temperatures during summers (40-45^{o}C) with mean temperature being 28^{o}C and short mild winters with temperature as low as 3^{o}C (Alsharhan and Kendall, 2002 and Raafat 2006). Humidity is the highest along the coastal fringes and decreases inland. The mean annual rainfall is about 111 mm.

Materials and methods

The present study was conducted as part of a comprehensive inventory of soil resources of Abu Dhabi Emirate that was completed 2009 (EAD, 2009). Geoinformation technologies such as Remote Sensing (RS), Geographic Information Systems (GIS), Soil Information Systems (SIS), etc. were used. Intensive field investigations were carried-out for groundtruthing as described below.

1. Fieldwork and Laboratory Analyses

A generalized soil-landscape preliminary map, a broad categorization of the soils and landscapes, was produced prior to fieldwork activities that helped to guide the subsequent field surveys operations and facilitated an understanding of soil landscape relationships (this map is available but due to space limitation it is not presented here). Fieldwork activities were undertaken (2006-2008) through investigating 22,000 observation sites across the study area, on average one site for every 250ha. Each observation site was fully described for site characteristics (slope, landscape, landform, erosion, land use and cover, drainage class, surface condition) and in-depth soil morphological description (colour, texture, structure; consistence, concretions, gravels, excavation difficulty, effervescence, EC and pH). Representative soil samples were collected and analyzed for physical, chemical, engineering and mineralogical characteristics. Field techniques, soil classification, nomenclature and interpretation were based on the scientific and technical standards of the United States Department of Agriculture-Natural Resources Conservation Service (Soil Survey Staff, 2010). The inventory was undertaken as a fourth order level at a scale of 1:100,000, supported by laboratory soil analytical results. On average, an observation site was made for every 250ha. Analytical data were populated into the developed database and used to confirm soil classification and to generate soil properties required for degradation assessment on which the various degradation criteria and ultimately degradation map were based.

2. Application of Geoinformation Technologies

A detailed visual interpretation of the satellite imagery was undertaken, supplemented by the results of image classification and a digital elevation model generated from the Shuttle Radar Topography Mission (SRTM, 2006) data. The Landsat 7 ETM "Enhanced Thematic Mapper, 2000-2001" data from the Global Land Cover Facility was geometrically transformed to the WGS84 datum and a user UTM projection. Precision checks were made using ground control points and differential GPS fixes to ensure the reliability of the transformations. Further adjustments to the selected images were performed to reduce the impacts of atmospheric scattering and to create a seamless image. Data management, interpretations, analyses and map was done through the Abu Dhabi Soil Information System (ADSIS). ADSIS is a web-based soil information system to deliver data and interpretations from this and other soil-related studies (www.adsis.ae). The system provides access to all the soil data and interpretations, plus additional functionality to allow users to examine and extract information to suit their individual needs. More details about the system and the geodatabase it contains is described under the "building and managing of the geodatabase" section below.

Results and Discussion

1. Image Processing and Interpretations

Two types of satellite imageries were used in the present study, Landsat 7-ETM and IRS-P6. The study area was covered by six images of Landsat 7- ETM acquired on 2002 with 8 bands and eight IRS-P6 images acquired on 2004 with 4 bands. The images were geo-rectified and enhanced to produce a precise color composite mosaic of three bands that were ultimately used for the purpose field mapping. Digital image processing algorithms and classification techniques were applied to produce preliminary soil and surface information which helped to better understand the relationship between soil types, land uses, and landscapes. Unsupervised, followed by supervised classification techniques were applied prior to fieldwork activities. The enhanced images were used for visual interpretation and field mapping. A thematic spectral classification layer was produced and integrated with the Digital Elevation Model (DEM) (SRTM 90m), which resulted in a topographically-aligned spectral classification of the study area (Fig. 2). This technique provided valuable information that facilitated fieldwork and allowed for a study of a range of soils and landscapes. Transect A-B represented in Figure 2 shows sands (red) that have been blown from coastal Sabkha (violet). Light blue designates a deflating tertiary scarp, partially inundated by sands. Yellow depicts mini-barchans and transverse dunes deposited on an underlying rise (sloping upward to the south). The orange to the south represents the famous mega-barchans associated with the Liwa oasis. Remnants of old linear dune systems are shown in light orange.

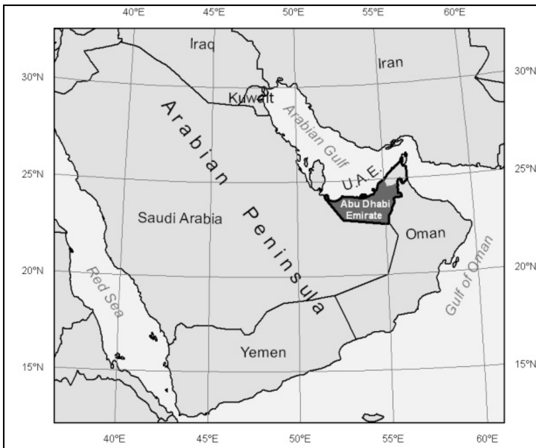

Fig. 1. Location map of Abu Dhabi Emirate within the UAE and Arabian Peninsula

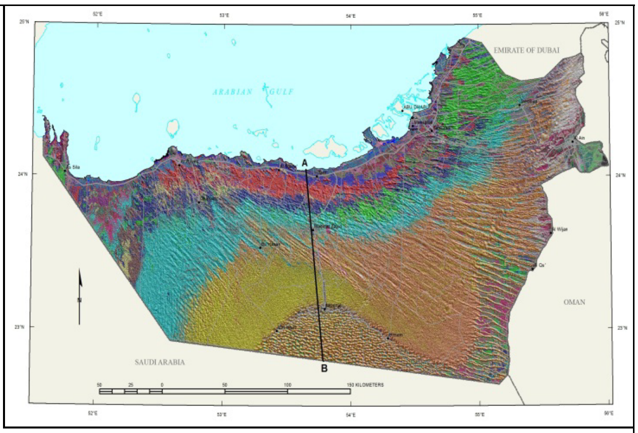

Fig. 2. Spectral classification of ETM bands 1, 5, and 7 underlain by filtered SRTM Digital Elevation Model

2. Building and Managing the Geodatabase

The main physical and chemical characteristics of each site were stored as attributes in the geographical soil database that was developed as one of the main components of ADSIS. ADSIS is comprised of number of components: a) Geodatabase; b) Soil Information System Application; c) Field Operation System; d) Soil Information System Internet Application; and e) Soil Information System Training Package. The geodatabase provides a spatially enabled repository for the capture, storage, management, query and retrieval of the following: 1) Field observations including soil profile description data comprised of site descriptions, pedon descriptions, and horizon descriptions; 2) Information regarding laboratory soil samples analyses (chemical and physical analyses); 3) Map unit characterizations and other map unit attributes (thematic maps) with associated information regarding their suitability for a range of uses and available resources. The data structure/model is based on the USDA National Soil Information System but modified to match local physiographic conditions. The Field Operation System (FOS) is an essential component of the system to load site information collected in the field to the geodatabase. ADSIS was used to interpret and generate all required data for each site, soil types, and map units.

3. Composition of Map Units

Map units reflect groups of soils rather than individual soil types, particularly when map unit components are families and phases of soil families. In the present study, soil map units were delineated and named. The names of soil map unit were derived from the dominant component or components identified within each map unit. One or more soil taxonomic subgroup names are used to name the map unit depending on whether the map unit is a consociation, association, or complex, together with a brief reference to the topography or landscape which dominates or is particularly characteristic of the map unit. In addition, each map unit was given a code that reflects the dominant soil subgroup within the map unit (e.g., EHG - Leptic Haplogypsids) and a two digit number (e.g. 01) that is used as a serial number (Table 1). The code is used to label individual delineations of the different map units comprising the soil map. The map unit legend is derived directly from a combination of the map unit label and the map unit name. The soil properties used for assessing and mapping degraded areas were attributes of these map unit, i.e., surface and subsurface salinity, hardpan (rock depth), water table depth, surface gravel, and surface texture as shown in Table 3.

4. Ratings of Soil and Map Unit Components

The soil map attribute database, which shows the location of every delineation (polygon) of each map unit, includes a listing of the soil components within the unit. In each soil component, a tabulation of relevant properties (e.g. salinity, depth to hardpan, erosion, salinity, etc.) is included. These properties were generated for each site through calculating the weighted average of field and laboratory data of each observation site. Whereas, the properties of each soil type were generated by listing the field and laboratory data for all relevant observations for each soil class. Then median values for each property were generated for all soil profiles and observation sites with data for that soil taxon. Exploratory data analysis of the values was conducted to evaluate the data distribution. In all cases the median was found to be more representative than average. As each map units consist of several components and hence, the method termed “dominant rating by percent” was used to calculate rating of each map unit, 103 map units were identified in the present study (Table 1). This procedure calculates the map units rating based on the rating of the component soils and the proportion they make up of the map unit. Table 3 presents a summary of map unit codes (in columns) and their properties and degradation status (in rows), (due to space limitation, few map units are presented “25 out of 103”). The procedure used for allocating ratings to each soil components and ultimately each map unit is described in Table 1.

Table 1: Method of calculating the weighted average of surface salinity (0-50cm) for the map unit EHG01 “Leptic Haplogypsids – Typic Torripsamments - Typic Petrogypsids complex, level to gently undulating

Component soils (soil classes)	Codes	Percentage of each soil class	Surface salinity of each soil class (ECe dS m^{-1})	Weighted average of surface salinity for EHG01 (ECe dS m^{-1})
Leptic Haplogypsids, sandy, mixed, hyperthermic	AD112	15	6.78	18.5
Typic Petrogypsids, sandy, mixed, hyperthermic	AD123	15	7.5186	
Typic Torripsamments, mixed, hyperthermic	AD158	15	0.6426	
Typic Calcigypsids, sandy, mixed, hyperthermic	AD107	10	4.28904	
Typic Haplogypsids, sandy, mixed, hyperthermic	AD117	10	6.7488	
Gypsic Haplosalids, sandy, mixed, hyperthermic	AD136	10	68.76	
Petrogypsic Haplosalids, sandy, mixed, hyperthermic	AD143	10	47.148	
Leptic Haplogypsids, sandy, gypsic, hyperthermic	AD110	5	8.784	
Gypsic Aquisalids, sandy, mixed, hyperthermic	AD127	5	59.997	
Lithic Torripsamments, mixed, hyperthermic	AD153	5	1.611	

5. Land Degradation Rating / Production of Land Degradation Map

The soil interpretation for ‘Land Degradation’ evaluates soil factors that imply presence of a soil condition that may be limiting to plant growth. Categorizing land degradation in a highly eroded desert environment is problematic. Plant growth restriction or degradation protection factors are presented in Table 2. The overall degradation rating has been developed through a consultative process among individual soil scientists and stakeholders as well as previous research work in the study area to obtain a consensus rating of important land degradation qualities in this environment (Abdelfattah & Shahid, 2007; Abdelfattah, 2009; and Shahid & Abdelfattah, 2008). These land degradation qualities includes: surface and subsurface salinity (0-50 cm and 50-100 cm), hardpan or rock depth, water table depth, surface gravels, and surface texture. Table 2 identifies the criteria used to assess the presence and severity of land degradation status for different degradation qualities in relation to plant growth restriction. Each soil map unit delineation has a single rating degradation as calculated in Table 2, which were ultimately converted to three categories of degradation, i.e., slight, moderate, and high. Figure 1 displays the extent and distribution of degraded areas. Table 4 gives number of polygons and percent from total as well as areas in hectares and percent from total.

Table 2: Criteria used for assessing land degradation status for different degradation qualities in relation to plant growth restriction

Land degradation qualities	Degradation status				Plant growth restriction or degradation/protection factor
	High	Moderate	Slight	None or protected	
Surface salinity 0-50cm (ECe dS/m)	>16	8 -16	4 - 8	<4	High salinity is toxic to plants.
Subsurface salinity 50-100cm (ECe dS/m)	>16	8 - 16	4 - 8	<4	High salinity is toxic to plants, restricting root exploitation of subsoil moisture
Hardpan or rock depth (cm)	<25	25-100	100-150	>150	Shallow hardpan limits root exploration.
Water table depth (cm)	<100	150-100	200-150	>200	High water table limits root exploration and causes waterlogging
Surface gravels (%)	>5	5 - 1	1 - 0	0	Surface gravels are remnants of significant wind erosion.
Surface texture	CS	FS	LFS, LS, S, SL		Very sandy soils are prone to wind erosion.

6. Conclusion and Recommendations

The resulted land degradation map showed that an area of 1296,000 ha (23%) are categorized as highly degraded, 4000 ha (less than 1%) as moderately degraded, and 4424,000 ha (77%) as slightly degraded (Table 4). Areas along the coastal sabkha are considered highly degraded due to high level of salinity. Deflation plains are also degraded by shallow depth hardpan or bedrock. The greater part of the emirate, where sandy soils and dunes occur and where erosion by wind is current hazard, are evaluated as having a slight degradation risk. The current evaluation developed here deviates from conventional assessments of land degradation that usually consider either the soil's risk (vulnerability) to erosion and degradation under a given set of circumstances (e.g. irrigated agriculture), or the level of degradation that has occurred as a result of human intervention. The above evaluation approach accounts for long-term natural factors that have led to the land being in a relatively degraded state. Thus a saline soil is considered to be degraded even though this may now be considered its natural condition. Similarly a surface lag of gravels is evidence that erosion has happened in the past. The soils may now be stabilized by this surface cover and erosion may no longer occur though the current evaluation would show them as being degraded. In contrast the dune systems that are by definition evidence of soil particle mobility are evaluated as having no degradation. The ratings are for soils in their natural condition; however these ratings also take present land use into consideration by considering land under forestry or agriculture as being protected and so not degraded.

Table 3 Map unit qualities and degradation status*

Map Unit ID	Map Unit Code	Surface Salinity (0-50 Cm)	Subsurface Salinity (50-100 Cm)	Hardpan Depth (Cm)	Water Table Depth (Cm)	Surface Coarse Fragments (%)	Texture (Surface layer)	Degradation Status
1	THC01	2.2	2.4	169	201	4	FS	Slight
2	THC02	1.3	1.4	169	201	11	FS	Slight
3	THC03	2.6	3.7	174	201	6	FS	Slight
4	TPC01	1.4	0	40	201	11	LFS	High
5	TPC02	31.9	32.6	80	192	8	LFS	High
6	TCG01	6.7	6.3	184	197	8	FS	High
7	TCG02	3.0	5.1	122	201	11	LFS	High
8	EHG01	18.5	16.4	159	187	5	LS	High
9	EHG02	8.7	5.3	95	201	12	LFS	High
10	EHG03	8.8	9.1	201	201	7	LFS	High
11	EHG04	12.1	10.3	181	201	22	SL	High
12	EHG05	22.6	13.7	201	193	10	SL	High
13	EHG06	9.5	8.1	161	201	29	SL	High
14	TPG01	14.0	6.3	86	201	19	FS	High
15	TPG02	24.6	14.8	119	201	5	LS	High
16	TPG03	9.0	10.6	105	201	10	LS	High
17	TPG04	11.6	10.9	117	193	9	LS	High
18	TPG05	32.4	8.3	44	201	17	SL	High
19	TPG06	14.7	4.2	57	201	33	LS	High
20	TPG07	31.6	15.3	73	193	7	LFS	High
21	GAS01	76.3	84.0	201	110	4	LFS	High
22	GAS02	63.1	56.4	201	101	0	LFS	High
23	GAS03	62.8	83.1	194	101	1	LFS	High
24	GAS04	48.6	48.9	163	141	7	LFS	High
25	GAS05	100.9	138.0	201	90	11	LFS	High

* Total number of map units is 103 but due to space limitation, properties of 25 units are presented.

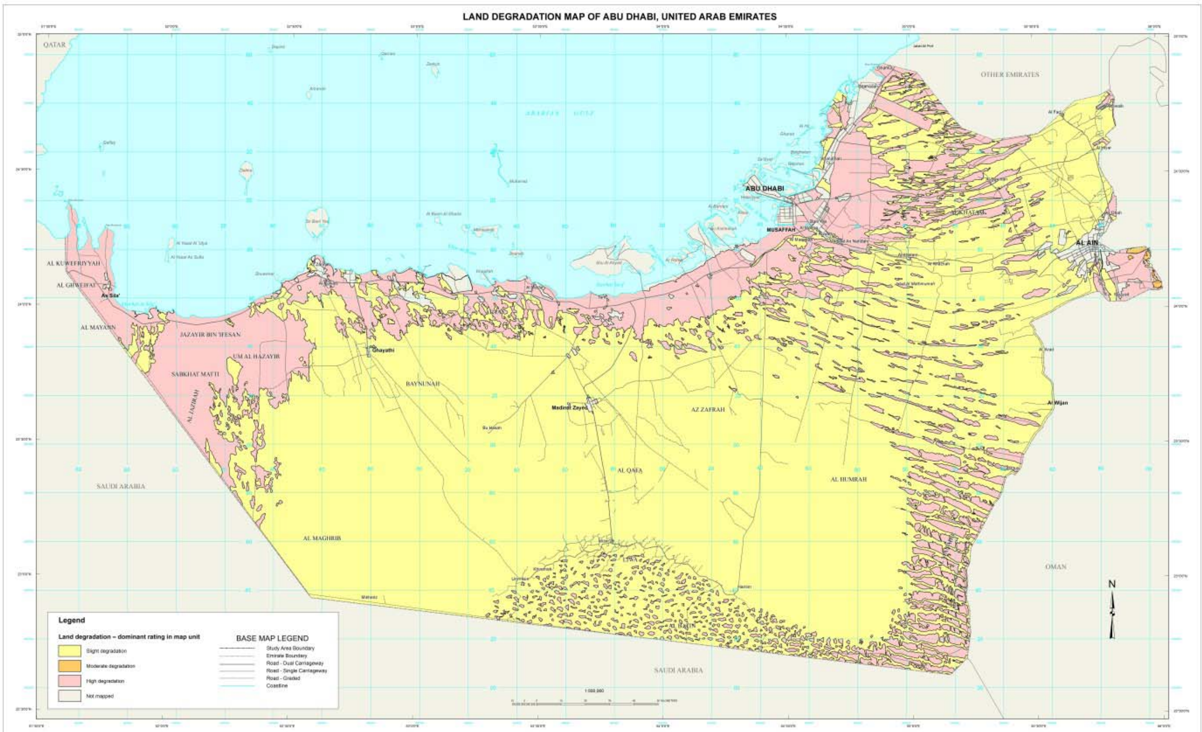

Fig. 3. Land degradation map of Abu Dhabi, United Arab Emirates

Table 4: Number of polygons and areas in hectares and percent from total of degraded areas of different land degradation status in Abu Dhabi area

Degradation status	Polygons		Areas	
	Number	%	Hectares	%
High	888	90.70	1,295,944.14	22.64
Moderate	6	0.61	3,632.49	0.06
Slight	85	8.68	4,423,519.53	77.29
None	81	7.64	139,240.48	2.38
Total	979	100.00	5,723,096.16	100.00

The study concludes that areas along the coast and at Sabkhat Matti are considered degraded due to high salinity. Many inland sabkha, such as in the Liwa area, are also degraded by salt. Deflation plains elsewhere are typically degraded by shallow depth to hardpan or bedrock. The greater part of the Emirate, where sandy soils and dune systems occur and where erosion by wind is current hazard, are evaluated as having a slight degradation risk.

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Determination of soil behavior under tractor tire using strain transducer

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Abstract

Soil compaction is the index which indicates the physical and structural damage of soil that is determined as increase of bulk density or decrease of porosity. A quantitative description of soil compaction is necessary to improve soil management to reduce its negative effect on crop production. The objective of this paper is to show soil behavior during compacting under MF285 tractor tire in three different directions of x, y and z using strain transducers. The experiments were carried out in the field and three strain gauges were situated in the dogged profile with dimension of 1×1 meter and depth of 70cm. Experiments were carried out in a moisture level of 11percent, three velocity levels of 1, 3 and 5km/hr and a depth level of 45cm. All tests were arranged as randomized complete design with 3 replications. Soil behavior in three main direction of coordination axis with regarding to the strain gauge data showed that the soil compacted in the vertical direction and expanded in the lateral direction, however in the longitudinal direction the soil compacted initially, then expanded and then recompressed. Comparison of the obtained data from measuring bulk density by sampler cylinders and measured density using strain gauge showed that there wasn't a significant difference between these two measurement methods. It was concluded that strain gauge can be used as proper device for measuring soil compaction.

Keywords: Soil compaction, strain gauge, bulk density

Introduction

To make the right decision to be associated with the agricultural implements, water, soil and other agricultural inputs requires having the right information about the machine and its interactions with the environment. Since soil is the source of nutrition and an environment for plant growth, hence the design of devices that are in contact with soil is important. One of the adverse effects of agricultural machinery traffic on soil is compaction. A part of that occurs because of tillage operation especially when moldboard plow is used. Another part can be due to traffic of the tractors and agricultural machinery during planting and harvesting operations. Knowing and understanding the relationships between soil properties and machine system would be helpful to determine the effect of compaction on soil properties. Evaluation of density and compaction effects on soils due to its negative effect on crop growth and production is necessary. Soil compaction can easily reduce production efficiency up to10% and degradation of soil structure and reduction water flow through the soil will lead to reduced soil quality. Soil compaction under tractor wheels increased because of mechanized farming in recent years. By accepting of compaction effect on soil degradation and erosion, we have to find ways to manage and decrease that. Precision farming can reduce it; however modern tractors are heavier than past and with the high power and capacity to draw large implements increases soil compaction possibility. In general the following objectives are considered in this study:

1. Compare the density obtained by the strain transducers with sampling cylinders results
2. Determine whether these strain transducers can be used as a means to measure soil compaction under tractor tire or not
3. Determine soil behavior under passing tractor tire in three main directions of the coordinate system

Material and methods

Experiments were conducted in a Loamy soil at soil moisture of 11%. For tests MF285 tractor equipped with single rear wheels (18.4R30) and weight of 1694kg on rear axle was used. During tests a moldboard plow was on three hitch point and that increased weight on rear axle to 2086 kg.

Trials were conducted at three forward speeds of 1, 3 and 5 km/h. Tire inflation pressure was constant for all tests.
Soil strain was measured in three directions of x, y and z using strain transducers (LVDT, Model DLH-A-50) with sensitivity of 3.64 mv/v. All data from strain transducers were logged to laptop via data logger (Model: DT800).

Three similar strain transducers were placed in three directions of longitudinal, lateral and vertical. Schematic design of the tire movement and transducers placement was shown in Fig. 1. Transducers were located in a profile with cross-section of 1m × 0.7 m and its length was 1m. As indicated in Fig. 2, within the soil profile from left to right transducers respectively were vertical, lateral(perpendicular to the direction of the tractor) and horizontal(along the direction of tractor movements (Erbach et al. 1991).

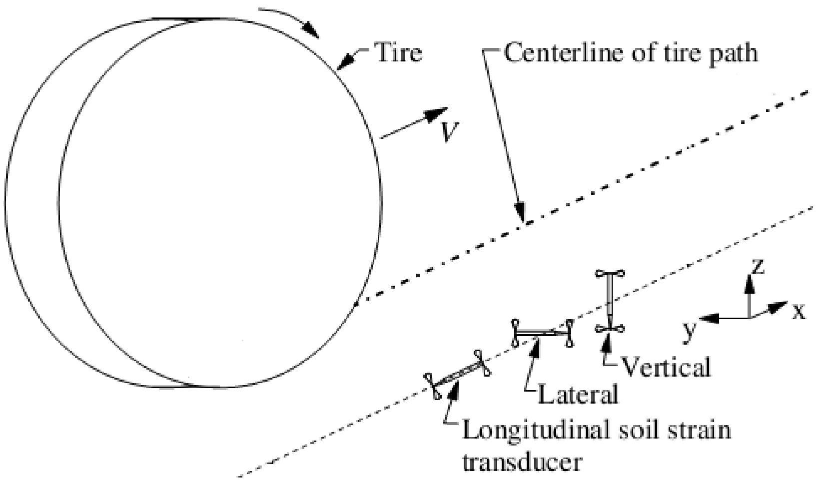

Figure 1. The positions and orientations of three similar soil strain transducers relative to the tractor tire

Experiments were conducted at a depth of 45cm, such that the distance between the longitudinal and lateral transducers from soil surface equal to mentioned depth, while vertical distance between the upper endplate of vertical transducer from soil surface was 40cm.

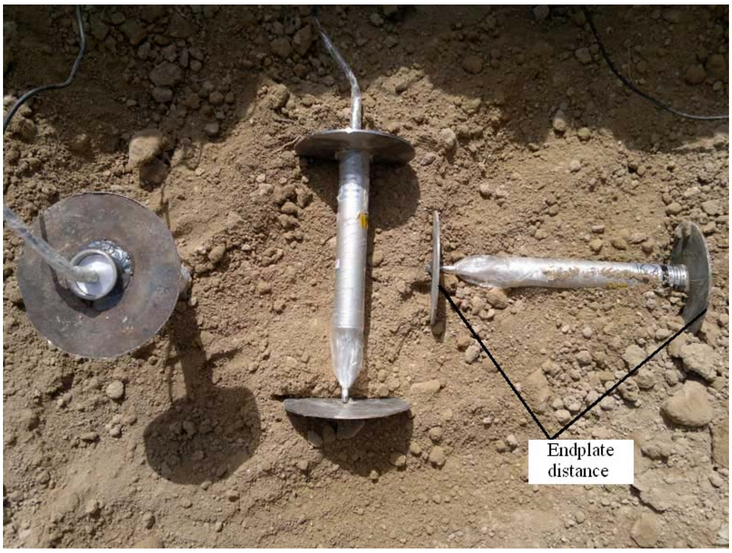

Figure 2. Position of transducer inside soil profile left to right, vertical, lateral and longitudinal

After placement of transducers the data recorded by data logger were considered as the actual initial endplate distance, l_i, after passing the tractor for each transducer endplate distance was considered as final endplate space. Soil strain along three axes of x, y and z was determined from equation (1).

$$\varepsilon = \frac{l}{l_i} \quad (1)$$

Where:
l_i =intial endplate distance, (mm)
l=endplate distance of trnsducer after passing of tractor, (mm)
ε= natural strain of soil between the endplates of a transducer, (-)
It was considered that three orthogonal soil strain transducers may as the length, width, and height of a right hexahedron of soil which its volume equal to the product of the endplate distances of the transducers.
The initial volume of the hexahedron, Vi would be product of l_{ix}, l_{iy} and l_{iz} and final volume of soil hexahedron after passing tractor V would be $l_x \times l_y \times l_z$.
Tthe natural volumetric strain was determined by follow equation (Way et al. 2005).

$$\boldsymbol{\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z} \quad (2)$$

Where:
ε_x, ε_y and ε_z= soil strains in the x, y , and z directions, (-)
Volume and bulk density change were calculated by Equation 3.

$$\boldsymbol{\varepsilon_v = \ln(V/V_i) = \ln(\rho_i/\rho)} \quad (3)$$

Where:
V_i= initial volume, (mm^3)
V= final volume, (mm^3)
ρ_i=initial bulk density, (kg/m^3)
ρ=final bulk density, (kg/m^3)

To validate the density results were obtained from strain transducers, also soil density was measured using sampling cylinders under passing tractor tire and compared with strain transducer results. 15 cylindrical samplers with diameter of 10 cm and height of 20 cm were used. Cylinders were located at a profile with depth of 70 cm, width of 50 cm and length of 3 m (Fig.3). Cylinders were separated in 5 groups (each group 3 cylinders shows number of replications) and there was 50 cm distance between groups. Under cylinders was filled with a layer of loosened soil to obtain soil behavior for loosened soil, in this case cylinder top plate distance from soil surface was 40 cm. To show the effect of tractor trafficking effect on soil compaction, 5 runs were accomplished and after each run one group of cylinders was removed from the soil, hence the first group corresponding for one run and second group corresponding for two runs and at last the fifth group stands for 5 runs.

Figure 3. Positions of cylinders inside soil profile before filling with loosened soil

Results

Comparison between values obtained by the cylindrical samplers and strain transducers showed that the difference between these two methods was not significant. The variation curves showed that the measured density using sample cylinders was higher than that obtained by strain transducers (Fig. 4).

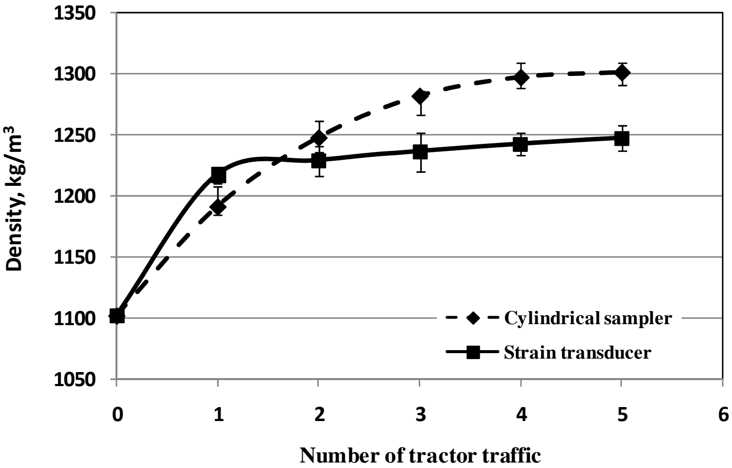

Figure 4. Comparison density using cylindrical samplers and strain transducer

In all replications the endplate distance of vertical transducer significantly changed from zero to negative values as ε_z varied. When the wheel axle was about 0.6 m in forward of the vertical transducer, vertical strain was started and when wheel axle was on top of transducer, almost the entire vertical compression occurred. As shown in Figures 5 up to a distance of approximately 0.2 m from the reference point on the vertical transducer its strain ended. When the rear axle was 0.4-0.5m in forward of lateral transducer axis its strain ε_y started uniformly. All replication results showed that horizontal strain was as compression and ε_x showed negative values first. Later it was expanded in comparison to past situation, and at last enplates distance decreased and strain showed negative values again. When the wheels axle was 0.3-0.5 before the reference point of horizontal transducer, its strain began and when the wheel axle was passed 0.6-0.8m from the reference point it was ended. As soil compacted in front of tire the primary negative strain occurred.

As Fig. 5 shows by increasing travel speed from 1 to 5 km/h, soil strain along three main coordination system decreased. Maximum vertical strain which occurred when tire axle was on top of transducer at velocity of 1 km/h was about 23 mm and it decreased to 17 and 14 mm at velocities of 2 and 5 km/h, respectively. Strain along x and z directions showed almost the same results.

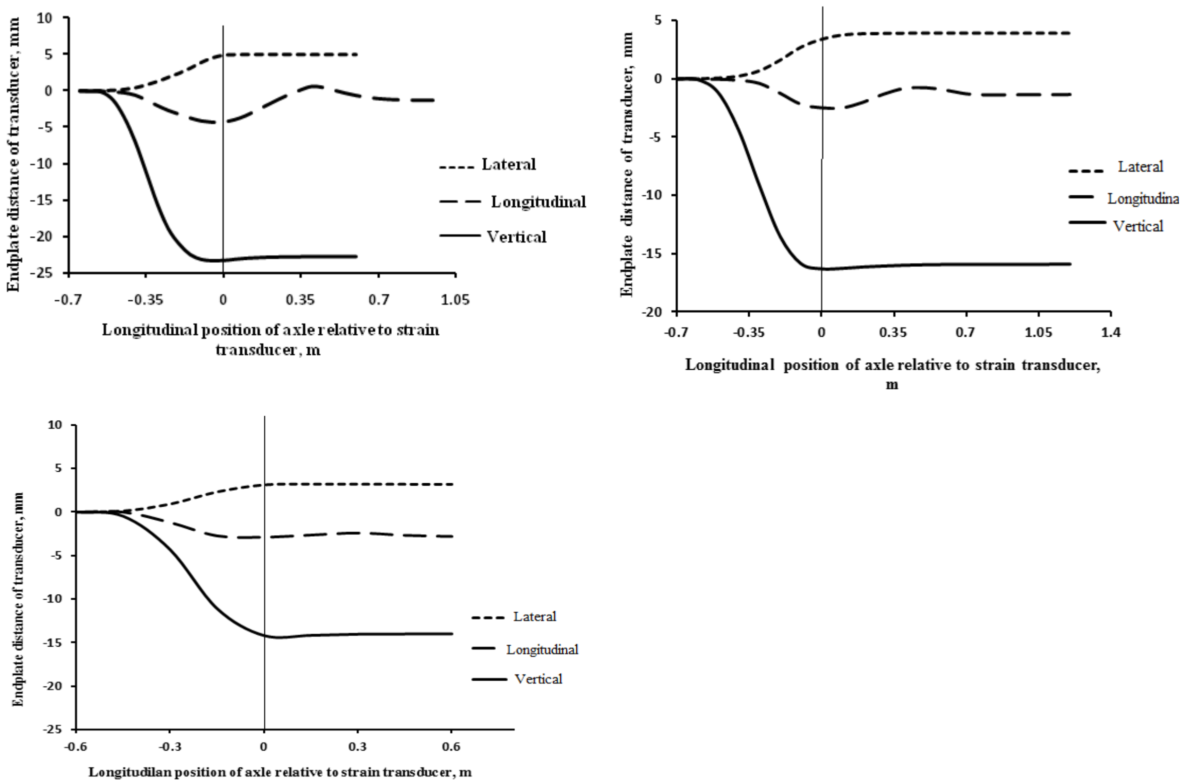

Figure 5. Soil strain along the longitudinal (x), lateral (y), and vertical (z) directions at different velocities of 1, 3 and 5 km/h (top left, top right and bottom respectively). Longitudinal position is positive when the wheel axle is forward of the strain transducer centerline

Discussion

The difference between sampling cylinders and strain transducers can be because of closed chamber around the cylinders while there was not buffer wall to prevent removal of soil form area between endplates of strain transducer.

When horizontal strain variation stopped, apparently, the soil resistance was significantly increased to support the propulsion force on tire. The Results of this research similar and agree with Way et al. (2005) research. They located three orthogonal soil strain transducer in directions of x, y and z at a depth of 20 cm. They found that soil was compacted horizontally and was expanded laterally and in horizontal direction it was compacted first and expanded later and at last it was compacted again.

Conclusion

1. There was not significant difference between density measured using strain transducers and sampling cylinders. Transducers can be used as a mean to measure soil compaction and its behavior under agricultural operation loads.
2. Soil behavior results showed that soil compacted vertically during tractor tire passage and expanded laterally. In longitudinal direction, first it was compacted and later expanded and at last it was compacted again.

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Land Degradation Assessment in Dry Land According to LADA Project Approach Tunisia Case Study (Gouvernorat of Kasserine)

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Abstract
Land degradation causes damage of physical, social, economic features, and reduction of ecosystem diversity. There may be a mix of factors, bio geophysical, and socioeconomic. A major challenge is to learn how interactions between development and land degradation can be better managed.
The Land Degradation Assessment in Dry land (LADA) Project have two major objectives. First, to develop tools and methods to assess and quantify the nature, extent and severity of land degradation of dry land ecosystems at spatial and temporal scales. The assessment will integrate biophysical factors and socio-economic driving forces. Second, the project will build national, regional and global assessment capacities to enable the design and planning of interventions to mitigate land degradation and establish sustainable land use and management practices.
Tunisia was chosen among the other experimental country to apply the local approach LADA to identify the scale of the degradation (2004-2010). The project is financed by the Global FEM, implemented by UNEP and executed by the FAO.
This study is interested in an evaluation of land degradation according to the LADA approach in the region of Kasserine: Sbeitla watershed. The work is based on quantitative and qualitative information collected in field during various stages of characterization of the degradation. The data set generated allowed the analysis of links between the activities and the state of lands, the management of the resources: changes, trends, Impacts ,to understand the strategy of the developers finally the reconstruction of the history of the zone and establishment of recommendations and measures that must be undertaken, and a planning of the interventions for sustainable management of lands is also proposed .
The **LADA methodology** and approach **adopted** the driving forces-pressure-state-impact-response (DPSIR) model as its methodological framework. The DPSIR approach allows the linkages between the **driving forces** behind the **pressures** on land resources that cause the current state of degradation, the **impacts** of such degradation on environment and on human livelihoods, and the **responses** of land users.
Keywords: Land degradation, biophysics and socioeconomics characteristics, driving force, pression response

Introduction
LADA methodology is considered as an ambitious assessment approach to assess land degradation. It is based on Multi-sectoral (soil, vegetation, water and socio-economic factors). The evaluation integrates biophysics and socioeconomic factors

- ***Biophysic characteristics*** (climate, soils, vegetation, water resources, land use etc);
- ***socio-economic characteristics*** (population; agricultural, livestock and forestry production levels; household income and livelihood activities; food security and health etc); and
- ***institutions*** (community organisations, local gouvernent, Privat sector etc).

The results Looks at **drivers** and **impacts** of land degradation as well as the **state** of land resources and processes of **change.** The **DPSIR** framework is (fig. 1) used to link and help synthesize all parts of the assessment and guides the synthesis and analysis of the data. Assessment can provide base-line data on land degradation for planning, priority setting and monitoring.

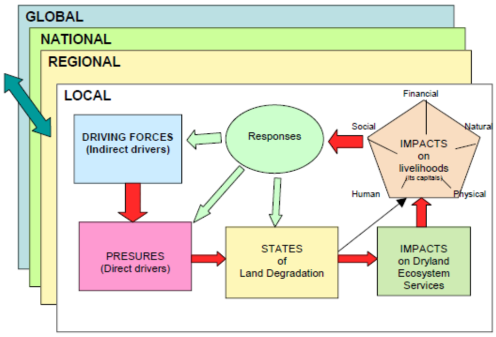

Figure1. Methodological framework DPSIR

Materials and methods

There are steps for evaluation of the land degradation in the local scale is proposed by LADAapproach:

1. Planning the sampling/assessment
2. Identifying of assessed areas. Area characterization
3. Identifying plots & households for the detailed assessments
4. Assessing the biophysical impact of LD on soil properties
5. Assessing the LD impact on (socio-economic)
6. Analyses and reporting

The evaluation of the vegetation on the site concerns the selection the indicator species. Any information and character collected on the vegetation is translated into term of degradation or preservation of the various units of the ecosystem. This allowed to compare different LUT(Land use type)**,** to establish the relation between the quality of the vegetation, the land quality (Fig2, 3), to identify processes of the degradation related to the human practices and management and to have an idea on the type of breeding, the size livestock, the pasture, the movements of the cattle finally to estimate the surface having a deforestation, or burned field. Plant place setting influences the hydrological processes: the infiltration and the erosion.

Figure 2:Evaluation of vegetation

Figure3: Evaluation of covert density

The evaluation of the Soil properties_is based on the sampling of soil (nature depth, structure, color, compaction), biotope (verses and roots) pH, Infiltration of the water, organic Carbon, the salinity according to a protocol VST, distribution of the aggregates.

The erosion of land was also characterized thanks to several indicators of the loss in ground proposed by the approach LADA-L. These are most used in the dry zones:

- exposure of the roots of plants / trees - mounds at feet of trees - ratios of enrichment - depth of the ground and the roots of plants; The aspects of the degradation of the land are directly or indirectly related to the water erosion, and land management .

Results

The results presented are those of Nfadh Leherma a part of Sbeitla watershed situated in the South of the region of Kasserine.

The basin is characterized by a very degraded plantation. Except for some forest areas in upstream part, the plant is essentially raised. These areas constitute a very degraded steppes. On mountains dominate forest groupings constituted by *Pinus halepensis, Quercus ilex, Juniperus phoenicea et*

Rosmarinus officinalis, when piémonts and plains are caracterised by steppiques groupements as Stipa tenacissima, (JP. **Delhoume 1981***).*

The harvest of Alfa constitutes an important source of income and offer opportunity for the creation of jobs with 900D in 1200D/person/season. (Ben Chaâbane H and al). On 2005 these groupings steppiques, in particular Stipa tenacissima (alfa), show a fast degradation during the last centuries (clearings, overgrazing, paper **manufactory**) (Attia. H, on 1977).

Figure 3: hand collecting of Alfa

Figure 4: Alfa collection for manufactory

The characterization of the site Nfadh lehram concerned the ***Biophysic*** and ***socio-economic aspects.*** The results are presented in the form of cross section incorporating a maximum of information about every subject. The LADA evaluation uses the system of classification by type of use of lands (L.U.T).

the major land units and the major land-use are recognized (Fig5). A number of transects are made after the community discussion. They cut across the major land use type LUT and land use system LUS .A Protocol of characterization of every subject and aspect is described by the approach LADA and applied during the working stages.

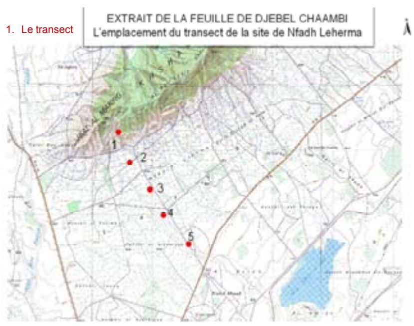

Figure 5: Location of transect selected in Nfadh lehram





Table1. Transect of characterization

Caracterestic of LU.T	Forest	Garrigue +Mise en défens	Alfa	Crops	Irrigated area
Location	35° 04' 05 " 8° 35' 23 "	35° 03' 59 " 8° 35' 82 "	35° 03' 21 " -8° 36' 08 "	35° 02' 67 " 8°36' 51 "	35° 02' 29 " 8°37' 23 "
Altitude	1080-910	910-880	880-845	845-820	820
slope	20 %	10 %	4 %	2 %	1 %
-Sol -Texture - Coleur - Fertility - Salinity	Lithosol Pas de texture Brun foncé Bonne	Calcimorphe(rendzine) Limono sableux Brun rougeâtre Moyenne 1.2 mmhos/cm	Calcimorphe (rendzine) Limono sableux Brun Moyenne 0.92 mmhos/cm	Peu évolué d'apport Limono sableux Brun 0.8 mmhos/cm	Peu évolué d'apport Limono sableux Rougeâtre Moyenne 0.78 mmhos/cm
Point of water	Eau pluviale	Eau pluviale	Eau pluviale	Oued Nfadh Leherma	Forage Nfadh Leherma
Major Contraints (biophysic and human)	Érosion hydrique en nappe Récolte d'alfa - Surpâturage - Coupe de bois. défrichement	Sécheresse (irrégularité et variabilité des pluies) - Surpâturage - Récolte d'alfa	- Récolte illicite d'alfa - pâturage	- gelée - Sirocco - Sécheresse - Eau de ruissellement	- gelée - Sirocco - problème financier
Main occupation	Forêt naturelle dégradée -	Alfa + pin d'Alep (jeune plantation) Ovins + caprins	Alfa Ovins + caprins	Céréales en sec (orge) Ovins + Caprins	Arbo en irrigué (submersion –goutte à goutte -céréales (aspersion)
Végétation -Type of cover - Indicator	Forêt naturelle (15 %) Genévrier, romarin, pin d'Alep	Alfa (42 %) Alfa Alfa	Alfa (72 %) Alfa Alfa	Céréales + jachère	olivier + Céréale
Type of dégradation	Ravinement Sol dénudé	Cailloux en surface à cause de ruissellement en nappe	Cailloux en surface à cause de ruissellement en nappe	Eau de ruissellement Labour sens de la pente	Carence en élément de fertilité
Managment practice	Mise en défens Reboisement Poste de contrôle travaux de CES	Mise en défens Reboisement (pin d'Alep) cactus	Mise en défens d'alfa	travaux de CES (Banquette mécanique)	l'accès aux crédits fertilité du sol subventions travaux CES

Discussion

1-State of the Land resources and ecosystem

The analysis of all land use type across the transect(Tab1)allowed us to have an idea on the state of the soil, water resources and the vegetation in the pilot site. The information of the user helped us to establish state, the level and the dynamics of land degradation.

-Degraded Forest:LUT1 An irreversible degradation of the upstream part of the hillside , We notice the frequency of the rocky elements on-surface with gravel and calcareous crust marked by a very scattered plant. We notice the presence of some trees of pine of Alep and some bundles stunted by rosemary, and alfa. The cover rate is < 5 %. There's no management in ravines, these ravine are active in strong rain .

- The second unit: it is forbids area . it is constituted totally by alfa. We note the introduction of young plantations of pine of Alep and the abundance of pebbles and surface gravel, in the intercalary spaces. The alfa reaches 72 % cover rate.

- at the bottom of slope on the alfa and the natural space the soil are poor little evolved , without structure they result from deposits of slight elements which result from the water erosion and wind erosion in the upstream part.

- **The plain soils** are deep with light texture (deep, silt-sandy soil). It is cereal in dry with plantation of cactus with line shape distant about 5 metres.

-The last LUT is a private irrigated perimeter which is covered by cereal, and the trees culture (olive tree / almond tree). There is no particular degradation, because it is a new creation. Soil has a weak content in organic matter, a good porosity, a weak cohesion and a low rate of saltiness.

2-Les driving strengths and pressure on the environment: - The direct and indirect strengths of changes in the state of the land, are caused by several constraints that decrease the development and the good management of lands in the studied zone such as:
The drought : irregularity and variability of rains, the lack of water during the summer period.
The extreme temperatures: frozen – Sirocco, water erosion, financial problem, illicit harvest of alfa, overgrazing, and the fragmentation of parcel is often considered as a handicap in the agricultural development, and Wood cutting.
- The mechanization provoked a clear degradation of lands.
-T he level of surface wells during years of drought decrease disponibility of water in the irrigated area.

3-The Impacts:

- The observation in field and the discussions with livelihood show:
- For forest we notice a strong degradation of the natural plant (disappearance of trees and shrubs), the cover rate reaches TC < 5 %.
- - The water erosion is always active and leads to a loss of soil and biodiversity which contribute to loss of the economic and ecological functions of the forest.
- the organized collecting of the alfa insures a good regeneration of the alfa resources and an increase of the income.
- The protection of the ground with forbids of grazing can decrease of the size of the livestock and decline of the incomes, the barley in dry is often used as feed.
- The diversification of the production thanks to the introduction of the irrigated perimeters facilitates the satisfaction of the needs of the livestock, the increase of the incomes of the household and the improvement of the living conditions.
- This mode of management can engender in the long term a risk of quality change of water resources and the loss of the Land due to over exploitation.

4-Responses

The protection of the resources requires the continuity of several levels of intervention; LADA results analysis can orient these measures:

- the application of the forests code must be respected
- To continue the regulations of the collection of alfa and the control of the use of grazing space are strongly recommended.
- At the political level: we have to develop a strategies of preservation of the resources.
- the reforestation (plantation of pine of Alep), correction and stabilization of ravines) must be strengthened.
- Advising farmer for a good practice, enforcing socioeconomic measures with the improvement of the access to the credits and more implication of the households
- The management of the grazing space by varying the fodder resources (plantation of fodder shrubs in more high yield) and the search how to fill the deficit of food.
- better circulation of the information, in particular that relative to the measures introduced by public authorities.
- The creation of a grouping of agricultural development (GDA)

Conclusion

LADA methodology for local assessment allowed us to understand the effects of the degradation of lands and management of the resources on the ecosystems services, productivity and socio economic aspects.
It emerges from this study that the region is characterized by the importance of the constraints undergone by the land such us erosion of the glacis and the terraces that conduce to the loss of the fine materials by selective erosion the factors of the climate are marked by the irregularity of the annual, seasonal total rain and especially monthly pulling that reduce the development of plant cover by a fast erosion of lands.
According to the history of this zone, the alfa was very dense in the upstream towards the approval (LUT- I to LUT- V). Forest (Pine Alep, Juniper, rosemary) was also well developed until LUT-III.

Today, the overgrazing, illicit exploitation of the forest plantations and alfa and the mechanization induce to net degradation of lands. So there's necessity of a severe application of law forest, a rational exploitation of the alfa and good crops practice.
On the other hand the weakness of the ecosystems of Piedmont is not only due to the effects of the variability of the climate (rains and droughts) but also by the reorganization of the rural use of the space and the inappropriate practices. The consequence of this is more and more responsible of the disappearance of the plant place setting and the deterioration of the structural properties of grounds.
The pastoral activity remains very important in spite of the fluctuation which knows the size of the livestock from period to the other one. The limited grazing space and the low fodder production, decrease a good regeneration of the vegetation
The interaction between biophysics factors and socioeconomic factors engender irreversible erosion that affects the landscapes of the region and increase the sterilisation upstream part of hillsides
Degradation results also from the inadequate management of the resources (overgrazing, livestock size, not adapted farming techniques, lack of financial support). This affects too much uniformity of the studied zone.
The synthesis of the data of three other transects according to the approach LADA will allow to have a general idea on the state of the degradation of the water shed of O. Sbeitla Kasserine and to propose recommendation for a better planning of management of the resources in the region.

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Degradation of Biological Properties of Soil Through Salinity

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Abstract: Soil degradation through salinity is a serious problem in agriculture. Salinity is believed to alter many soil characteristics. A study was conducted to determine the soil biological properties of 30 salt affected soils in North Western Pakistan during March 2010. The soils were alkaline in reaction and had electrical conductivity (EC) gradient from 0.60-32.0 dS m^{-1}. All microbial indices showed a decreasing trend with increasing salinity. The average microbial biomass C of soils decreased from 391 mg kg^{-1} in soils with salinity level of <4.0 dS m^{-1} to 209 mg in soils with salinity level of >12 dS m^{-1}. Microbial biomass N, N mineralization, nitrification and soil respiration exhibited the same trend with respect to elevated salinity. The C/N ratio of soil microbial biomass however increased with increasing salinity. These results suggested that soil biological indices were highly sensitive to salinity and can be used as indicator for management of salt affected soils.
Key words: Soil degradation, soil salinity, microbial biomass, N mineralization, C/N ratio

Introduction

Soil degradation through salinity is a serious problem in agriculture. Soil salinity affects physical and chemical properties of soil (Choudhary *et al*., 2004; Sharma and Minhas, 2005). Deteriorating soil properties causes low seed germination and poor plant growth because of crust development on the surface of the soil. In addition to physical and chemical soil properties, biological characteristics are also greatly influenced by salinity (Rietz and Haynes, 2003). Bandyopadhyay and Bandyopadhyay (1983) reported reduced rate of N mineralization and immobilization in saline soil. Wollenweber and Zechmeister-Boltenstern (1989) noted reduction both in nitrification and ammonification in salt affected soils. Nelson *et al*. (1997) found negative correlation between sodicity levels and C mineralization. Whereas, Chander *et al*. (1994), Pathak and Rao, (1998) and Tripathi *et al*. (2006) noticed a decrease in soil microbial biomass, soil respiration and microbial activities with increasing salinity. The reason for the reduced microbial population and activity with increasing salinity is likely to be osmotic stress, ion toxicities and adverse pH conditions (Rietz and Haynes, 2003).

The use of microbial indicators in soil monitoring programs has been introduced in some advanced countries. The most common microbial indicator for the monitoring of soil health is the microbial biomass or the microbial activities (Nielsen and Winding, 2002). The purpose of this experiment was to evaluate the relationships of soil salinity with different soil microbial properties.

Materials and Methods

Site characteristics

Soil samples at 20 cm depth with different salt concentrations (i.e. EC of < 4.0 to >30 dSm^{-1}) were collected from 30 different locations from two districts in North Western Pakistan in March, 2009. District Charsadda is located between 34° 02’ and 34° 40’ N and 71°30’ and 71°34’ E. Main crops of the area are tobacco, sugarcane, sugar beet and rice. The soils are mostly water logged and saline or saline sodic with heavy texture. The mean maximum temperature in summer (May-August) is 45°C (average 32°C) and in winter (December-February) is 20°C (average 5.3°C). Mean annual precipitation in the area is 433.2 mm. District Mardan is located between 34° 07’ to 34° 31’ N and 71° 49’ to 72° 26’ E with almost similar climatic conditions as of Charsadda. The soils are mostly waterlogged and saline or saline-sodic with poor drainage, restricted leaching, and shallow water table. The samples were broken down by hand and passed through < 4.0 mm sieve whilst still moist.

Laboratory Studies

Microbiological Properties

Chloroform fumigation incubation method was used for the determination of soil microbial biomass C and N (Horwath and Paul, 1994). Microbial activities were measured in terms of CO_2 evolution (Stromberger et al., 2011). In this method, soil sample was inoculated in the presence of NaOH solution to trap CO_2. The NaOH solution was titrated against HCl to measure the amount of NaOH reacted with CO_2. The amount of CO_2 was calculated from the amount of NaOH reacted with CO_2 as 2 moles of NaOH react with 1 mole of CO_2 (or 1 mole of NaOH = 22g CO_2). For measuring N mineralization and nitrification in soil, total mineral N and NO_3-N were determined in soil sample before incubation (day 0). The soil sample was incubated for 10 days and analyzed again for total mineral N and NO_3-N after incubation. Both mineralizable N and nitrification were calculated by difference as total mineral N at day 10 – total mineral N at day 0 and NO_3-N at day 10 - NO_3-N at day 0.

Other soil properties

Steam distillation method was used for the determination of total mineral N in soil samples as described in Mulvaney (1996). Soil pH and soil EC were determined in the saturation extract obtained through a vacuum pressure apparatus from soil saturation paste.

Statistical Analysis

Descriptive statistics was use to calculate means and co-efficient of variation. Correlation co-efficient between salinity (EC) levels and various soil microbiological properties was determined.

Results and Discussion

Microbial Biomass C and N (mg kg^{-1} soil**)**

The soil microbial biomass C (MBC) ranged from 147 to 516 mg with the lowest value in soil having highest salinity (Table 1). The range of microbial biomass C was 317-516 mg for soils with EC of <4.0 dSm^{-1} which reduced substantially to 147-275 mg for soils with EC of >12.0 dSm^{-1}. Similarly, level of soil microbial biomass N was lowest in soils with highest EC. The range of microbial biomass N (MBN) was 47-170 mg in soils with EC of <4.0 dSm^{-1}, which reduced significantly to 19-35 mg in soils with EC of >12.0 dSm^{-1}. These results indicated that salinity had negative effect both on soil MBC and MBN. Microbial biomass-C (Fig 1) and –N (Fig 2) decreased proportionally with increasing salinity. Pearson correlation coefficient between EC and MBC ($r = -0.89^{**}$) and between EC and MBN ($r = -0.74^{**}$) was negative. Rietz and Hayness, (2003) also found negative exponential relationship of MBC and MBN with soil EC. A strong negative correlation value ($r = -0.82^{**}$) between MBN and soil EC was also reported by Yuan *et al*. (2007). Our results are in line with the published literature which shows that MBC ranged between 100 and 600 mg kg^{-1} in normal soils (Anderson, 2003), and between 120 and 440 mg kg^{-1} in soils containing excess salts (Tipathi *et al*., 2006).

C:N Ratio of Microbial biomass

Unlike other soil microbial indices which showed a depressive effect with increasing salinity, the C:N ratio in microbial biomass increased with increasing salinity (Table 1). The range of C:N ratio in microbial biomass was 3-9 for soils with EC <4.0 dSm^{-1} and was 5-15 for soils with EC value of >12.0 dSm^{-1}. Microbial biomass C:N ratio showed positive relationship with soil EC ($r = +0.61^{**}$, n =90) (Fig 4). Yaun *et al.* (2007) reported a C:N ratio between 4 and 8 in microbial biomass which is quite low. Chander and Joergensen (2007) however observed a wide C/N ration in microbial biomass is soil amended with glucose.

Table 1: Microbial properties of soils collected from salt affected areas in Northern Pakistan

EC (dSm^{-1})		Microbial biomass-C ($mg\ kg^{-1}$)	Microbial biomass-N ($mg\ kg^{-1}$)	Microbial biomass C/N ratio	Net N Mineralization in 10 d ($mg\ N\ kg^{-1}$)	Net Nitrification in 10 d ($mg\ N\ kg^{-1}$)
<4.0	Range	317-516	47-170	3-9	10-63	-3 to 74
	Mean	391	114	4	33	31
4.0-8.0	Range	313-391	38-66	5-9	14-23	8-24
	Mean	341	56	7	18	15
8.0-12.0	Range	264-302	23-52	6-12	5-20	-11 to 19
	Mean	276	37	8	12	1
>12.0	Range	147-275	19-35	5-15	2-26	-19 to 10
	Mean	209	25	11	11	-5

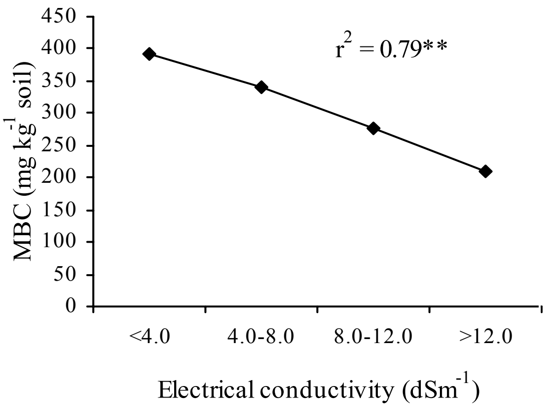

Fig-1: Relationship of soil MBC with electrical conductivity

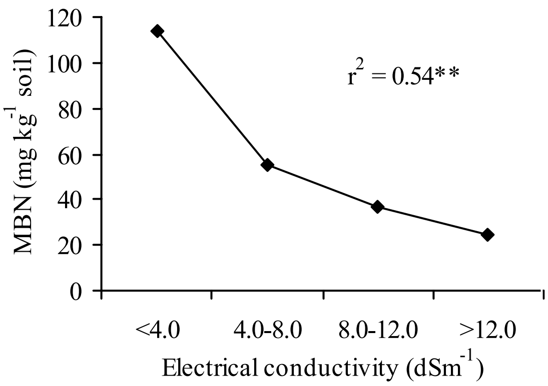

Fig-2: Relationship of soil MBN with electrical conductivity

Net N Mineralization

The net N mineralization varied considerably with salinity. The range of N mineralization was 10-63 mg N kg^{-1} in soils with EC of <4.0 dSm^{-1} and was 2-26 mg in soils with EC of >12.0 dSm^{-1} (Table 1). Nitrogen mineralization showed negative relationship with salinity and decreased proportionally with increasing salinity (Fig 3). The Spearman correlation coefficient between EC and N mineralization was negative (r = -0.57**, n = 90). Salinity may inhibit organic matter decomposition by suppressing microbial growth and activity. Soil microbial biomass itself is an important pool readily mineralizable organic N in soils (Bonde *et al.*, 1988) and low potentially mineralizable N may be linked to low microbial biomass N due to saline environment. The soil microbial biomass controls turnover and mineralization rate of organic substrate in the soil (Killham, 1994).

Nitrification

The nitrification process in soil showed negative relationship with soil salinity. The net NO_3-N formation decreased with increasing salinity levels (Fig 5). The nitrate formation ranged from -3 to 74 mg N kg^{-1} soil for soils with EC of <4.0 dSm^{-1} and was -19 to 10 mg in soils with EC of greater than 12.0 dSm^{-1} (Table-2). Pearson correlation coefficient between nitrification EC was significant but negative (r = -0.64**, n = 90). It is evident from literature that both nitrification and N mineralization were inhibited by high salinity (Pathak and Rao, 1998). Quanzhong and Guanhua (2009) found an increase in ammonical-N and a decrease in NO_3-N with increasing salinity. However, nitrification was more sensitive to salinity than mineralization (Martikainen, 1985).

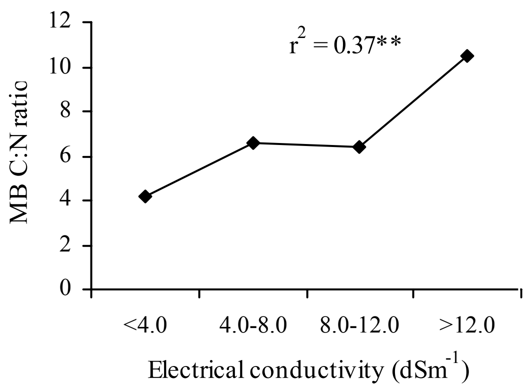

Fig-4: Relationship of soil MB C:N ratio with electrical conductivity

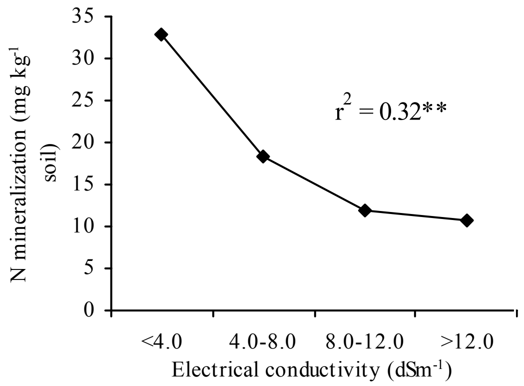

Fig-3: Relationship of soil N mineralization with electrical conductivity

Rate of Soil Respiration

The results showed that the rate of CO_2 evolution decreased with increasing salinity levels (Table 2). The rate of CO_2 evolution during the first 2 days of incubation was 10-25 mg kg^{-1}soil d^{-1} with average value of 18 mg for soils with EC value of <4.0 dSm^{-1} which reduced to 2-14 mg with mean value of 7 mg for soils having EC >12.0 dSm^{-1}. However, the rate of CO_2 evolution at day 10 was 3-9 with average value of 6 mg kg^{-1} soil d^{-1} which reduced to 2-6 with mean value of 4 mg with EC >12.0 dSm^{-1}. Overall, the relationship between rate of soil respiration and salinity during 10 days of incubation period was negative (Fig 6). The effect of salinity was more evident during early days of incubation. Differences among salinity treatments however narrowed down with increasing incubation period. Reason could be that the reserve of easily decomposable C would be exhausted in the less saline treatments during early days of incubation.

Table-2: CO_2 evolution in soils with different salinity levels during 10 days of incubation periods

EC (dSm^{-1})		CO_2 (mg kg^{-1} d^{-1}) during incubation period (days)			
		2	5	7	10
≤4.0	Range	10.0-25.1	5.0-16.5	8.1-18.0	2.7-9.0
	Mean	18.3	9.5	13.1	6.1
4.0-8.0	Range	13.2-17.8	5.1-7.9	7.6-9.4	5.9-7.6
	Mean	14.9	6.6	8.4	6.6
8.0-12.0	Range	8.8-10.6	7.0-8.2	6.5-9.4	4.0-5.7
	Mean	9.8	7.5	7.6	4.8
>12.0	Range	1.8-14.1	1.8-10.4	4.3-7.0	2.0-5.7
	Mean	7.0	5.1	5.6	3.7

Soil respiration and soil microbial biomass has been reported to have decreased with increasing salinity (Pathak and Rao, 1998), and this was attributed mainly to stress placed on the microbial population due to change in osmotic potential (Batra and Manna, 1997). Wong *et al.* (2008) reported that soil respiration was highest (56-80 mg kg^{-1}soil) in the low salinity treatments and lowest (1-5 mg kg^{-1} soil) in the mid salinity treatments. Laura (1974) also reported that total microbial activity was generally depressed as soil salinity increased. Similar results were found by Trapathi *et al.* (2006) where basal soil respiration exponentially decreased with increasing salinity.

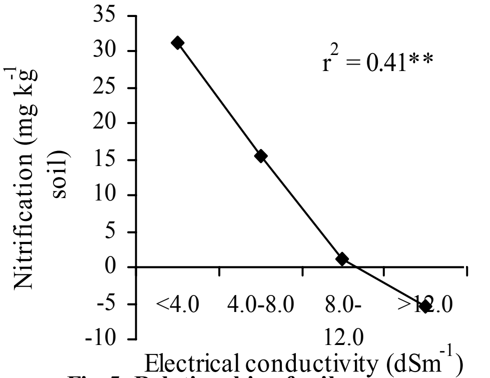

Fig-5: Relationship of soil nitrification with electrical conductivity

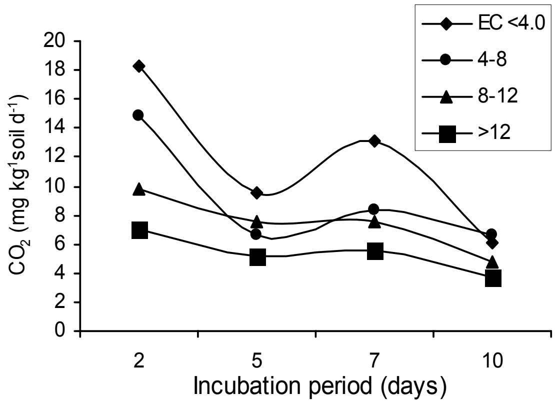

Fig-6: Influence of salinity on soil respiration during 10 days of incubation period

Acknowledgments

The work embodied in this paper was financially supported by the Higher Education Commission, Islamabad under 5000 Indigenous Ph.D program.

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Land Degradation Impacts on Soil Quality of Different Land uses in Central Zagros, Isfahan, Iran

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Abstract
Land use change without scientific studies can increase destruction and erosion possibility of soils. Soil properties and soil erosion were investigated respectively by using standard laboratory methods and a rainfall simulator with intensity of 60±5 mm/h for 2 hours in different land uses included pasture with good vegetation cover, pasture with medium vegetation cover, abandoned dry land farming and degraded dry land farming in central Zagros. The results indicated that soil organic matter, cation exchange capacity, microbial respiration and available K decreased 66.6, 38.8, 81.8 and 70 percent respectively in degraded dry land farming compared to pasture with good vegetation cover but calcium carbonate had a reverse order. Total N in pasture with good vegetation cover was the most but available P did not indicate any significant differences. The most aggregate stability was measured in pasture with good vegetation cover and degraded dry land farming. Also surface runoff, sediment generation and turbidity increased 90.3, 94.5 and 58.2 percent respectively in dry land farming compared to pasture with good vegetation cover. Concerning to the results, it seems that land use change can decrease soil quality and increase soil degradation and lead to undesirable consequences.
Keywords: Land Degradation, Soil Quality, Erosion

Introduction

From the advent of agriculture, there has been an innate interest in soil and land quality (Carter et al., 2004). Maintaining or improving soil quality can provide economic benefits in the form of increased productivity, more efficient use of nutrients and pesticides, improvements in water and air quality, and lessening of greenhouse gas emissions (USDA-ERS,1997). Karlen et al. (1997) proposed a complete definition for soil quality: they defined soil quality as ‘‘the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain biological productivity, maintain or enhance water and air quality, and promote human heath’’. Soil quality began to be interpreted as a sensitive and dynamic way to document soil conditions, as a response to management or as resistance to stress imposed by land use changes (Karlen et al., 2001). Assessing soil quality involves measuring physical, chemical, and biological soil properties and using these measured values to detect changes in soil as a result of land use change or management practices (Adolfo Campos et al., 2007). So the objective of this study was to investigate the impact of converting range lands to dry farming land use on some chemical and biological properties of soils.[1]

Materials and Methods

Study area

For the purposes of this study, Ghareh Aghaj watershed, located in central Zagros (51˚36′ E, 31˚ 31′ N) in Isfahan Province, was selected as the study area. The soils in the study area were classified as Typic Calcixerepts according to key to soil taxonomy 2010 (Soil Survey Staff, 2010) and as Hypercalcic Calcisols according to WRB (IUSS Working Group, 2007) in all the land uses. Mean annual temperature and rainfall in the study area were 9.5˚C and 362 mm, respectively. The dominant natural vegetation in the rangelands included Astragalus sp. and Bromus tomentellus. Because the study areas were selected quite close to each other, climate conditions and landforms were assumed to be identical.

[1] Abbreviations: GP, pasture with good vegetation cover; MP, pasture with medium vegetation cover; ADF, abandoned dry land farming; DDF, degraded dry land farming; $CaCO_3$, calcium carbonate; SOM, soil organic matter; CEC, cation exchange capacity; TN, total nitrogen; AP, available phosphorus; AK, available potassium; MWD, and mean weight diameter; MR, microbial respiration.

Field study
Undisturbed soil samples were collected in a completely randomized design with four replications from a depth of 0 to 10 cm in the following land uses: Pasture with good vegetation cover (GP),pasture with medium vegetation cover(MP), abandoned dry land farming(ADF) and degraded dry land farming (DDF).

Laboratory analysis
Soil samples were air dried in the laboratory and passed through a 2-mm sieve prior to analysis. The particle size fractions were determined by pipette method(Day, 1965), pH by using a pH meter in a 1:1 soil/water ratio (Page et al., 1986) and soil organic carbon by the Walkley–Black oxidation method(Walkley–Black, 1934). The percent of soil organic matter (SOM) was calculated by multiplying the percent organic carbon by a factor of 1.724, following the standard practice that organic matter is composed of 58% carbon(Brady, 1985). electrical conductivity(EC) by using an EC meter in a 1:1 soil/water ratio(Page et al., 1986); Cation Exchange Capacity (CEC) was determined using sodium acetate at a pH of 8.2 (Rhoades, 1986), Total N(TN) was determined by the Kjeldahl digestion, distillation and titration method(Bremner et al. 1982), available P(AP) was determined by the Olsen extraction method (Olsen et al. 1954) and available K(AK) was extracted with a solution of ammonium acetate (1 mol/L) adjusted to pH 7 and measured by flame emission (Chapman, 1965). Calcium carbonate (CaCO3) was determined by back titration method (Allison and Moodie, 1965). Microbial respiration (MR) was measured by the closed bottle method of Anderson (1982). Aggregate stability was determined by the wet sieving method (Van bavel, 1950) and expressed as mean weight diameter (MWD). Soil samples were passed through a 4.6mm sieve, sprayed with water as a pretreatment and oscillated in water for 5 min using a set of sieves with 2, 1, 0.5, and 0.25mm apertures. For runoff producing a rain fall simulator with intensity of 60±5 mm/h for 2 hours were used.

Statistical analysis
Data analysis were done using randomized complete design with four replications and comparison of means were done by duncan test using SPSS program at 0.05 probability levels.

Results and Discussion
Some physical and chemical soil properties of studied land uses are given in table 1. Also values of compare means are given in table 2.

Calcium Carbonate (CaCO3)
The results showed that this parameter in GP was the minimum (30.37%) and in DDF was the maximum (85.25%), that indicates 64.3% increasing compared with GP(table2). This can be due to inappropriate management practices, including tillage or severe soil erosion that lead to underlying soil that contains more $CaCO_3$ become to the surface.

Soil Organic Matter (SOM)
The results showed that this parameter in GP was the maximum (2.66%) and in DDF was the minimum (0.945) that indicates 66.6% decreasing compared with GP(table 2). The results indicated that land use change from pasture to dry land farming, degraded the soil and reduced SOM content. Khademi et al. (2006) also compared some indicators of soil quality in different land management practices of Boroojen area in Iran. They concluded that dry land farming and released pastures has caused a significant decrease in the amount of SOM rather than conservational pastures; because in conservational pastures, biomass production is more than the rate of respiration, which causes accumulation of carbon in biomass and eventually in soil. Chuluun and Ojima (2002) and Ross (1993) also have achieved similar results. In dry land farming, tillage accelerates the decomposition rate of SOM and increases soil erosion and consequently wastes SOM of soil. This is in accordance with the results of Mc Dowell and Sharpley (2003), Amsalu et al. (2007) and Akinola (1981) about the effect of tillage and management operations as well as the results of Ronggui and Tiessen (2002) about the effect of erosion on SOM reduction. The other reason for significant decrease in the amount of SOM in this land use type can be related to decrease in returning plant residues to

the soil compared with pasture lands. Hajabbasi et al.(2007), reported that in weak and abandoned dry land farming, the returning SOM to the soil decreased, thus land use change causes SOM to reduction.

Cation Exchange Capacity (CEC)

The results showed that this parameter in GP was the maximum (27.26 Cmol+/kg) and in DDF was the least (16.74 Cmol+/kg) that indicates 38.8% reduction compared with GP(table 2). It can be due to essence of more SOM than other land uses in GP. The amount of CEC in these four land uses is related to the amount of SOM in soil. So, it can be said that changing land use from pasture to dry land farming has reduced CEC. Sanchez- Maranon et al. (2002) reported that reducing CEC during land use change from Mediterranean pasture to dry land farming was 50%.

Table 1. Some soil chemical and physical properties in studied land uses: pasture with good vegetation cover (GP); pasture with medium vegetation cover (MP); abandoned dry land farming (ADF); degraded dry land farming (DDF).

Land use	pH	EC(ds/m)	clay(%)	silt(%)	sand(%)
GP	8	0 .54	31	62	7
MP	7 .6	0 .54	34	64	5
ADF	7 .6	0 .42	32	63	6
DDF	7 .7	0 .41	29	62	9

Table 2. Comparison means of some physical, chemical and biological soil quality indices.

Land use	$CaCO_3$	SOM	CEC	TN	AP	AK	MWD	MR
	(%)	(%)	($Cmol^+$/kg)	(%)	(mg/kg)	(mg/kg)	(mm)	(mg CO_2/day/kg)
GP	30 .37^{d*}	2 .66^{a}	27 .26^{a}	0 .177^{a}	56 .65^{a}	623.21^{a}	0.33^{a}	0.11^{a}
MP	37 .37^{c}	1 .27^{b}	23 .45^{b}	0 .106^{b}	57 .97^{a}	596 .12^{a}	0.19^{b}	0.04^{b}
ADF	47 .12^{b}	1 .26^{b}	23 .32^{b}	0 .118^{b}	54 .05^{a}	525.07^{a}	0.16^{b}	0.03^{bc}
DDF	85 .25^{a}	0 .94^{c}	16 .74^{c}	0 .076^{b}	66 .64^{a}	187.15^{b}	0.32^{a}	0. 02^{c}

. Values in each column with different letters indicate significant differences at *p*□ *0.05*; **GP,** pasture with good vegetation cover; **MP,** pasture with medium vegetation cover; **ADF,** abandoned dry land farming; **DDF,** degraded dry land farming; **$CaCO_3$,** calcium carbonate; **SOM,** soil organic matter; **CEC,** cation exchange capacity; **TN,** total nitrogen; **AP,** available phosphorus; **AK,** available potassium; **MWD,** and mean weight diameter; **MR,** microbial respiration.

Total Nitrogen (TN)

The results showed that this parameter in GP was the maximum (0.177%) (table 2). In DDF intensive erosion occurred due to land use change and maybe it is the main reason for this reduction. Soil surface disturbing, destroies natural conditions of soil surface, causes negative impacts on soil structure and infiltration rate, increases runoff and losses the large amount of nitrogen from soil surface. Another reason for nitrogen reduction in dry land farming is the removing of natural vegetation. Natural vegetation in the pastures with good cover, and returning their residues to the soil is the reason of existence more SOM in soil. The most SOM can increase the amount of NT. Wang et al.(2009) studied NT changes under different land uses in China and the results showed a strong relationship between total nitrogen and total soil organic carbon. Also SOM prevents soil erosion and losing nitrogen with sediment. Removing vegetation cover and soil surface disturbing by land use change affect soil temperature and soil moisture and therefore accelerate biological decomposition of SOM, increasing nitrogen mineralization and ultimately reducing TN in dry land farming. Unger(1997) reported the deterioration of soil fertility under cropping and concluded that the soils under various types of agricultural land uses contained less organic matter content, total nitrogen, exchangeable bases and cation exchange capacity(CEC) than similar soils under natural vegetation.

Available Phosphorous (AP)

The results showed that land use change did not significantly affect AP (table2). In pastures, vegetation cover and their returning to the soil will increase SOM and ultimately AP in soil. In dry land farming, cereals vegetations, uptake phosphorus from soil and then because of crop harvesting phosphorus returning to the soil not be done; but due to phosphorous fertilization during cultivation years, the concentration of this parameter increases in these land uses and ultimately they do not show any significant differences with pasture lands in AP. Hajabbasi et al.(2002) in their investigations also indicated no significant differences between undisturbed pasture and abundant dry land farming about available phosphorus in Boroojen soils.

Available Potassium (AK)

The results showed that this parameter in DDF was the minimum (187.15 mg/kg) that indicates 70% reduction compared with GP (table 2). The results indicated that land use change from pasture to dry land farming destroyed the soil and caused AK loss. High AK levels in pasture lands maybe due to increase of weathering in minerals containing potassium. In dry land farming there are similar conditions, but leaching and lessivage of this element to the lower layers lead to potassium loss. Also increasing AK in soil surface pasture lands maybe due to high ability of pasture plants to absorb potassium from underlying layers of soil and release it to the soil surface layer by plant residues. Kayser and Isselstein (2005) reported that continued nutrient export without K supply will lead to depletion in the soil that, depending on K storage, may take from 3 to10 years.

Aggregate stability

Results showed that MWD in GP and DDF land uses were significantly the most (table2). The reason for this in GP can be high levels of SOM and in DDF can be attributed to the highly amount of CaCO3 in soil. Boix-Fayos et al.(2001) reported that in Mediterranean soils, Water stability of the macroaggregates depended on the organic matter. They also indicated that carbonate content was strongly correlated with aggregate stability. Dorioz et al.(1993), explained that strong rooting and extracellular polysaccharide production of pastures are especially effective in gluing soil particles together at the micro-aggregate 5–200 mm.scale, although packing effects may also influence macro-aggregation up to 1000 mm.

Yadav and Girdhar(1981) and Shainberg et al.(1981) also realized the positive impact of CaCO3 in increasing MWD of calcareous soils. CaCO3 lead to gluing soil particles to gether and hence MWD will increase.

Microbial Respiration (MR)

The results showed that this parameter in GP was the maximum (0.11 mg CO2/day/kg) and in DDF was the least (0.02 mg CO2 /day/kg) with 81.8% reduction compared with GP(table2). MR means carbon dioxide production or oxygen consumption as a result of microorganisms metabolism such as bacteria and fungi. Therefore the difference in proportion of MR is a result of being differences in microbial activity and it seems that the difference in values is related to SOM changes. In the other word, more biomass production and consequently more accumulation of organic matter in soil affect the soil microbial populations and hence MR will increase in soil. Dube et al.(2009) in an study reported that soil microbial respiration was also correlated positively with microbial biomass C and SOC. In an other study Mallik and Hu(1997) reported that soil organic matter is strongly related to soil microbial respiration and is one of the important factors controlling it. The different land uses affect the formation of organic matter, SOC and microbial biomass C, which in turn will affect soil microbial respiration.

Surface runoff, Sediment generation and Turbidity

During 2 hours of experiment, surface runoff, sediment generation and turbidity increased 90.3, 94.5 and 58.2 percent respectively from pasture with good vegetation cover to dry land farming and accordingly erosion increased (table3).

Table 3. Land use effect on surface runoff, sediment generation and turbidity during 2 hours of experiment.

Land use	surface runoff(ml)	sediment(mg)	turbidity(mg/L)
GP	46.65 [a*]	511.6 [a]	16.25 [a]
MP	4.53 [b]	28.2 [a]	6.8 [b]
DF	37.18 [c]	225.2 [c]	7.44 [c]

* Values in each column with different letters indicate significant differences at p> 0.05; GP, pasture with good vegetation cover; MP, pasture with medium vegetation cover; DF, dry land farming

The results of this research showed the effects of different management systems on agricultural and natural ecosystems. In a very short time, pasture land use changes lead to significant changes in soil quality in this region.
The overall result is that the use of lands and resources should be adjust with all the phenomena and laws that protect nature and their survival. Otherwise, although adverse effects of ignoring such laws and phenomena may not be seen in the short-term but in the long term, productivity of natural resources for human will be lost and nasty consequences are inevitable.

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Effects on soils of the restoration actions to combat desertification. First results of the PRACTICE project in Pula (Sardinia, Italy) and Ouled Dlim (Morocco)

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Abstract

Land Degradation and Desertification affect much of the world's drylands, resulting in a significant loss of biological and economic productivity. However, the evaluation of the actions to combat desertification remains limited. The PRACTICE EC-FP7 project develops integrated participatory evaluation protocols to assess the impact of restoration practices on the provision of ecosystem good and services, and on human well-being, in drylands.
Two study sites were considered: the Pula reforestation area (*Pinus communis – Pinus halepensis*) in Sardinia, Italy, and the Ouled Dlim fodder shrub plantations (*Atriplex nummularia*) in Morocco. The LFA Landscape Function Analysis (LFA) was taken as a reference method to study the effects of restoration actions on the soils and ecosystems. It includes vegetation cover pattern and soil surface indicators to be estimated along linear transects, and related to infiltration and nutrient cycling. Soils were also sampled by horizon, and analysed for SOC, pH, N, and other emerging properties, as appropriate with reference to the two different local contexts.
In each study area, representative plots were selected in restoration sites, as well as in "non-intervention", reference sites, to perform a comparative analysis. The first results show that (i) restoration actions impact in different ways (positive and negative) the provision of ecosystems goods and services; (ii) the overall impact is in some cases controversial, also in terms of social perception; and that (iii) more than an univocal assessment of their effectiveness, a multi-criteria analysis must be performed to best understand the overall effects of restoration actions.

Keywords: integrated protocols; ecosystem good and services; soil functions; landscape functions.

Study of Drought Stress Treatments on Agronomic Traits of Rapeseed Varieties Winter (*Brassica napus* L.)

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Abstract

Canola (*Brassica napus L.*) has recently been introduced to Iran hoping to overcome oil deficiency. Little, if any, is known about agricultural practices to maximize canola oil production in Iran. Drought and opportune water use is too important for water saving and high yield product, In order to investigate of drought stress on agronomic traits of winter canola experiment was carried out in 2005-06 crop season. Using two treatments and three replicates, in which irrigation remained as the main factor in seven levels and the two secondary factors consisting of Zarfam & Opera varieties. The results showed that the effect of variety on the seed yield, seed-oil yield, seed-oil ($P<0.01$) and 1000- seed weight ($P<0.05$) was significant ($P<0.05$). Interaction between irrigation and cultivars were determined in comparison with the highest grain yield in the normal water conditions Zarfam Variety, the average is 4800 kg\ha among the studied parameters, the correlation between the seed-oil yield and seed-oil percent was found positive and significant ($P<0.01$) compared to the number of seed in forming pods and the maximum correlation was found between seed yield and oil yield ($r = 0.99$).
Key words: Drought stress, Rapeseed, Varieties , Yield and yield component.

Introduction

It is apparent that water stress has no considerable effect on grain quality but in flowering time cause for decrease in grain oil contents (Wilcox and Frankenberyer, 1987). One third of the world lands are classified as Arid and Semiarid Region and the remains are faced with water seasonal or local fluctuations (Beweley and Krochko.,1982). Aridity is the most common environmental stress and approximately includes 25% of the world lands (Christianse, 1982). Among the most important criteria for genotypes assessment to environmental conditions is study of respective effect of genotype and resistant study of grain operation through non-considerable changes in different environmental conditions. The fact that water stress effects on growth and yield are genotype-dependent is well known (Bannayan et al., 2008). Identification of the critical irrigation timing and scheduling of irrigation, based on a time and accuracy to the crop, is the key for conserving water and improving irrigation performance and sustainability of irrigated agriculture (Ngouajio et al ., 2007). In arid and semi-arid environments, both efficient use of available water and a higher yield and quality of safflower are in -demand (Lovelli et al., 2007; Dordas & Sioulas., 2008; Koutroubas et al., 2008).

Canola is sensitive to drought in time of germination and pod grows. The case being most important when sufficient water is available for commencement of germination and new planted seedling faced within -sufficiency water. Irrigation performance after 50 mm evaporation of Class A in Canola is produce the most grain operation and with increase irrigation period to 100 and 150 mm evaporation of class A, grain operation show meaningful decrease (Shirani-e-Rad., 2005). After Irrigation with 50 mm evaporation in control Class A in Canola, the most production of grain operation is attain and with increase of irrigation to 80 mm evaporation of Class A, grain operation is not receive meaningful decrease but in irrigation of 110 mm of class A; shown meaningful decrease of grain operation regarding control sample (Shirani-e-Rad ,2005). Whereas most part of consumable oil of the company are import from foreign countries, also due to limitations of water resources, the necessity of planting oil seeds have an important features. The aims of this research were to study the effects of late season drought stress on seed and oil yields and their components, and to evaluate their relationships among autumn rapeseed cultivars.

Materials and Methods

For finding of resistance to drought stress two varieties of autumnal rapeseed and survey of component of their function in conditions of treatment for examination drought stress and regular irrigation (control group), examination in case of split plot in form of complete basis design block in three repetitions that which the irrigation was the main factor in seven levels: consist of regular irrigation (control group), cutting irrigation in stage of jointing, cutting irrigation in stage of flowering, cutting irrigation in stage of forming pods, cutting irrigation in stage of jointing and flowering, cutting irrigation in stage of jointing and forming pods, and cutting irrigation in stage of flowering and Forming pods and also the accessory factor in two levels consist of Zarfam & Opera varieties. The experiment was carried out at the Seed and Plant Improvement Institute (35°59΄N, 50°75΄E, and altitude of 151m above the sea level), in Karaj, Iran during 2005-06. This region has a semi-arid climate (230mm annual rainfall).

In this survey all the stages of plant's phonology and various attributes such as length of the bush, number of the secondary branches in the bush, the sickness of the stem, the length of pod's main stem, secondary branch, the length of the pod, the number of the pod in the main stem and the secondary stem, number of the pod in the bush, the number of seed in the pod in main stem and secondary stem, the number of the seed in the pod, the weight of the thousand of seeds, function of the seed, biologic function of harvest's coefficient and the percentage of oil of the seed and the function of the seed's oil were measured. The experiment was organized in a randomized complete block design, with split plot arrangement, employing three replications. Data matching statistical models split plot design in randomized complete block design was simple variance analysis and comparison of means using multiple range Duncan test 5% level was performed.

Table 1. Irrigation stage and amount of irrigation (m^3)

Irrigation and stress stage	Irrigation phase	Irrigation amount
regular irrigation	8	5120
cutting irrigation in stage of jointing	7	4480
cutting irrigation in stage of flowering	7	4480
cutting irrigation in stage of Forming pods	7	4480
Cut. Ir. in stage of jointing and flowering	6	3840
Cut. Ir. in stage of jointing and Forming pods	6	3840
Cut. Ir. in stage of flowering and Forming pods	6	3840

Results and Discussion

Variance on the results of this experience was the variety of traits such as grain yield, grain oil yield, grain oil percent ($P \leq 0.01$) and 1000-seed weight ($P \leq 0.05$) were significantly. The interaction between irrigation and cultivars on the adjective has a significant effect on the number of seeds per pod. The results of this study showed that, is significant due to a variety($P<0.01$) of grain yield. Interaction between irrigation and cultivars were determined in comparison with the highest grain yield In the normal water conditions Zarfam variety, the average is 4800 kg \ha. and the lowest grain yield in the water phase (7) In the field condition, Water stress of the Opera variety was found around 2100 kg\ha (table 2).Adverse effect of water stress can affect the performance of canola, but these effects depend on genotype, stage of plant development and adaptation to drought (if previously exposed land is located) (Azizi et al., 2000). Khoshnazar and et al (2000), Reddy and Rudy (1998) were observed between the different variety of *Brassica* significant difference in grain yield. Puma (1999) stated, one advantage among canola ability to absorb water from the depths of the earth and need to be rain in dry areas (Poma et al.,1999). Simple interaction effects of irrigation and irrigation and variety was not significant on 1000-seed weight. While was significant ($P<0.05$) the simple effects of variety. Interaction between irrigation and cultivars was in mean in condition of drought stress, the highest 1000-seed weight as for Zarfam Variety (4 gr) has been by cutting at the water in stage of flowering and jointing and the lowest value of this attribute to the variety Opera has been in condition stress in stage flowering and jointing (table 3). Sadaghat (2003), In the physiological study of drought tolerance in canola, said, under drought conditions, is not significant differences in 1000- seed weight (Sadaghat et al.,2003). It seems that in this study, the low number of pods per plant water stress, keep their weight has remained seed pods . Analysis of variance of seed oil was determined the variety of effect were significantly ($P<0.01$) of these traits (Table 2) Also in mean comparison of effect between Variety and irrigation in condition common irrigation was the highest oil percent for Zarfam variety by 40.5% and in condition drought stress, obtained most of the oil percent Zarfam variety (42.5 %) in condition water cutting in stage flowering and jointing (Table 2). Jensen (1996), showed that drought stress in canola, only one of the experiments the soil was sandy cause 3.3 % reduction in the amount of oil seeds and significant effects other tests showed (Jensen et al.,1996). The number of seeds per pod is an important trait that in canola yield is a very important role. Analysis of variance showed that the number of seeds per pod, which was a significant ($P<0.05$) the property interaction between varieties and irrigation. Comparison of means in the interaction between irrigation and varieties under drought stress conditions maximum number of seeds per pod is varieties to the opera with an average 20.6. This value is obtained with cutting irrigation in stage jointing (Table 2). Niknam and Tarner (2003) stated that drought stress during pollination and grain filling in the canola crop will reduce the number of seeds per pod (Niknam and Turner .,2003). In the present study was that the number of seeds per pod was low due to drought stress(Opera), which results with the results of researches such, (Halshem et al .,1998 ; Niknam and Turner.,2033; Poma et al.,1999; Sana et al.,2003) all of which reduce the number of seeds per pod of stress reported is consistent. A simple effect variety was significant($P<0.01$) of oil seed yield. Comparison of means in the interaction between irrigation and varieties the maximum of oil yield, averaging 1945 kg/ha achieved Zarfam variety. And maximum oil yield in drought conditions, the variety Zarfam stage (2) was allocated to drought stress , also during flowering and pod feeding had a sharp reduction in oil yield this could be due to water shortage at this stage is of plant growth (table 2). The results of this study is in accordance with the findings of other researchers (Sadaqat et al.,2003; Poma et al.,1999; Pritchard.,1999 ; Jensen et al .,1996).

Table 2. Mean comparison the interaction of irrigation and variety effect on some traits of rapeseed

Irrigation	Grain yield		1000- seed weight		Oil Content		No.of grain in Forming pods		Oil yield	
	Varity Opera	Varity Zarfam	Varity Opera	Varity Zarfam	Varity Opera	Varity Zarfam	Varity Opera	Varity Zarfam	Varity Opera	Varity Zarfam
regular irrigation	3996 abcd	4800 a	3.82 ab	3.77 abc	39.49 cd	40.57 bcd	19.5 c	16.2 abc	1574 abcd	1945 ab
cutting irrigation in stage of jointing	2971 bcde	3758 abcd	3.77 abc	3.8 abc	39.63 bcd	40.5 bcd	20.6 a	15.3 c	1177 cde	1521 bcde
cutting irrigation in stage of flowering	2167 e	3108 abc	3.61 bc	3.84 ab	40.5 bcd	41.49 ab	13.6 c	17.6 abc	879.5 e	1289 abcd
cutting irrigation in stage of Forming pods	2438 cde	3204 abcd	3.69 abc	3.78 abc	39.19 d	41.26 abc	15.3 abc	13.3 abc	955.4 cde	1321 abc
Cut. Ir. in stage of jointing and flowering	2321 abc	2850 a	3.45 c	4 a	39.85 bcd	42.52 a	14 bc	18.3 abc	924 abc	1211 a
Cut. Ir. in stage of jointing and Forming pods	2805 abcde	2625 de	3.66 abc	3.83 ab	38.75 bcd	41.23 abc	15 abc	19.6 ab	1085 bcde	1080 de
Cut. Ir. in stage of flowering and Forming pods	2100 abcd	2452 ab	3.84 ab	3.92 ab	40.32 bcd	42.56 a	15 abc	16.3 abc	846 abcd	1043 ab

Means in each column having similar leter (S) , are not significantly different at the 5% leve (DMR-Test)

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Effect of Planting Density on the Agronomic Traits of Rapeseed Cultivars (*Brassica napus* L.)

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Abstract

Rapeseed and canola are closely related members of the mustard family (Brassicaceae) that are both grown as oilseed crops. to determine the effects of row spacing on yield components of three cultivars of Winter canola and planting them in the test treatments and variety**,** factorial experiment in randomized complete block design in three replicates in which the planting distance in 3 levels: 30, 40 and 50 cm in 3 levels and three varieties, including new lines (crossed two varieties of H19, goliath), Zarfam and Pahnab-e-joybar(Local varieties). This experiment was carried out in 2010-11 crop season. the results showed that simple effect of varieties has significant on the number of branches in plants($P<0.05$), number of pods per branch, number of pods on main stem and oil content ($P<0.01$). The effect of planting distance has a significant effect on the number of branches and pods on main stem ($P<0.01$). In the mean interaction between varieties and sowing was found that the highest percentage of oil in this study Zarfam varieties with an average 41.8 % and 30 cm row spacing.
Keywords: Rapeseed , Row spacing, Seed oil percent, variety

Introduction

Canola is an important oil crop growing in many part of the world. Canola in Iran is mostly cultivated as a winter annual for oil production and rarely livestock feed. If planted in spring, they can be grown as summer crop but the seed yield would be decreased due to short growing season and lack of enough water at the end of growing season, thus, winter cropping is preferred. In oilseed rape, row spacing or plant density vary considerably worldwide, depending on the environment, production system and cultivar. Previous studies have shown that plant density is an important factor affecting rapeseed yield. Plant density in rapeseed governs the components of yield, and thus the yield of individual plants. A uniform distribution of plants per unit area is a prerequisite for yield stability (Diepenbrock , 2000).

Al Barzinjy et al (1999) investigated the effects of different plant densities ranging from 20 to 130 plants/m2 in rapeseed. They concluded that pods per plant, seed weights and dry matter per plant decreased as plant density increased. Leach et al (1999) also reported that plants grown at high density had fewer pod-bearing branches per plant but produced more branches and that with an increase in density 1000-seed weight increased. The same researchers also observed that there was no effect of density on seed oil content. Rapeseed is sometimes grown in rows with spacing wide enough to allow for mechanical cultivation. In most areas where herbicides are used, the crop is either broadcast seeded or planted in drill rows spaced 15–20 cm apart (Lewis and Knight , 1987). Rapeseed has generally slight or inconsistent seed yield responses to various row spacing's. Therefore, optimum densities for each crop and each environment should be determined by local research. However, there are no published research data on the plant density or row spacing response of rapeseed in the region of Chaloos, Iran of North. The objective of this study was to evaluate the effects of different spacing's between or within rows on the agronomic characteristics of three genotypes of *Brassica napus* new lines (crossed two varieties of H19, goliath), Zarfam and were Pahnab-e-joybar (Local varieties).

Material and Methods

In this field experiment was conducted in 2010-2011 in chaloos branch , Islamic Azad University Research Farm according to the weather , the weather hot and humid regions of the and with mild winters and hot summers and temperate and humid tropical areas is public.

To determine the effects of row spacing on yield components of three cultivars of rapeseed fall and planting them in the test treatments and variety**,** Factorial experiment in randomized complete block design in three replicates in which the planting distance in 3 levels: 30, 40 and 50 cm in 3 levels and varieties, including new lines (crossed two varieties of H19, goliath), Zarfam and were Pahnab-e-joybar (Local varieties). At the end of the growing season, to determine the agronomic characteristics of each experimental plot, 10 plants were randomly selected and their characteristics were measured. According to statistical data model factorial design in randomized complete block analysis of variance was simple and mean comparison using Duncan's multiple range test was performed. Comparison of data for analysis and statistical software MSTAT-C – SPSS and Excel software was used for drawing diagrams.

Results and Discussion

The number of branches per plant

Simple effects of planting distance and number of branches per plant in the level of five percent and one percent is in the critical region**,** The interaction of cultivar and planting distance was not significant on the branches of the rapeseed plant (Table 1). Effect of planting distance on average than the maximum number of branches per plant, branches per plant Pahnab-e-joybar with mean 3.1 and the lowest number of branches per plant, number of new lines with mean 2.2 is the time difference has been significant analysis of variance (Table 1).

In the mean interaction between cultivars and planting was found that the highest number of branches per plant of canola in this study , the new line is 50 cm row spacing. The interaction is also shown that with increasing density (planting distance of 30 cm) is reduced of the number of branches per plant .

The number of pods on lateral branches

Simple effects of planting distance and number of pods on lateral branches is probably a significant percentage the interaction of cultivar and planting distance has no significant effect on the lateral branches and pods per plant of canola. In the mean interaction between cultivars and planting was found that the highest number of pods on lateral branches in this study**,** Zarfam varieties with an average of 32.4 and the planting distance of 50 cm and a new line(crossed two varieties of H19, goliath) with the average minimum is about 19.1 and the planting distance of 30 cm(Table1)**.** Johnson and Hanson (2003), reported a higher performance culture within narrower than wider rows , the plant is uniformly distributed, The proper distribution of solar radiation in vegetation and reduce is competition within species and this will increase the number of pods per plant.

The number of pods on main stem

Simple effects were significant numbers of pods on main stem($P<0.01$). The effect of planting distance and the interaction between cultivars and planting on the main stem, number of pods per plant canola is not significant(Table 1). In the mean interaction between cultivars and planting was the largest bag in the main stem in the present study , a new line with the average 39.4 and planting distance of 30 cm and the lowest trait varieties Pahnab-e-joybar with an average 24.5 and the planting distance is 30 cm.

Concentration of seed oil

A simple analysis of variance showed that Simple varieties of the seed oil was significantly ($P<0.01$). The comparison showed that varieties mean varieties Zarfam 40.9 of the most and new line (crossed two varieties of H19, goliath) with a mean of 27.9 percent allocated to the lowest seed oil. as noted above ,this difference was significant among the varieties ($P<0.01$)(Table 1). In the mean interaction between varieties and sowing was found that the highest percentage of oil in this study Zarfam varieties with an average 41.8 % and 30 cm row spacing. and the lowest value of this attribute to a new line(crossed two varieties of H19, goliath) is obtained with the average 26.8 % and planting distance 30 cm. In this study, the density has no significant effect on the varieties the varieties of varieties Zarfam won the highest percentage of oil, In this study has not been seen the relationship between density and seed oil .

Table 1. Mean Comparison the effect of cultivars and planting row spacing on some canola agronomic traits.

Treatment	The number of branches per plant	The number of pods on lateral branches	The number of pods on main stem	Concentration of seed oil
Variety(A)				
V_1=New line	2.8a	22.2b	37.6a	27.9c
V_2=Zarfam	2.3b	28.3a	36.6a	40.9a
V_3=Pahnab-e-joybar	2.8a	19.3c	27.5b	31.1b
Row Spacing(B)				
$R.S_1$=30 cm	2.2c	20.2c	33.4a	33.4a
$R.S_2$=40 cm	2.7b	23.2b	34.1a	32.7a
$R.S_3$=50 cm	3.1a	26.3a	34.2a	33.8a
Variety* Row Spacing(AB)				
V_1*$R.S_1$	2.2cd	19.1de	39.4a	26.8d
V_1*$R.S_2$	2.8abc	21.4de	34.9a	28.2cd
V_1*$R.S_3$	3.4a	26.1bc	38.6a	28.7cd
V_2*$R.S_1$	1.9d	23.5cd	36.4a	41.8a
V_2*$R.S_2$	2.4bcd	28.8ab	35.5a	39.5a
V_2*$R.S_3$	2.8ab	32.4a	38.1a	41.4a
V_3*$R.S_1$	2.5bc	17.9e	24.5b	31.7b
V_3*$R.S_2$	2.9ab	19.5de	32ab	30.3bc
V_3*$R.S_3$	3.1a	20.5de	26.1b	31.2b
Significant (M.S)				
A	*	**	**	**
B	**	**	NS	NS
A*B	NS	NS	NS	NS
CV%	11.43	10.31	12.36	4.17

Means with similar letter were not significant at the 5% probability level.
Levels of significant:* =P< %5, **= P<%1 and NS = not significant
New line:(crossed two varieties of H19, goliath) Pahnab-e-joybar:(Local varieties)

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The Treatment of Chlorophene-Contaminated Soil in Columns by Combined Application of Persulfate and Biosurfactant

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Abstract
Chlorophene is a halogenated phenolic compound widely used as an antibacterial agent in personal care, hospital and household cleaning products. Chlorophene has been listed under the group of emerging pollutants, which are defined as compounds that are suspected to have negative impacts on the environment, humans and wildlife. Chemical oxidation is an effective technology for degrading an extensive variety of hazardous compounds in soil. Such chemicals as persulfate are among the most recent ones successfully used for the soil decontamination. Combined application of a biosurfactant and a chemical oxidant could be another promising approach. In the present study, chlorophene-contaminated soil (1.32±0.11 g/kg) was persulfate-treated in soil-packed columns (40-cm long section of nominal 8.0 cm diameter). Effects of a biosurfactant addition and activation with either chelated iron (0.007g Fe2+/kg soil per day) or NaOH (10g/kg soil per day) on the persulfate oxidation process performance were investigated. While biosurfactant addition improved chlorophene removal by the persulfate treatment, the addition of chelated iron did not have a remarkable influence. The highest removal level (71%) of chlorophene was achieved with the base activated persulfate, but only in the upper part (3.5-cm) of the soil column. Dehydrogenase activity measurements indicated no substantial changes in the microbial activity during the treatment; in fact, even a slight increase was observed with the biosurfactant addition. The combined application of persulfate and biosurfactant at natural soil pH has prospects as a promising method for chlorophene-contaminated soil remediation.
Keywords: emerging pollutant, soil treatment, persulphate oxidation, biosurfactant, chelated iron

Introduction

Chlorophene (Fig. 1) belongs to the class of biocides, which has been utilized as ingredient in many commercial products (USEPA, 1995a). It has been recently listed as an emerging pollutant that requires ecological risk assessment (USEPA, 2011). Direct release of chlorophene into the environment via waste streams is expected due to its widespread use both as a disinfectant and a germicide (Davoren and Fogarty, 2005). Since chlorophene has gained attention only very recently, its concentrations in soil have not been reported yet. However, the high sludge accumulation potential (Wick et al., 2011) and the logK_{ow} of 3.6 suggest partitioning to soil. Due to the potential carcinogenicity and toxicity of this compound, investigation of chlorophene removal in soil is of interest.

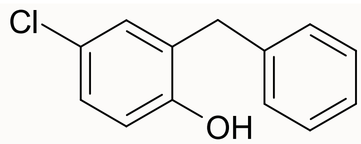

Fig. 1. Structure of chlorophene.

Chemical treatment technologies have proven to be effective for the destruction of a great variety of pollutants in soil. They can provide rapid and complete contaminant degradation at moderate costs (Stroo, 2010). Among various chemical techniques, the persulfate oxidation is a relatively novel process, which recently gained interest as a soil remediation technology. The treatment with persulfate is especially advantageous due to the higher oxidant stability over the other remedial chemicals, for example, hydrogen peroxide. Oxidation with persulfate involves either the direct reaction of the pollutants oxidation or the reaction with the highly reactive radicals (mainly persulfate radicals) that can be produced by applying different activation aids (Siegrist et al., 2011).

In this study, persulfate with and without the supplemental activator addition was utilized to treat chlorophene-contaminated soil in packed columns to simulate *in-situ* injection. The persulfate metal activation with chelated iron and base activation with NaOH was performed. The effect of the biosurfactant (BS) addition was also investigated. Biosurfactants can enhance the release of targeted compounds into the bulk solution and aid in their destruction during the chemical oxidation process (Goi et al., 2012). Dehydrogenase activity (DHA) in the soil samples was measured as a measure of the effect of the treatment on soil microbial activity.

Materials and Methods

The column experiments were conducted using a 40-cm long section of nominal 8.0 cm diameter PVC pipe. The top of each column was constructed from PVC fittings tapped to accommodate Teflon (1.6 mm id) capillary tubes. Columns were packed with 0.5 kg natural top (0-20 cm) soil that was oven-dried (30ºC, overnight), homogenized (30 mm sieve) at a density of 1.4 g/cm^3 and to a depth of 7.0 cm. Prior to packing, the soil was amended with chlorophene-acetone solution followed by homogenization and subsequent evaporation of acetone resulted in a final chlorophene concentration of 1.32±0.11 g/kg soil. Treatments were in duplicates.

Several characteristics of the soil are presented in Table 1. Soil characterization is described elsewhere (Goi et al., 2011). The soil pH was measured as described in the method of USEPA 9045C (1995b). Total iron and iron (II) analyses were carried out by the phenanthroline method spectrophotometrically at 492 nm (Merck, 1974). The soil texture was measured according to ISO 14688-1 (2002) using a laser scattering particle size distribution analyser (LA-950, Horiba).

Table 1. Several soil characteristics.

Parameter, unit	Value, mean±standard deviation
pH	6.96
Total extractable iron (mg/kg)	1900±500
Ferrous iron (mg/kg)	12.1±0.9
Exchangeable Fe(II) fraction (mg/kg)	2.0±0.3
Organic carbon (mg/kg)	460±30
Sand (%)	45.5
Silt (%)	52
Clay (%)	2.5

Each column was operated in an up-flow mode using a peristaltic pump to control the rate (0.5 mL/s) of inflow. The persulfate ($Na_2S_2O_8$ >99%, Riedel-de Haën) treatment of soil was performed by injecting 45 mL of persulfate and activator (NaOH or Fe^{2+}-EDTA) solution once a day during 5 or 10 days. Only double-distilled water was injected to a control column. The total volumes of the solution injected to the column were 285 and 510 mL during 5 and 10 d, respectively. The soil pH was not pre-adjusted. The BS was a rhamnolipid-alginate complex that was prepared by the biosynthesis of strain *Pseudomonas* sp. PS-17. BS solution at pH 7 was injected to the soil to a final load of 0.5 g BS/kg of soil. 72 h prior the addition of the chemicals. The 5 and 10 days doses of persulfate were 0.36 and 0.72 g/kg soil, respectively. Iron and NaOH concentrations were 0.007g Fe^{2+}/kg soil per day and 10g/kg soil per day, respectively. The respective weight ratios of $S_2O_8^{2-}/Fe^{2+}$ and Fe^{2+}/EDTA were 10 and 5.

After the treatment, the columns were allowed to drain for 24 h and the soils were dissected into top 3.5-cm and bottom 3.5-cm sections. Chlorophene in the soil and column effluent was extracted with n-hexane/acetone (1/1, v/v) and n-hexane, respectively. Analysis was carried out by GC-MS utilizing a Zebron capillary column ZB-5MS (30 m × 0.32 mm × 0.25 μm). Docosane (99%, Sigma-Aldrich) was used as the internal standard.

DHA was measured spectrophotometrically at 546 nm by triphenylformazan (TPF) formation (ISO/DIS 16072, 2002). Soil microbial respiration was measured according to the procedure presented by ISO/FDIS 23753-1 (2002). Residual persulphate in soil-column effluents was determined spectrophotometrically at 446 nm by *o*-dianisidine complex formation (Sof'ina et al. 2003).

Results and Discussion

As can be seen in Fig. 2, some chlorophene removal was achieved with persulfate addition only. This indicates possible ability of soil natural minerals or transition metals chelated by natural soil chelating agents, soil organic substances (organic acids, amino acids and hydroxamate siderophores) either applied or produced by plants or microorganisms, to activate persulfate oxidation of chlorophene at natural soil pH. The addition of BS improved the chlorophene removal in the top soil by 18%, while only 6.5% of the chlorophene removal improvement was observed in the bottom soil. The reduction in the removal of the contaminant with the soil depth was probably caused by rapid persulfate decomposition in the upper column part before being transported to the lower part of the column. The improvement in the chlorophene removal with the addition of BS can be explained by a possible enhanced desorption of the hydrophobic contaminant to the aqueous phase that increases its availability to the oxidizing agents.

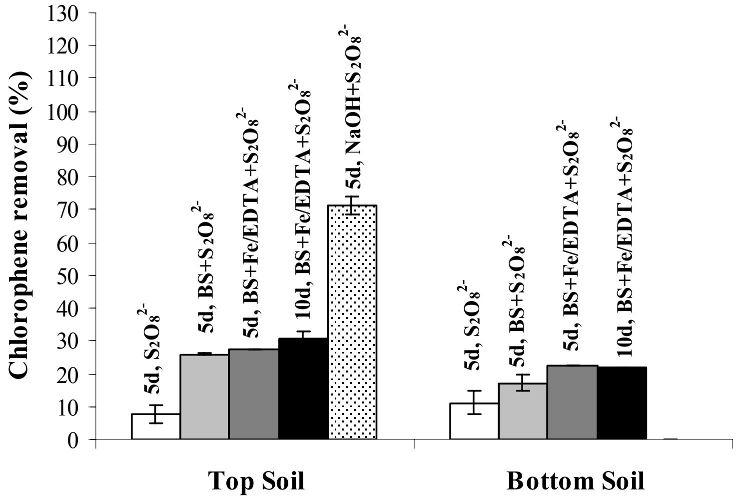

Fig. 2. Chlorophene removal in soil applying different treatment systems with persulfate.

Upon activation of the persulfate with the chelated iron, the overall removal efficacy was not substantially improved resulting in only 5% chlorophene removal increase in the bottom soil with no any changes in the top soil (Fig. 2). The average Fe(II) and total iron concentrations in the effluents were less than 3% of the initial load. The prolongation of the treatment time to 10 d in the treatment system with the chelated iron only slightly (3%) improved the chlorophene degradation in the top soil. No chlorophene removal was observed in the control experiments. The persulfate consumption, which was estimated as the non-leached amount in the column leachates was in the range of 86-96% for all the experiments (Table 2).

Table 2. Persulfate concentrations in the combined effluent from each column and the assumed proportion of persulfate consumed (standard deviations were in the range of 0-0.1).

Treatment system	Residual $S_2O_8^{2-}$, mg/L	$S_2O_8^{2-}$ consumed, % of initial
$S_2O_8^{2-}$, 5 d	198	91
BS+$S_2O_8^{2-}$, 5 d	297	86
BS+$S_2O_8^{2-}$+Fe^{2+}/EDTA, 5 d	83	96
BS+$S_2O_8^{2-}$+Fe^{2+}/EDTA, 10 d	140	91

Addition of NaOH substantially improved the chlorophene removal in the top soil due to persulfate activation (Fig. 2). However, no chlorophene degradation was observed in the lower part of the column. This can be explained by the reduction in the soil permeability achieved with the NaOH addition. Since, no leachate evolved from the NaOH activated soil columns, probably as a result of loss of hydraulic conductivity, it can be assumed that the persulfate did not reach the bottom soil layer.

As can be seen in Fig. 3, the persulfate treatments (without NaOH) did not change the soil pH, demonstrate that the soil buffer capacity was sufficient at the application doses used. Hence, these treatments exert no pH stress to the soil microbial community.

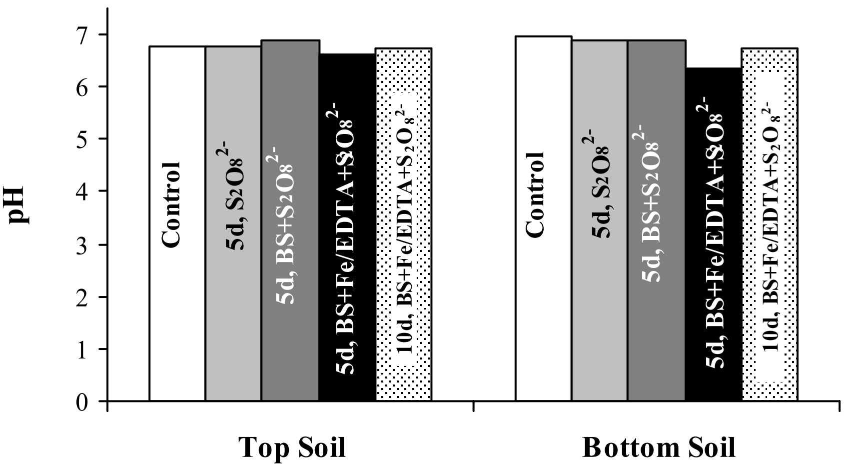

Fig. 3. Chlorophene removal in soil applying different treatment systems utilized persulfate.

The DHA slightly decreased during the treatment with persulfate only (Table 3). However, the addition of BS could slightly stimulate the enzymatic activity of endogenous soil microflora. The DHA of initial soil was 0.40 ± 0.03 μg TPF/h g of soil. The enzymatic activity decreased with column depth, indicating lower DHA values in the bottom soil. Extending the treatment time from 5 to 10 d reduced the DHA in the BS+$S_2O_8^{2-}$+Fe^{2+}/EDTA treatment system. This can be due to decreased activity due to EDTA addition, which has been also shown previously for EDTA concentrations of 1 g EDTA/kg DW soil as a result of low biodegradability of the compound (Epelde et al., 2008). Thus, the application of BS for the soil decontamination can be preferable over EDTA.

Table 3. DHA in the treated soil (standard deviations are obtained from duplicate experiments).

Treatment system	DHA, μg TPF/h g of soil	
	top soil	bottom soil
Control, 5 d	1.75±0.02	1.20±0.33
$S_2O_8^{2-}$, 5 d	1.60±0.33	1.01±0.04
BS+$S_2O_8^{2-}$, 5 d	1.87±0.03	1.63±0.02
BS+$S_2O_8^{2-}$+Fe^{2+}/EDTA, 5 d	1.73±0.37	1.33±0.04
BS+$S_2O_8^{2-}$+Fe^{2+}/EDTA, 10 d	1.23±0.12	0.96±0.02
$S_2O_8^{2-}$+NaOH, 5 d	1.69±0.60	-

-not measured

The oxygen consumption of the incubated soil samples was lowered with the application of persulfate (Fig. 4) compared to that observed in the untreated control. The application of persulfate with the chelated iron and BS resulted in similar oxygen consumption with the application of the persulfate only indicating a close metabolic activity of indigenous microbial populations in the soils. The combined application of BS and persulfate resulted in the highest microbial respiration values among others obtained after 28 d of incubation. These data are also consistent with the contaminant removal indices (Fig. 2).

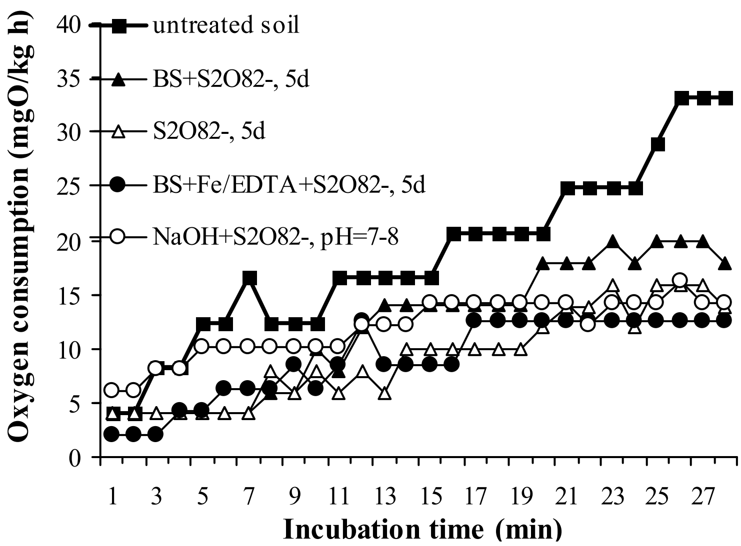

Fig. 4. Oxygen consumption in untreated and the treated soil.

Thus, the process integration achieved by joint application of BS and persulfate can be a promising option for soil decontamination resulting in the improved treatment efficacy.

Conclusion

While activation of persulfate with the chelated iron did not substantially improve the chlorophene removal over that achieved by the treatment with persulfate alone, the increased (71%) removal was achieved by base activation with NaOH, but only in the upper part of the column. However, the absence of chlorophene degradation in the bottom part of the column suggested the reduction in the treated soil permeability. Minimal effects on the soil pH and soil microbial activity as well as efficient oxidant transport in the columns with the substantial contaminant removal suggests that the combined application of BS and persulfate can be the more promising option among the others studied for chlorophene-contaminated soil treatment.

Acknowledgements

The financial support of the Estonian Ministry of Education and Research and the Estonian Science Foundation (Grant 7812) is gratefully acknowledged. PhD student Nalan Bilgin Öncü is grateful to the Archimedes Foundation and the European Social Fund for the participation in the Internationalization Program DoRa, activity 5 “Facilitating international research cooperation by supporting short-term research projects of visiting doctoral students in Estonia”.

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The influence of slope length on soil loss in skid trails in the north forest of Iran

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Abstract:
Surface runoff and soil loss on forest roads and skid trails are one of the serious concerns for forest managers. The objective of this study was to determine the influence of slope gradient and slope length on soil loss. We compared the data of experimental plots soil loss to assess the effect of slope length (between 25, 75 m) on soil loss. The investigation was carried out on 12 experimental plots. Total soil loss was determined after each duration of rainfall. This study was done in Nav 3, parcels 14 and 26, field plots. The results of this investigation indicated that the slope length effect is different for two slope classes. For both slope classes soil loss increased with increasing slope length but differences between two slope length on 10% moderate slope was non significant while this difference was significant among two slope lengths on 31% moderate slope. Furthermore, slope gradient affected the soil loss, too. Thus skid trails are an important source of erosion associated with forest activities. Therefore, using of forest management practices such as reducing skid trail gradient (approximately 10%), proper construction and post harvest treatments of skid trails are necessary for decreasing soil loss and subsequent problems of it.

Key word: Skid trail, Soil loss, Slope length, Slope gradient, Iran

1- Introduction
In steep train, roads and trails contribute most sediment loss per unit area within the catchments. The modification of hydrological pathways by roads and trails affects both surface erosion and landslide processes, but in different ways (Sidle et al., 2006). Increased rates of sediment delivery from forest roads can occur from poor road construction and maintenance (Forsyth et al., 2006). Erosion from forest roads is a major concern in forest management due to the capability to cause adverse environmental effects (Grace III, 2000). Exposure of forest soils, particularly from logging roads and skid trails are the main sources of sediment supply (Lai and Samsuddin, 1985). Managed forests are also recognized as a significant source of increased soil erosion and runoff fallowing logging. There are significant disturbed surfaces in managed forests, notably the extensive array of skid trails and roads networks, where soil loss is high (Croke and Nethery, 2006). Serious environmental concern has been expressed skidding operation on sensitive terrain. Skid trail network in particular are often criticized as being too dense and the source of soil erosion. They also have poor regeneration qualities and cause soil compaction and disturbance (Josoff and Majid, 1986). Logging operations have always been described as one of the major for altering the often near complicated hydrological processes (Lai and Samsuddin, 1985). Disturbances to forested watersheds, such as timber harvesting and road construction, can result in large sediment inputs into the downstream, rivers and waters and reduce water quality [Ide et al., 2009; Kahklen, 2001; Damin, 2003; Elliot, 2006; Prasad et al., 2005]. Soil erosion is influenced by rainfall distribution, soil characteristics, slope length and steepness, and management. The key to reducing the amount of sediment delivered to water ways is to identify the source of erosion. The best erosion mitigation can be achieved through careful planning, location, design, construction and maintenance of forest roads (Grace III, 2000). In general, the steeper the slope the more soil loss because of the increase in velocity of the runoff water [Gabriels, 1999; Fox and Brayan, 1999]. There are a few observations on the effects of forest slope, road segment length, soil texture, maintenance practices on road sediment production. Gabriels (1999) found a dependence of soil erosion on slope length under laboratory experiments. Moreover the slope length effect was most pronounced for the smallest aggregates. Luce and Black (1999) considered sediment production from forest roads in

western Oregon. The results of their study confirmed that increasing in both road length and gradient can lead to increasing erosion. Fox and Bryan (1999) by investigation of relationship between soil loss and slope gradient indicated that the erosion rate influence by the size of experimental plots and slope length. In this study we considered the influence of skid trail slope on soil loss. The objectives of this experiment were to investigate the influence of slope length on soil loss and to see the variations in soil loss amount by increasing slope gradient.

2- Materials and Methods

Study area is located on north of Iran, Guilan provience, Nav 3 district, parcel 14, 26 with 49.7 and 60.78 ha, respectively. Nav 3 district is situated between 39′ 30″ to 44′ 30″ north latitude and 37′ 20″ to 61′ 12″ east longitude. The height of study area at sea level starts from 500 m and continues till about 2100 m. The mean annual precipitation was 1038.7 mm at Hashtpar city metrological station, which is closet metrological station to our study area. Soil texture was clay loam. This research was performed in the autumn of 2009. The average slope on skid trails was 31% (parcel 26) and 10% (parcel 14).

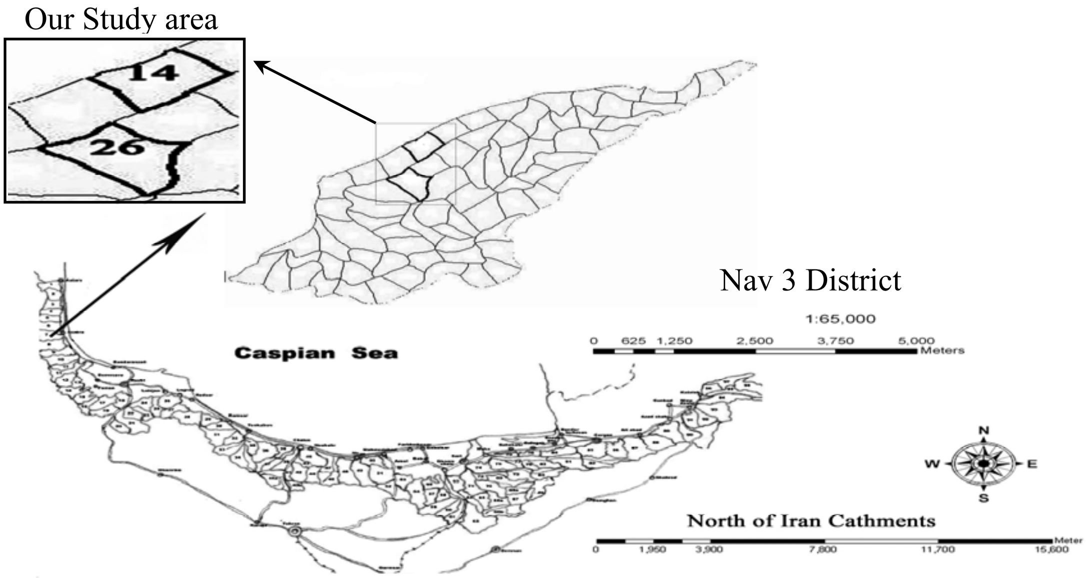

Figure 1. Study area

For considering the effect of slope length on soil loss, we created sediment traps along two skid trails in two general distances. The length of experimental plots was 25 m and 75 m and 3 m wide on each skid trail. For each slope class 3 replications (in total 12 plots, 6 blocks) were selected. Sampling procedure was randomized complete block method. The mean value of rainfall was the same in each duration on 2 skid trails. Table 1 lists the variables that were treated in the study area.

We placed a tank side of sediment trap (the end of plot) to collect the overland flow during rainfall (Fig 2). The sediment trap that was used in this study was earth berm that limited each plot. After 3 rainfall durations water samples for soil loss were collected after thoroughly mixing the runoff and sediment collected in them. The samples were taken to the laboratory, filtered and were dried at 105° C for 24 h, then weighted. The weight of sediment samples were converted into soil loss in gr/m^2. We compared soil loss of different plots (slope length) with each other (25 m with 75 m in each slope class) to measure the influence of length of experimental plots on soil loss in each slope class and then considered the effect of slope gradient on soil loss (soil loss of 10% experimental plots with soil loss of 31% experimental plots).

Soil loss data of skid trail segments and slopes were analyzed by statical package for the social science (Spss) for windows, version 13. Univariate analysis of variance was used to analyze the difference in amount soil loss among plots by the slope gradient. The length of plot treatments in each slope class was compared with each other, too.

Table1. Factors considered in experimental plots

variable	treatment
Soil type	Clay loam
Segment length	2 levels used: 25 , 75 m
Skid trails slope	10 , 31%
Skid trails width	3 m
Skid trail use	More than 15 passages on skidding duration
Time since construction	0 year
Skid trails vegetation cover	No vegetation cover

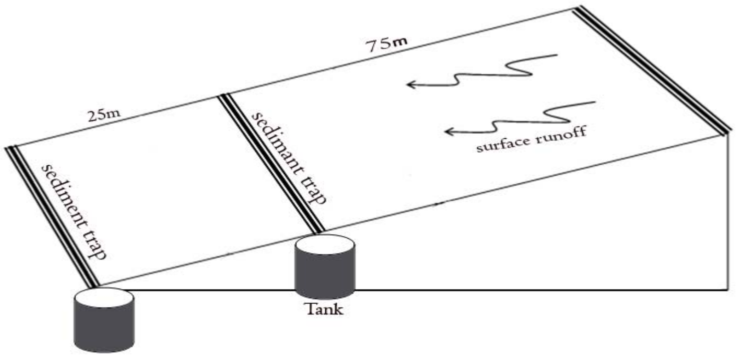

Figure 2: layout of experimental plots

3- Results

3-1- soil loss and slope length

In skid trail with 31% moderate slope (parcel 26) maximum soil loss mean occurred in 75 m slope length and minimum soil loss occurred in 25 m slope length. At parcel 14, skid trail with 10% moderate slope the maximum and minimum soil loss occurred in 75 and 25 m slope length, respectively. Therefore, the highest amount of soil loss mean was detected on 75 slope length in parcel 26 that was 17.2 ± 2.94 gr/m^2 and the lowest soil loss mean was detected on 25 slope length in parcel 14 that was 0.19 ± 0.04 gr/m^2. The results of soil loss on different slope length are shown in table 2.

Table 2. Results of soil loss on skid trails

Soil loss mean	slope length (m) 25	75
Parcel 26		
Mean	3.88a	17.2b
Standard deviation	2.46	8.84
Parcel 14		
Mean	0.19a	0/76a
Standard deviation	0.13	0.09

Within-a-row means followed by the different letter are not significantly different.

3-2- soil loss and slope gradient

Except slope length, slope gradient affected the soil loss amount in experimental plots, too. The ANOVA results of soil loss on different slope gradient are shown in table 3. It is clear from p values that gradient is the important variable in controlling soil loss amount. On the other hand, there were significant differences between soil loss of 2 slope class in each duration of rainfall (p=0).

Table 3. Analysis of variance (p value) of the effects of slope gradient and slope length on soil loss in duration of 3 rainfalls.

Source of variance	df	P value
Duration 1		
Slope gradient	1	0
Slope length	1	0
Duration 2		
Slope gradient	1	0
Slope length	1	0
Duration 3		
Slope gradient	1	0
Slope length	1	0

4- Discussion

Forest roads and skid trails have been identified as an important source of erosion associated with forest management activities. Skid trails on timber harvest unit cause to erosion because of the reduced infiltration and disturb organic layer (Anisur Rahman and Hiura, 2004). The results of this study showed that the differences between soil loss of two slope lengths (25 , 75 m) in skid trail with 31% moderate slope was significant while the differences between two slope lengths soil loss in skid trail with 10% moderate slope was non significant. Thus, slope length is positively related with soil loss and this relation is obvious in steepness slopes. The rates of soil loss increases as slope length increases [Luce and Black, 2001; Gabriels, 1999; Fox and Bryan, 1999; Anisur Rahman and Hiura, 2004; Luce and Black, 1999]. As previous studies mentioned when the slope gradient increase, surface runoff that flow on skid trail also increases and this cause to increasing soil loss. Moreover, the longer slope need more time for runoff infiltration so that amount and velocity of runoff per slope length increase and this lead to increasing soil loss. Furthermore, we considered the differences between soil loss in two slope classes in this study. The results showed that the differences in amount of soil loss among two classification of slope gradient were significant. Increasing in skid trail slope gradient can lead to increasing soil loss [Luce and Black, 2001; Luce and Black, 1999; Arnaez et al., 2004; Jordan Lopez et al., 2009]. A major influence of slope gradient on soil loss appears to be through the impacts of slope gradient on runoff velocity as slope length. Thus, we must use some practice to control runoff in skid trails. Runoff control cause to direct water from skid trail surface at a non erosive velocity by the aim of water control practices and if we don't use these practices, skid trails present greater hazards to water quality, fish habitats, etc [Grace III and Clinton, 2007]. Although, other factors such as mean daily rainfall, soil conductivity, soil erodibility [Anisur Rahman and Hiura, 2004; Nik and kasran, 1994; Erpul and Canga, 1999] are affective indexes to evaluate soil loss but we didn't consider the effects of rainfall characteristics, soil characteristics and rutting on soil loss in experimental plots of this study.

Hence, steep skid trails can cause considerable increasing in soil loss amount after rainfall spatially in first durations of skidding after its construction and soil loss may travel down slope the stream networks. This is a serious concern in last decades in forest area and we must use management practices to conservation skid trails and prevent subsequent environmental problems. Anyway, that is better we will consider skid trail condition immediately after skidding on different forest trains to evaluate the effects of other factors on runoff and soil loss rates.

This study provide only a limited understanding of relative differences of skid trail soil loss subjected to varying degrees and length of slopes. Ontheotherhand, we investigated the effect of slope on soil loss amount. The results showed that the soil loss amount from skid trails highly depends on slope length and slope gradient and such other factors. However, the effects of slope on soil loss were in good agreement with the results of previously studies. Identification of sediment sources and their delivery potential can assist in recognizing and evaluating best management practices. Using of BMps and streamside management zone guidelines are largely effective in decreasing soil loss amount and stream pollution. The results suggest that proper construction of skid trails (with fit slope) and proper post harvest treatments of skid trails are necessary for reducing the soil loss and prevents of entrancing sediment to streams. Underlying factors that increase erosion risk such as steep topography, soil characteristics and rainfall should be more considered in future studies. As a recommendation for reducing soil loss by skid trails is implementing soil loss control. Reducing the skid trail gradient by approximately 10% is necessary for decreasing soil loss. A possible action is the design of proper skid trails drainage (e.g., with the construction of sediment traps).

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Determination of land use problems in two protected areas (Ayder and Kafkasör) in northeast of Turkey

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Abstract
The aim of this study is to determine land use problems in two protected areas (Ayder and Kafkasör) in northeast of Turkey. For this purpose, field survey was done in different seasons in the year of 2008 and 2011 and evaluated the informations obtained. In addition, visitors were interviewed face to face method and obtained informations combined with field survey results. Research results are summarized as follow: There is no land use plan in both Ayder and Kafkasör protected areas. Especially in special days (such as: religious and national holidays) the number and density of visitors are over the land carrying capacity. There is no acceptable car parking area in both Ayder and Kafkasör protected areas. Visitors can access in protected areas without any restriction. Facilities (Such as: picnic areas, kids garden, water, seating and resting places, toilets, etc) are insufficient in both Ayder and Kafkasör protected areas. Garbage and domestic based pollutants cause a serious environmental problems. Vegetation and landscape view partially altered in both Ayder and Kafkasör protected areas. Excessive and unplanned construction has been continued increasingly in Ayder protected area. The majority of visitors stated that unplanned construction is a serious environmental problem in Ayder and this problem reduces the quality of Ayder Natural Park.
Keywords: Protected areas, land use problems, visitor density, Ayder and Kafkasör

Site Description and History

Ayder Location:

The study area is located in Ayder, a site close to Çamlıhemşin town, in the northeastern of Turkey, Rize (lat. 40°57' 14"- 40°57' 30" N, and longt. 41°06'15"-41°06'24" E, altd. 1250 m above sea level) (Figure 1).

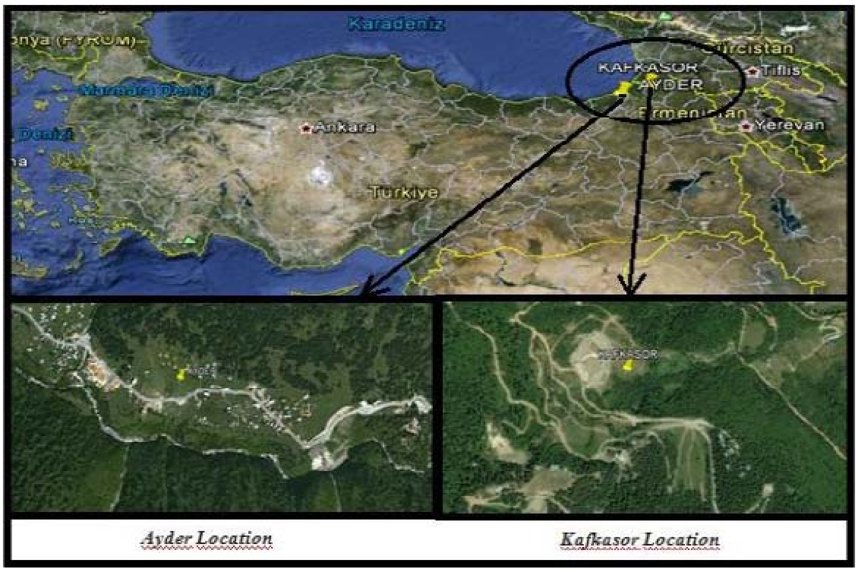

Figure.1: Study area in Ayder and Kafkasör

Since there was no meteorological station in the study area, the nearest meteorological stations in Pazar and Çamlıhemşin were taken into account. The climate is humid, with an annual average rainfall of 1350 mm with a minimum in spring (250 mm), and maximum in autumn (680 mm) and the mean annual temperature is 8.2 °C in the meteorological station, which is located 7 km apart at a similar altitude (Anonymous 1981, 2005; Yüksek, 2009; Yüksek et al., 2010a). The altitude ranges between 1190 and 1285 m, and the slope of the study area is moderate (18±2 %). The soils are classified as brown forest soils according to International Soil Classification System (ISCS)

(Anonymous 1981, 1993a; Yüksek, 2009; Yüksek et al., 2010a). The rock mass is extensively intrusive disrupted, and parent material is granite (Gattinger, 1962). The study area mainly consists of *Lolium perenne* (L.), and *Poa nemoralis* (L.), *Poa pratensis* (L.), *Trifolium repens* (L.), *Taraxacum sp*., *Alchemilla sp*., *Plantagosp*., *Carex sp*., and *Geranium arundinacea* (Kunth). Ayder and its environment have different topography, rich and abundant vegetation, clean and fresh air and it is 15 km away from Çamlıhemşin County. For these reasons, people who live in northern east of Black sea region show big interest for recreational activities in this area. It was estimated that more than 500 000 people visited Ayder during 2006, and most of the visitors visited Ayder during July and August (Yüksek, 2009). Prevalent recreational activities, Ayder Culture, Art and Nature Festival have been carried on since 1994, tourism is nowadays the main source of income for local inhabitants since the abandonment of traditional agriculture, and there is a strong social and economical pressure for tourism in protected areas. Ayder and its close environment is about 72 ha and there is no accepted land use plan with it. Except for traditional Ayder festival, people can also enter the area free of charge and can camp in any part of grassland in forest gap and there is randomly light grazing in the grassland in forest gap (Yüksek, 2009).

Kafkasor Location:

The study was conducted in Kafkasor-Artvin in the North-Eastern Blacksea of Turkey (lat. 41°09' 46''–41° 10' 04'' N, and longt. 41° 47' 44''–41° 47' 57'' E, alt. ca 1200 m above sea level (Figure 2). Since there is no meteorological station in the study area, the nearest meteorological station in Artvin was taken into account. The climate is sub-humid, with a long-term annual average rainfall of 689 mm, while it was 880 mm in 2007, with a minimum in summer (103 mm), and maximum in winter (262 mm) and the mean annual temperature is 12□38 °C in Artvin Meteorological station (Anonymous, 2007). Heavy rains occur in a short time period during the summer season, while high snow levels (more than 1m high) occur in the winter season. The study area is moderately sloped (20±2 per cent). The soils of the area were classified as brown forest soils with sandy–loam— loam texture according to International Soil Classification System (ISCS) (Anonymous, 1993b; Yüksek and Olmez, 2002; Yüksek et al., 2008). The rock mass is extensively volcanically disrupted and parent material is andesite. The forest site of study area consists of Picea orientalis Link (74.5 per cent), Carpinus betulus (L.) (2.2 per cent), Quercus petraea (L.) (6.5 per cent), Fagus orientalis (L.) (7.2 per cent), Abies nordmanniana Stev (7.4 per cent), Pinus sylvestris (L.) (2.2 per cent) (Anonymous, 2005) and grassland in forest gap consists of Brachypodium pinnatum (L.), Bromus tectorum (L.), Avena sativa (L.), Poa annua (L.), P. trivialis (L.), P. nemoralis (L.), P. bulbosa (L.), Agrostis stolonifera (L.), Dactylis glomerata (L.), Cynosurus echinatus (L.), C. cristatus (L.), Phleum alpinum (L.), P. pratense (L.), Cynodon dactylon (L.), Trifolium pratense (L.), T. repens (L.) and T. arvense (L.) (Eminagagaoglu and Ansin, 2005). Kafkasor and its environment have different topography, rich and abundant vegetation, clean and fresh air and it is 8 km away from the city centre of Artvin. The landscape beauty of Kafkasor has been advertised often on magazines and television programs after 1990s; therefore, the number of visitors has been increasing from day to day. It was estimated that more than 100 000 people visited Kafkasor during 2006, and most of the visitors visited Kafkasor from July to September. Beside prevalent recreational activities, Kafkasor Culture, Art and Tourism Festival has been carried on since 1984 and tourism is nowadays the main source of income for local inhabitants since the abandonment of traditional agriculture, and there is a strong social and economical pressure for tourism in protected areas (Yüksek et al,. 2008; Yüksek et al., 2010b). The festival area is about 23 ha (while Kafkasor and its close environment is approximately 41 ha) and there is no accepted land use plan for this area. Except for the traditional Kafkasor festival, people can enter the area free of charge and can camp in any part of grassland in forest gap and there is randomly light grazing in grassland in forest gap (Yüksek et al., 2010b).

Sampling

Different methods were used in the collection of data in the study areas, in Ayder and Kafkasor. Sampling procedures and method of data collection summarized in Table 1.

Table 1. Sampling procedures and methods of data collection in Study area in Ayder and Kafkasör

Variety of Data	**Methods of data collection**
Number and structure of buildings, advertising boards, and waste container, etc..	These data were determined by counting and observing. Supplied data transferred on map using AUTOCAD software
Traffic Density (Number of vehicles and visitors arriving in Ayder and Kafkasör)	These datas were supplied from Çamlıhemşin and Artvin Municipalities and Literature reviews
Parking problems, visitors waste (such as: Nylon bag waste, paper waste, canister waste)	These datas were determined by observing in the study area
Variety of tourism activities	These data were determined by counting and observing of study ereas and literature review and public inventory
Garbage and household watse	These data were supplied from Çamlıhemşin and Artvin Municipalities
Erosion	These data were determined field survey and observation literature review and public inventory
Water pollution	
Noise pollution	
Landscape change	
Visual pollution	
Land cover change Loss of potential carbon sequestration	Maps of study area were taken from Google earth software. Grassland in forest gap, bare area, road density was determined using AUTO-CAD software. Carbon sequestration was calculated from the following equations $CT = CF*D_b* V$; where C_T is total carbon for the layer in metric tons, C_F is the fraction of carbon (percentage carbon divided by 100, CF= SOM/1.72), Db is bulk density, and V is volume of the soil layer in cubicmeters (Donovan, 2010)*.
Property issues	Interview with institution that works related to propected areas

***:** Data utilized in calculating the amount of SOC was supplied from Yüksek, 2009.

Results and Disscussion

In Ayder Protected Area

During the 1989-2011, number of building increased from 162 to 245. Urbanization has increased by 51% and 30.7 ha forest gap have been destroyed to make these buildings. In addition, 1.72 ha grassland in forest gap (totally 32.44 ha) have been destroyed to road construction, parking area, festival activities area, etc.

The total SOC storage capacity upper 50 cm in adjacent area of destroyed grassland in forest gap was between approximately 17264-22431 t in a year.

The number of visitors who access in Ayder protected area have constantly increasing over the years. However, accessing by visitors in the protected area is irregular throughout the year. The maximum number of the visitors was observed in the summer months, while the lowest number of visitors was observed in the end of autumn and winter months.On special days during the year (Such as:Ayder Festival, Snow Festival, Religious Holidays), the number of visitors who Access the area reaches the maximum level. When the visitor density reach the maximum level, visitors have been found to cause serious traffic and parking problems (Figure 2a, b). Except the period of high visitors density, it was not found noise pollution in Ayder protected area.

Visitors who Access in Ayder protected area at different times, were carried out different recreational activities (such as: Skiing on grass, folk dance, volleyball, snowboarding, health tourism, trekking, camping, picnic, etc.). Household waste and garbage problem in Ayder protected area was reached in the maximum level when the visitor density was the highest (Figure 2a).

Figure 2a: Traffic and garbage problem in Ayder (Foto: Yüksek T).

Figure 2b: Noise pollution in Ayder (Foto: Google images).

It is unknown the real amount of garbage created by visitors in Ayder protected area. According to Çamlıhemşin Municipality cleaning stuffs, visitors create about 7 to10 ton garbage in a day in the summer months.

Sheet and gully erosion were determined in road slopes, camping areas, gravel roads, trails and festival area in Ayder protected area (Figure 3). During the field survey it was observed that due to insufficient infrastructure facilities, domestic based liquid pollutants caused water resources pollution (Figure 4).

Construction (such as: excavation and filling, etc.) activities, festival activities (such as folk dance, grass skii, snowboard, camping, etc.) caused of various degreees of landscape degradation in Ayder protected area. It was determined that ownership issue is one of the biggest problem in Ayder Protected area.

In Kafkasor Protected Area

There is 33 buildings in Kafkasor protected area. The vast majority of buildings are in forest. The number of visitors who access in Kafkasor protected area constantly increasing over the years. However, accessing by visitors in the protected area is irregular throughout the year. The maximum number of the visitors was observed in the summer months, while the lowest number of visitors was observed the end of autumn and winter months. On special days during the year (Such as: Kafkasor Festival, Religious Holidays, etc.), the number of visitors who access the area reaches the maximum level. When the visitor density reach the maximum level, visitors have been found to cause serious traffic and parking problems (Figure 5).

Figure 3. Land degradation and land use change and erosion problem in Ayder (Foto: Yüksek T).

Figure. 4: Visual pollution and waste water pollution in Ayder (Foto: Yüksek T).

Figure.5. Traffic and parking problem in Kafkasör (Foto: Yüksek T).

Visitors who Access in Kafkasor protected area at different times, were carried out different recreational activities (such as: folk dance, volleyball, trekking, camping, picnic, etc). 8607 visitors accessed in Kafkasor protected area during the festival time in the years of 2007 (Yüksek et al., 2008) and number of visitors who access in the area constanly increased ove the years.

Household waste and garbage problem in Kafkasor protected area was reached in the maximum level when the visitor density was the highest. Due to insufficient infrastructure facilities, domestic based liquid pollutants caused water resources pollution.

Figure.6. Garbage problem in Kafkasör (Foto: Yüksek T).

While, garbage collection was regular during the festival period, apart from the festival period this service was not regular.

Of 7.4 ha grassland in forest gap have been destroyed to make new buildings, road construction, parking area, festival activities area. The total SOC storage capacity upper 50 cm in adjacent area of destroyed grassland in forest gap was approximatelly between 3730-4850 t in a year in Kafkasör protected areas.

Sheet and gully erosion were determined in road slopes, camping areas, gravel roads, trails and festival area in Kafkasor protected area (Figure 7).

Figure.7. Erosion problems in Kafkasör (Foto: Yüksek T).

Due to inadequate infrastructure in Kafkasor protected area, household consisting of facilities and pollutants created by visitors caused directly or indirectly pollution of air (Fig.8.) and water resources.

Figure.8. Camp fire in forest and its effect on air pollution (Foto Yüksek T).

Especially on special days of activities carried in protected area have led to noise pollution and deterioration of landscape to varying degrees. Property issue in the Kafkasor protected area just as in Ayder protected area.

Conclusion

Problems caused by unplanned and mis landuse can be summarized as follows:

- Land cover and land use change
- Landscape degradation
- Loss of above ground biomass

- Loos of carbon sequestration
- Soil degradation
- Erosion problem
- Traffic and parking problem,
- House waste and garbage problem,
- Property issues problem
- Visual pollution,
- Water pollution
- Noise pollution

Although, both protected sites have similiar land use problems, land use problems in Ayder location is much more serious than Kafkasör location. The principles of management in Ayder and Kafkasor protected areas should be revised, and use of these areas without a plan should be stopped as soon as possible. First of all, the ownership problem of this area should be solved. Afterwards, Ayder and Kafkasor protected area planning and management offices should be established. The managers of these offices and their teams who are specialized in protected area planning and management should prepare an acceptable and sustainable land use plan for these areas. This management plan should bring solution to all land use problems of Ayder and Kafkasor protected areas. In order to achieve this, the planners should correctly analyse land use problems and their effects on soil, vegetation, water resources and air.

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Soil nitrogen dynamic in some Mediterranean soils: Tunisian case study

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Abstract: Tunisia (32-38°North; 7-12°East) constituting the upper most part of North Africa on the Mediterranean basin and corresponds mainly to semi-arid and arid climate. Soil nitrogen dynamic studies in such areas, were rare, but became an up-to-date target to be resolved. Indeed, soil nitrogen mineralization is a key process influencing the accumulation and loss of nitrogen in Mediterranean soils. These various concerns increase today the interest on nitrogen which even comes from the soil itself. In our research, we have focused on nitrogen dynamic in relation with some pedogenetic processes. The follow-up on the field of nitrogen evolution in some Tunisian soils was the subject of an experimentation study completed during January May 2005 period. The results show that nitrogen dynamic was inhibited with low soil moistures and temperatures. This dynamic passes by one or two peak rates during the growing season. Then, it falls down gradually when moisture and temperature continue to increase. Depth distributions of nitrogen results decrease from top to bottom of the profile for all studied soils. In January, the results relating to the ammoniacal form are much more significant than the nitric form. The latter shows, after rainy sequences, values which tend to decrease in surface horizons and to increase in the deepest horizons especially in the hydromorphic soil. In March, nitrogen values reach their maximum then they record a regression which practically spreads for all studied soils in May.
Keywords: Nitrogen, mineralization, moisture, temperature, Mediterranean soils.

Introduction

Nitrogen constitutes an old subject but constantly to actualize for the environmental and energizing considerations. This various interest made that several approaches (nitrogen organic matter characterization, dynamic studies from incubation systems and nitrogen studies from N^{15} tracers) have been considered to study nitrogen in soil. However, nitrogen has been rarely approached through full field methodology.

The object of these works was to identify conditions and liberation modes of soil organic reserves, as well as, to interpret transformations and displacements of mineral nitrogen shapes according to the environment conditions and the relation with pedogenetic process.

Indeed, nitrogen mineralization depends strongly on climatic and pedoclimatic conditions. Influence of this different parameters has been discussed extensively in our work. The understanding of these phenomena proves very useful to orient nitrogenous fertilization conduct in order to approach the best output and the best quality to preserve the environment in economically acceptable conditions.

It is in this perspective that we are proposed to follow in some northern Tunisian soils mineral nitrogen evolution of surface horizons, as well as, their vertical distribution according to soil humidity and soil temperature variation.

Materials and methods

Four soils, belonging to different ecological areas of Tunisia (Fig.1), were chosen to accomplish the aims of this study. The first one is a brown leached soil sampled on a natural slice located in the Aïn Draham region. The second is a vertisol located in Béja which is marked by an important bioclimatic variability from sub-humid mediterranean to a middle semi-arid bioclimate. The third one is a hydromorphic soil located in the Cap Bon and the last is a chalky brown soil located in the Sakiet Sidi Youssef (le Kef) in the north-west of Tunisia.

The process consists of monthly analysing, during the period from January to May 2005, samples that have been taking from each soil profile depth with equal intervals. After that, it comes the phase of the extraction operation that concerns the two nitrogen soluble forms which are $NH_4^+$and NO_3^-.

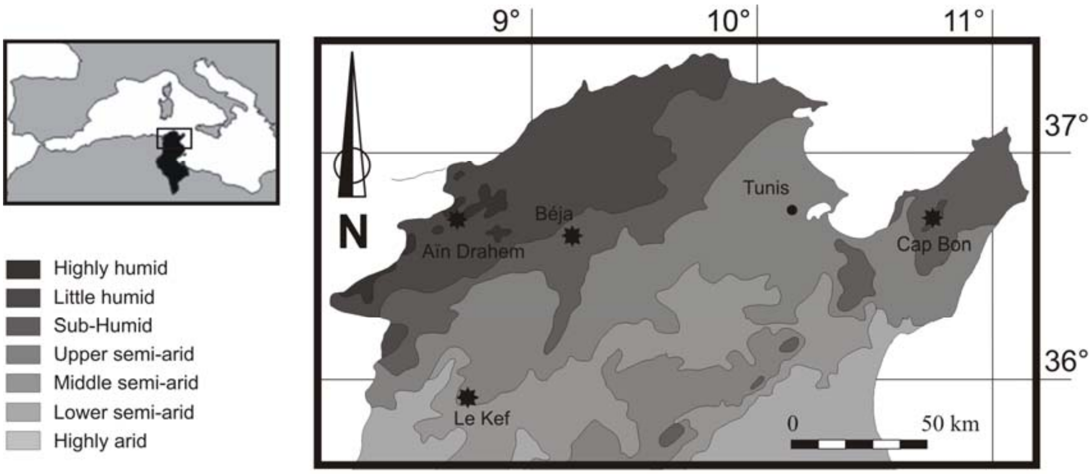

Fig.1: Sites localization according to bioclimatic stages

Results and Discussions

The results of the study reveal that the evolution of mineral nitrogen of surface horizons basing on soil moisture and soil temperature shows a great variability that depends on two factors: soil nature and pedoclimate conditions.

We note that the maximum of nitrogen mineralization is between 24 and 100 mgNkg $^{-1}$. It depends on the nature of mineralized organic matter and the soil physiological functions (Abbadi, 1990). We note also that the minimum concentrations are recorded with low soil moistures and temperatures, besides the mineralization decreases more or less quickly when moisture and temperature continue to increase (Van Gestel and al., 1993). These weak rates recorded at the beginning of the summer are due to the restricted microbial activity caused by the weak water contents of soil (Orchard and Cook, 1983; Bottner, 1985; Wardle and Parkinson 1990; Van Gestel and al., 1993; Nunan and al., 2000). Indeed, in dries season the biological activity is restricted but some nitrogen transformations can be done under solar radiation influence (Dommergues, 1960).

Generally, we note a constant progression of mineral nitrogen values, in March, in all studied soils. This rise is supported by the increase of soil temperature (Gill and al, 1995). Thus, there are positive and significant relationships between soil temperature and nitrogen mineralization (Hatch and al, 1991; Gill and al, 1995; Nunan, 2000). It is observed until flowering then we note a reduction until culture maturity (in May).

For some soils, the increase phase can continue in April and even in May, for example the vertisol and the calcareous brown soil. Indeed, Moisture values of these soils still allow mineralization or it is due to non-biological transformations. The calcareous brown soil has a retain water capacity thanks to higher clay content with the presence of a significant litter layer which keeps water content (Scholes and al, 1994).

Indeed, the offer of soil mineral nitrogen results from the interactions between soil, litters and the microclimate influence created by these last (Tian and al, 1993). This effect on the surface soil state has significant ranges on soil temperature and soil moisture, factors which influence their mineralization potential (Scholes and al, 1994; Tian and al, 1993).

Nitrogen mineralization in the vertisol shows a phase in March and April. This reduced the rate of mineral nitrogen but remains significant in May. This optimal zone is maintained for high soil temperatures (Fig.2). The climatic data relating to the water assessment illustrate a significant evaporation in this period (Fig.3) which increases in an exponential way during all the summer, but with a possibility of reconstitution of hydrous stock for the autumn winter period. Thus, during this year, the soils of this area passed by moistening and desiccation phases. These alternations have probably a stimulating effect on mineralization.

It was often observed (Birch and Friend, 1956; Dommergues and Mangenot, 1970, Charley, 1972) that soils subjected to alternation desiccation / moistening phases have a higher rate mineralization than those which are constantly wet. Dommergues and Mangenot (1970) showed that soil desiccation increases soil oligosaccharides content and stimulates soil nitrification by increasing the microbial biomass and its activity (Coppens and al., 2005).

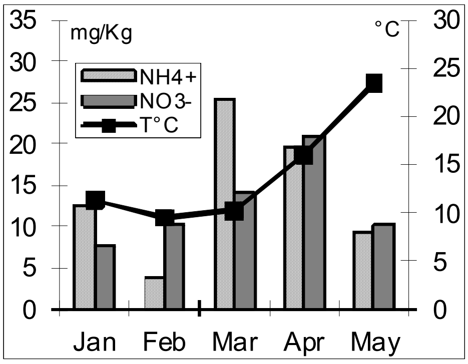

Fig.2: Monthly evolution of ammoniacal and nitric nitrogen of surface horizon of the vertisol according to soil temperature

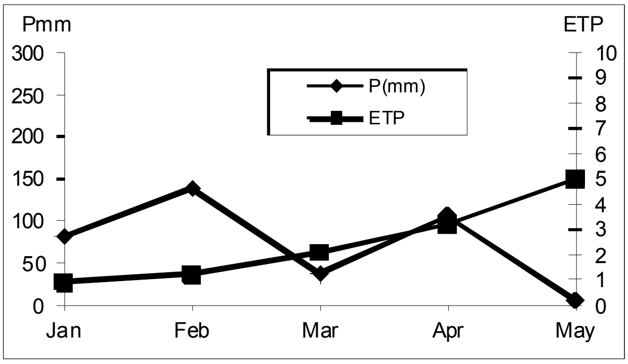

Fig.3: Hydrous assessment of Béja site (January-May 2005)

Thus, the presence of available carbon associated to soil rehumectation would stimulate soil nitrification by increasing the microbial biomass and its activity (Jackson, 2000; Coppens and al., 2005). Moreover, Herlihy (1979) noted that soils under moisture fluctuation mode had similar mineralization profiles to those maintained on levels moisture near to field capacity (Nunan, 2000).
In the example of the hydromorphic soil mineral nitrogen values are significant at the beginning of the rain season. The maximum is observed in January with 34 mgNkg $^{-1}$ for high rates of moisture 60 % (Fig.4). We can be surprised that optimal moistures can be also high. Indeed, this soil presents a clogging character which can reflect an adaptation of the microflore to these ecological conditions (Moureau, 1967).
According to the results presented on the graphs (Fig.5), we observe that the first rains (February and March) have a great influence on mineral nitrogen production in the leached brown soil of Aïn Draham. Indeed, in March 6 mm of rain were enough to make start mineralization. This precipitation rate was sufficient to maintain favourable moisture to mineralization in soil. It seems that the microflore finds a favourable substrate, rich in carbonaceous compounds easily usable.
We also noted following the examination of ammoniacal and nitric nitrogen contents variation, a relating indifference of the ammonification to moisture variations, probable consequence of the broad microbial spectrum providing these functions and taking turns according to ecological conditions (Moureaux, 1967).

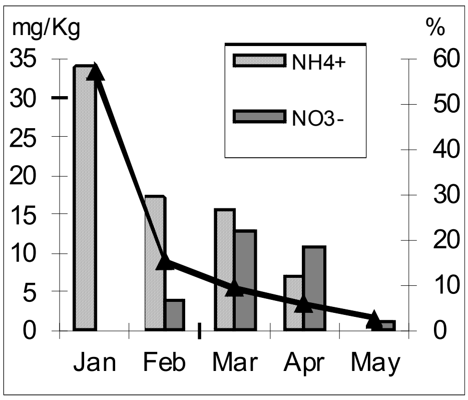

Fig.4: Monthly evolution of ammoniacal and nitric nitrogen of surface horizon of the hydromorphic brown soil according to soil moisture

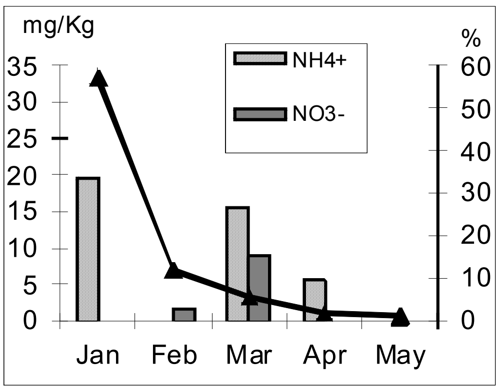

Fig. 5: Monthly evolution of ammoniacal and nitric nitrogen of surface horizon of the brown leached soil according to soil moisture

As for nitrification, it requires good ventilation; it is concerned very affected by water excess which displaces soil air. It is extremely sensitive to moisture variations. The bacteria ammonifiantes survive better at high temperatures that the nitrifying bacteria. These results were often confirmed by former work (Moureau, 1967) on temperature influence on soil biological activity.

The study shows that vertical distribution of mineral nitrogen differs from one horizon to another. Noting that the highest rate is recorded in the surface horizons and it decreases with depth. Several distributions are recorded for each month:

In January, depth distributions of ammoniacal nitrogen rates are more significant than nitric nitrogen contents. During this month, the nitrates are concentrated in the depth horizons of the vertisol and the hydromorphic soil. After the rainy sequence of January, we notice an absence of nitrates especially in the first centimetres of soil. It is about scrubbing (leaching) but with less consequent variations, because soil nitric values are reduced due to plants consumption.

In March, we note a remarkable ammoniacal and nitric nitrogen rates that they reach maximum in all studied soil profiles, especially in surface horizons. These values may be explained by the process of nitrogen migration from depth to surface horizon to satisfy the development of significant vegetable mass.

In May, we note a regression of mineral nitrogen contents in all studied soil profiles exception of some soils such as the vertisol which still records ammoniacal and nitric nitrogen contents on all soil profile. Indeed, under vertisolisation process, nitrogen forms are distributed in a homogeneous way along the soil profile. Whereas, out of this constraints, mineral nitrogen is presented primarily on surface horizon. We also note during this month ammoniacal nitrogen contents in depth horizons of the hydromorphic soil. The nitrification process requires two oxygen molecules for the oxidation of an ammonium molecule (Gallali, 1980). But, we can't find these conditions in soils affected by the hydromorphie. Indeed, oxygen deficiency in the hydromorphic soils makes a reducing environment and inhibits the aerobic microbial activity. This biological activity is blocked and involves a relative accumulation of ammonium ions (Haglund and al., 2003).

Conclusion

Based on our results, we can conclude that northern Tunisian soils are poor in nitrogen. This deficit concerns organic and mineral forms.

The main succeeded results of this study are of fundamental and convenient order. They concern the knowledge of nitrogen stock according to the pedological nature of soil, its conservation conditions and the bio-availability of its two most labile fractions, the ammoniacal and the nitric forms. The understanding of these phenomena proves very useful to orient nitrogenous fertilization conduct in order to approach the best production and the best quality to preserve the environment in economically acceptable conditions.

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Direct Benefits Derived From A Rehabilitated Semi-Arid Rangeland In Kenya

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Abstract
Combating land degradation in the semi-arid rangelands of sub-Saharan Africa is essential to ensure sustainable and long-term productivity of these environments. In the Lake Baringo Basin in Kenya, communities and individual farmers are restoring indigenous vegetation inside enclosures in an effort to combat severe land degradation and address their livelihood problems. This study quantified the direct benefits of range rehabilitation using yearly communal enclosures' utilisation data compiled by the Rehabilitation of Arid Environments (RAE) Trust over the last decade. Results showed that communal enclosures provide a source of income through the sale of fattened stock, harvested grass seeds, hay, honey and charcoal. Indirect products like milk, blood and meat are essential for household nutrition. The grasses also provide a cheap source of thatching materials, livestock feed and dry season grazing. Other products restored areas provide include wood products, roots and herbs for various remedies. Increased soil and biomass carbon storage could come with other indirect environmental benefits including increases in soil fertility, land productivity for pasture production and food security, and prevention of land degradation, thus leading to economic, environmental and social benefits for the local agro-pastoralist communities.
Keywords: enclosures; environmental goods and services; reseeding; semi-arid rangeland; Kenya

Introduction

The problem of land degradation in the arid and semi-arid lands (ASAL) of Sub-Saharan Africa is well documented. The ultimate impact of the climatic, ecological and environmental changes occurring in drylands is livelihood crisis for the agro-pastoral communities dependent on these ecosystems (Kitalyi et al., 2002). The persistent menace of recurrent droughts, floods, disease outbreaks leading to large livestock losses, and dryland crop failure are commonplace (UNEP, 2000). Food insecurity is a growing problem, and increasing poverty poses a major threat to the livelihoods of the communities that depend on these ecosystems, and the local biodiversity.

Combating land degradation is essential to ensure sustainable and long-term productivity of ASAL environments. In ASAL of Sub-Saharan Africa, options for improving pasture quantity and quantity where graminoid and non-graminoid herbaceous plant species have disappeared have been limited to destocking, bush management, and intermittent grazing (Mnene et al., 2000). Re-vegetation through grass reseeding has the potential to restore degraded rangelands and improve their potential for livestock, wildlife conservation and crop production. In Baringo, the Rehabilitation Arid Environments (RAE) Trust has for more than 29 years been training agro-pastoralists to restore and manage severely degraded areas in the Lake Baringo Basin with some pragmatic outcomes. RAE implemented its first reseeding project in communal rangeland on the lake plain (Njemps Flats) in 1982, later expanding these efforts to upland sites (de Groot, 1992). About 38 communal enclosures have been established since 1982, covering about 1496 ha. During the last decade, attention has turned increasingly to private (fields) enclosures. Rehabilitation of private enclosures by RAE started in 1994, and so far, private enclosures ranging in size from 0.5 to 20 ha each are well over 700 in the whole lake basin (RAE, 2010).

This trend is the result of the agro-pastoral communities realization that range enclosure through reseeding has the potential to address their food insecurity, alleviate poverty and restore rangeland productivity (Kitalyi et al., 2002). The general increase in the trend of exclusive property rights through enclosing the grazing commons may also be driven by the pastoralist's need to diversify asset portfolios in response to declining pasture and other common resources (Beyene 2009). For the gains in the fight against land degradation to be sustained, the physical and technical interventions must have a socioeconomic and cultural dimension, that addresses the needs and priorities of the local communities. Understanding the socioeconomic impacts of range rehabilitation is essential to the management and planning of similar initiatives. This study aims to quantify the direct benefits derived from the communally rehabilitated semi-arid rangeland in the Lake Baringo Basin. It is expected that the results of this study will set a foundation upon which future large-scale restoration in semi-arid rangelands can be initiated, and their management and sustainability improved.

Materials and methods

Study area and communal and private enclosures

The study area has been described by Verdoodt et al., 2010. A detailed description on the establishment of the communal and private enclosures has been published by Meyerhoff, 1991; de Groot et al., 1992) and Rosenschein et al., (1999), and their management by Verdoodt et al., (2010). Nine communal enclosures were systematically selected across the Njemps Flats for this study (Table 1). The selection criteria – similarity of terrain, soil, and land use – aimed at minimising variability in the abiotic determinants of rangeland vegetation composition and functioning, and hence productivity. The selected communal enclosure ages ranged from 18 to 28 years. In the subsequent section, we describe in detail the monitoring and collection of enclosures utilization (off-take) data in the communal enclosures.

Table 1. General characterisation of the selected enclosures

Local ID	Local Name	Sub-Location	Area (ha)	Age (yr) as at 2010	Utilization[b]
F1	Meisori	Salabani	9.3	28	LF – G – GC – BK – GS – WC – CB
F1A	Meisori	Salabani	6.6	27	LF – G – GC – BK – GS – WC – CB
F1B	Meisori	Salabani	16.7	23	LF – G – GC – BK – GS – WC – CB
F2	Kapkoror	Kipcherere	5.3	28	LF – G – GC –GS - WC
F2A	Kapkoror	Kipcherere	7.8	27	LF – G – GC –GS - WC
F2B	KYS School	Kipcherere	6.0	23	LF – G – GC –GS
F4	Ongata-Mara	Salabani	22.4	25	LF – G-GC – GS
F4A	Ongata-Mara	Salabani	102.3	21	LF – G – GC – GS
F13	Lamalok	Salabani	140.0	18	LF – G – GC – GS

LF (Livestock fattening), G (Grazing), GC (Grass Cutting), GS (Harvesting Grass Seed), BK (Bee Keeping), and WC (Wood Cutting), CB (Charcoal burning)

Enclosures utilization and benefits monitoring data

RAE keeps a record of all maintenance and utilisation activities carried out in all the communal and a number of private enclosures. When a Field Management Committee decides to open up their enclosure for utilisation (Verdoodt et al., 2010), they liaise with RAE to send Field Recorders to be present during the field utilisation days. The Field Recorders use of simple measurement-yardsticks and terminologies to collect valuable ecological and enclosure utilisation data (Table 2). Where a product is bought and later sold after value addition, the costs are also recorded. RAE has made an effort over time to standardize prices of enclosure products in effort to discourage farmers from being exploited by the middlemen buying for sale in secondary markets. Monitoring provides data of ecological and socioeconomic importance besides providing RAE and the local community with information on the productivity of the restored rangeland. Detailed monitoring began in 1992 and stopped in 1996 (Rosenschein et al., 1999), before resuming in 2001 to present. New data entry formats were adopted from year 2005, making a comprehensive benefits database. We used this quantitative and qualitative data (2001-2010) to quantify the direct benefits of range rehabilitation.

Data analysis

Analysis of data combined both qualitative and quantitative approaches. First, the analysis began from revising detailed field-notes and consolidating similar information with the use of a summary table. Second, data from RAE field monitoring database was sorted out for the selected enclosures. The data from 2001-2005 was not properly organised. This gave us a challenge while sorting it out which could also have given rise to gaps. However, due diligence was paid in trying to minimise their occurrence by having the data cross-checked by a different crew. The results were categorised into two; the quantitative (tangible product or good that had immediate economic value) and qualitative (those that improved the welfare of the household, communities or overall society and the environment, but could not be converted immediately into cash).

Table 2. Quantitative and qualitative data recorded during the enclosure utilisation days

Income Generating Activity (IGA)	Parameter recorded1	Product sold	[1]Sale Price (KES)
Livestock Fattening	No. of bull days	Fattened bull/steer	10,000/head
Dry season grazing	[2]No. of grazing days	–	–
Grass seed harvesting	Weight by species	Grass seed by species	500/kg
Hay Baling	No. of bales	Hay	100/bale
Thatching Grass	No. of backloads	Cut grass	10/backload
Wood cutting	Tree species cut	Building Poles / Fencing Posts	10/piece
Firewood	Shrub species cut / No. of backloads	Firewood	10/backload
Honey	Gross weight	Unpurified honey	120/kg
Charcoal	Woody plant species cut / No. of bags	Charcoal	500/bag

[1]Approximate minimum sale price in Kenya Shillings (KES) at enclosure gate. Exchange rate as at Dec. 31, 2010 was 1 USD ~ KES 78. [2]Per day grazing fees are chargeable per livestock head. Records include all known illegal grazing days, and specifies livestock species by age e.g. cattle or calf days.

Results and Discussion

Within the period studied (2001-2010), enclosure F13 at Lamalok generated the highest income though being the least diversified in terms of income generating activities (IGAs) (Table 3). It was followed closely by enclosure F1, F1a and F1b at Meisori that had the most diversified IGAs.

Quantitative benefits

Livestock fattening (particularly bulls/steers) was the leading income generating activity netting in over 80% of the total income in all the selected enclosures (Table 3), except for F2, 2a and 2b. The activity involves buying thin stock at the local livestock auctions during dry seasons when prices are low, grazing them within the enclosures for 3 to 5 months and selling at a profit. The average buying price is KES 7,000 translating to a profit of KES 3,000 after 3 months.

Grass seed harvesting was the second highest income generating activity after livestock fattening in all the selected enclosures except F2, 2a and 2b, where it was the leading income generating activity with 53% of the total income (Table 3). Harvested grass seed is transported to RAE Trust for processing (removing chaff and packaging), storage and sale at a minimum retail price of KES 600 per kilogram.

Dry season grazing was a key utilisation of the enclosures, though it did not necessarily generate an income except in enclosures F2, 2a and 2b (Table 3). The main category of the livestock grazed indicate the priority of the groups managing the particular enclosure. For instance, Ngenyin Women Group of enclosures F2, F2a and F2b utilised their field mostly for cattle and sheep dry season grazing. The activity is aims to sustain the livestock through the dry season and drought. During the wet season, the livestock graze in the communal open rangeland, therefore making the enclosures a buffer against dry season pasture scarcity and accompanied livestock losses.

Table 3. Selected enclosures benefits summaries for 2001 – 2010

Activity	F1, F1a & F1b		F2, F2a & F2b		F4 & F4a		F13	
	Total Income ([1]KES)	Per cent income	Total Income (KES)	Per cent income	Total Income (KES)	Per cent income	Total Income (KES)	Per cent income
Livestock Fattening - Bulls days	1,871,500	81	117,700	37	804,850	97	2,652,200	87
[2]Grass Seed Harvesting	221,458	10	167,663	52	22,890	3	37,900	1
[3]Dry Season Grazing - Cattle days	4,350	[4]0	26,6	8	_	_	264,311	9
- Calves days	100	0	1,100	0	_	_	4,346	0
- Bulls days	14,930	1	3,510	1	1,721	0	100	0
Goats days	281	0	_	_	1	0	86,843	3
Sheep days	361	0	780	0	1	0	200	0
Lamb days	_	_	250	0	_	_	_	_
Thatching Grass	27,580	1	912	0	96	0	437	0
Hay Baling	1,500	0	1,702	1	_	_	_	_
Honey (gross weight)	24,600	1	_	_	_	_	_	_
Building Poles / Fencing Posts	86,070	4	_	_	_	_	_	_
Firewood (bundles)	1,100	0	_	_	_	_	_	_
Charcoal (bags)	64,700	3	_	_	_	_	170	0
[5]Research fees	2,000	0	_	_	_	_	_	_
Totals: 10 Activities	**2,320,530**	**100**	**320,217**	**100**	**829,558**	**100**	**3,046,507**	**100**

[1]Exchange rate as at Dec. 31, 2010: 1 USD ~ KES 78. [2]The main species harvested are *Cenchrus ciliaris* (Cc) and *Eragrostis superba* (Es). [3]Includes known illegal grazing days. [4]Value less than 0 %. [5]Fees charged to researchers by the Field Management Committees.

Grass cutting and *hay baling* was carried out in all the selected enclosures except F13 (Table 3). Grass is cut for thatch, hay baling or cut-and-carry for livestock feeding at individual homes. The locals prefer *Cynodon plectostachyus* for thatching. Baling for pasture preservation is done with a box-manual baler provided by RAE. In enclosure F1, 1a and 1b, thatch grass contributed to 1 % of the total income over the period studied.

Wood cutting was carried out only in enclosures F1, 1a and 1b (Table 3), mainly for maintaining the enclosures as productive grass fields and to avert bush encroachment. The main species targeted include *Acacia nubica*, *A. reficiens*, *A. melliferra* and *Prosopis juliflora* which are all invasive and suppress grass growth making them not suitable for pasture fields. Over the period studied, building poles and fencing posts, and charcoal contributed 4 % and 3 % of the total income generated by enclosures F1, 1a and 1b respectively.

Bee keeping Honey was harvested in enclosures F1, 1a and 1b yielding 246 kg gross weight of *honey* (Table 3). Harvested honey is pooled at RAE Headquarters, and sold to a private company, Honey Care Africa (Kenya) Limited at KES 120 per kg gross weight. RAE releases the proceeds to individual farmers and community groups according to the kilograms of honey supplied. This guaranteed market links and channels for enclosure products is attracting many people to rangeland rehabilitation in the Lake Baringo basin and beyond.

Qualitative benefits

The cumulative 10 year data (Table 3) shows that restored areas have also other direct non-tangible benefits. These are:

Volunteers gains The community members composed of individuals or organised groups come together to work in the communal enclosures in the spirit of *harambee*. *Harambee* which literally means "all pull together" in *Swahili,* is a Kenyan tradition of community self-help events, e.g. fundraising for development activities. The benefits are quantified in terms of *harambee* days, and the volunteers involved are compensated with free grazing days, or direct cash compensation per *harambee* day per individual at times. Over the period studied, the communal enclosures maintenance work included uprooting *Acacia nubica* and *A. reficiens* seedlings, weeding fence lines, fencing of bulls *boma,* dipping, vaccination, de-worming and castration of bulls during fattening periods.

Successful rangeland rehabilitation Owing to RAE's cumulative experience and plugging in lessons learnt since 1982, appropriate rehabilitation techniques and water harvesting methods have been defined and tested, making it easier to replicate them in other drylands. Ecological studies and field monitoring exercises carried out in the restored sites show high biodiversity of flora and fauna compared to the open grazing areas (Verdoodt et al., 2010; Rosenschein et al., 1999). Rehabilitated areas in Lake Baringo basin are now a showcase of tackling land degradation problems in arid and semi-arid rangelands.

Improved livelihoods Personal interviews and focused group discussions showed that range rehabilitation in Lake Baringo basin has improved pastoral livelihoods in various ways. These include enhanced grazing and natural resources, increased water availability in open water pans and dams inside the communal enclosures, increased financial and food security, established markets links with reliable buyers, and diversified income generation through the quantitative benefits.

Improved land and livestock management RAE has trained many pastoralists on range rehabilitation, enclosures grazing management, sustainable enclosure utilization practices, and alternative IGAs and opportunities. This is based on realization that range rehabilitation provides alternative food security in dry lands. This has strengthened community adaptive capacity against land degradation and climatic change.

Capacity building for women and reproductive health care Majority of communal enclosures in Lake Baringo basin are managed by women groups. RAE trains individual women and women groups as environmental managers, and many have benefitted directly from restored areas and enclosure products. Alongside the environmental and financial skills capacity building, RAE also offers health care and education to women, and reproductive health services through RAE Clinic at Kampi ya Samaki at the shores of Lake Baringo.

Communal enclosures products off-take and diversification

The main rationale behind establishment of communal enclosures in the Lake Baringo basin was to demonstrate that severely degraded rangeland can be restored (Meyerhoff, 1991). Successful re-vegetation and sustainable management of a restored ecosystem is prerequisite to optimising the possible environmental goods and services and their range (Miller and Hobbs, 2007). Pasture is the most valuable enclosure product in a pastoral setup, where livestock keeping is the key livelihood source. For optimal benefits or range rehabilitation, multiple IGAs could be carried out in both communal and private enclosures. The utilization sequence of an enclosure proceeds as follows: Grass seed harvesting, thatch grass cutting from the *Cynodon plectostachyus* patches within the enclosures, livestock fattening in paddocks and lastly dry season grazing. Across the study sites (Table 3), livestock fattening programmes of particularly bulls were the most profitable activity, followed by grass seed harvesting and dry season grazing. Livestock fattening is purely a commercial activity practiced by enclosure owners and community groups. With time, diversification has been a necessity since pure reliance on livestock keeping, as an income and food source, does not meet subsistence requirements (Little et al., 2001).

Rangeland enclosure is itself a form of diversification to an alternative livelihood source for the pastoralists. However, the sociocultural and ecological changes in the common grazing areas are forcing the pastoralist to adapt. Notable ecological changes are characterized by increasing bush encroachment (especially by *Prosopis juliflora* like in Lake Baringo basin), increasers and invaders species that have replaced grasses forcing the pastoralist to adapt to new ways of life (Wasonga et al., 2011). It was noted that the more specialized a community group is in terms of IGAs, the more money they make from an enclosure. For example, Saluni Welfare Group managing enclosure F13 at Lamalok were the leading group in total income, while they were the least diversified (Table 3). They practice livestock (purely bulls) fattening programmes and grass seed harvesting. On the other hand, Naitemu Women Group that manages enclosures F1, F1a and F1b were the most diversified with a total of 10 IGAs carried out within the study period (Table 3).

Diversification of enclosure utilization and income sources cushions the enclosure owners to periodic climatic or market shocks. For instance, livestock disease outbreak lead to closure of auctions and ban of livestock movements. This translate into loss of extra pasture required to maintain the herds in fattening programmes until the ban is lifted. In emulation of the communal enclosures, the private enclosure owners in the Njemps Flats lowlands are using their fields mostly for commercial purposes. Main activities includes fattening of bulls, grass seed harvesting and hay baling using a box though in small scales depending on the enclosure size. In the foothills, farmers mostly preserve their enclosures fields for dry season grazing, but from recent observations some farmers are venturing into livestock fattening business.

Conclusion

This study has shown that rangeland rehabilitation is an effective way of improving the economic welfare of the agro-pastoral households. The mixed grass species used for reseeding degraded semi-arid rangeland in Baringo have additional benefits to the agro-pastoral communities in the area. These include being source of good quality feed for livestock, income through the sale of grass seeds, hay and a balanced diet from milk especially for children. The money generated from sales of these products is channeled to other social amenities like health, education and entertainment. Moreover, grasses provide a readily source of thatching materials for houses and granaries. This boosts the longevity of the harvested grass seed and other stored crops, thereby boosting overall food security for specific households.

Acknowledgements

The study was made possible through the financial support provided by Special Research Fund (BOF Grant #01W01510) of Ghent University, Belgium in favour of the first author.

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Phosphorous Leaching and Concentration Distribution in a Tile Drained Soil Profile Using Soil Pore Water Samplers

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Extended Abstract

Phosphorous concentrations and its transfer from agricultural lands to surface and subsurface waters pose an environmental risk and its mobility requires routine monitoring. Objective of this study was to monitor the dynamics of phosphor leaching and its distribution under the effects of different soil water pressure heads (SWP) and tile drainage system. Soil water samples were installed in 5 different depths of soil profile and -60 and -78 kPa suctions were applied interchangeably twice a week. P concentrations were always higher in the surface 0-25 cm depth than the rest of the soil profile during the experimental time. The concentrations reached 1 mgL^{-1} in the first month for the surface soil, whereas 120 cm depth lower concentration than 0.02 mgPL^{-1}. By the end of first month, the P concentration in the 120 cm depth increased greater than 10 times of its monthly average, indicating that different P loads were added to the soil by drainage flow in the profile. In March, P concentration in all sublayers of the soil increased from 0.02 mgPL^{-1} to 0.52 mgPL^{-1} as drain flow volume increased. In May, the surface P concentrations ranged between 0.22 and 0.55 mgPL^{-1} while the 90 cm depth soil maintained 0.44 mgPL^{-1} concentration values between April and June. On the other hand, tile flow never let P concentrations reach greater than 1 mgPL^{-1} in the soil profile. In general, 60 kPa suction produced higher P concentrations in the surface soil depth than 78 kPa suctions in the soil porewater samplers.

Soil solution samplers collected adequate but differential amount of samples for chemical analyses. Total volume differences of soil solution in the tubes can be attributed to water content, soil type, soil hydraulic conductivity, horizontal and vertical distance to drain tiles from the installation points. Essert and Hopmans (1998) reported that incomplete hydraulic contact could lead to extraction volume differences in the samplers. The effect of applied suction on the solution sampler to extract soil solution depends on water flow regime, size and conductance of the extraction device. As the soil water pressure decreases, size of the water filled pores decreases, the data showed that pore water concentration was higher in the soil pores exposed to 60 kPa suction. This contradicts to the results of Essert and Hopmans (1998) reporting that smaller pores with fully-filled solution had higher concentration.

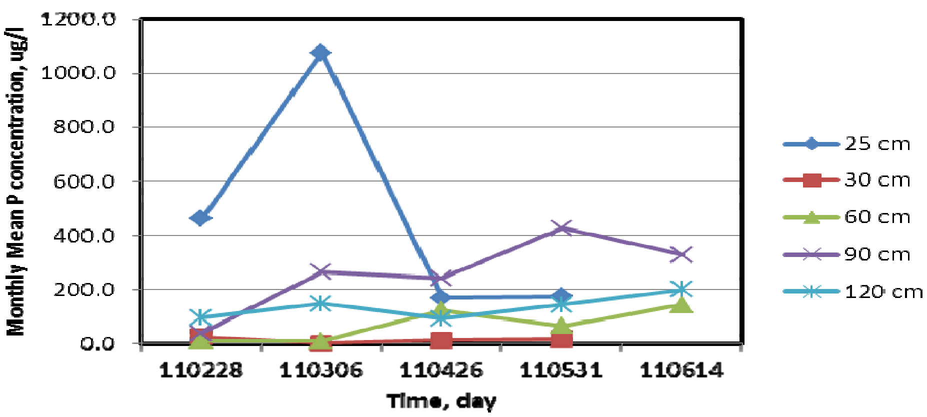

Figure 1. Mean monthly P concentration distribution in the soil profile.

The mean monthly P concentrations were the highest of all P concentration in the profile between february and midlle of April for the surface soil. P concentration started to increase from february to the end of June for all subsoil layers (Figure 1).

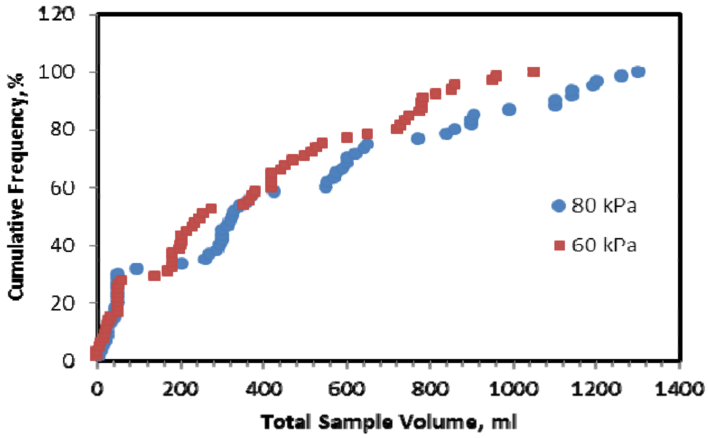

Figure 2. Sampling volumes for both suctions in the samplers.

Sampling volumes for both suctions are presented in Figure 2, indicating the volumes for 60 kPa were greater than the ones for 80 kPa. Thirthy five percent of the samples were equal to and less than 200 ml and both suctions produced the same amount of solution samples in the tubes.

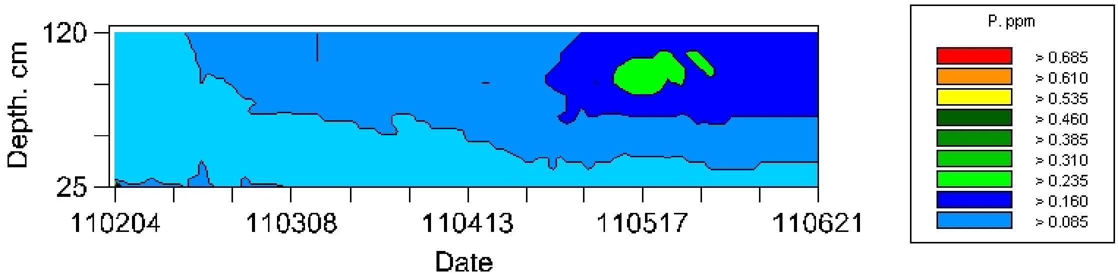

Figure 3. P concentration distribution in the soil profile for 60 kPa suction.

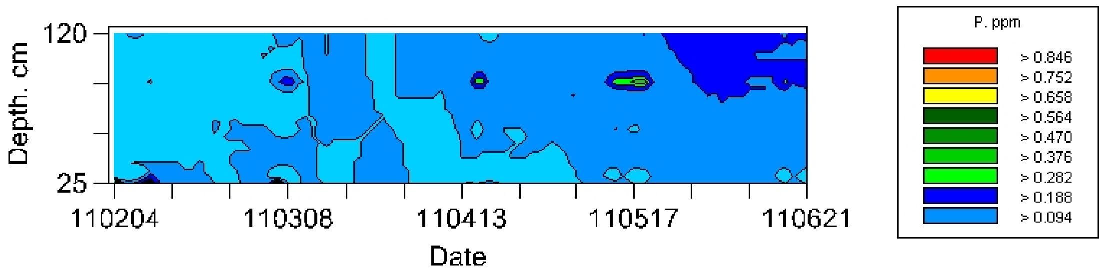

Figure 4. P concentration distribution in the soil profile for 78 kPa suction.

P concentrations were the highest at the surface soil between February and March 2011 for both suctions. For 60 kPa suction, the surface concentrations of P leached downward direction during this period, during which, surface soil reached at P concentrations less than 0.085 mgP $L^{-1}$and 60 cm and deeper soil layers reached at 0.16 mgP L^{-1}. In the early May and later, deeper soil layers became dominantly affected by highest P concentrations (Figure3).

The effect of suction on soil solution concentrations under drained conditions can be more obvious for 78 kPa (Figure 4). Dry conditions can result in local P concentration variable areas in the profile. This situation can be attributed to water flow regime at 78 kPa in the soil. P concentration were high in the surface soil for 78 kPa suction during the sampling period, while P concentrations started to increase in the late May in the soil profile. Ten-day uniform interval was used to create kriging maps of P distributions in soil, beyond which no spatial distribution map of P concentrations under tile drainage was found. No less than 92 sample pairs were used in the prediction maps of depth-wise concentrations.

Monitoring P contamination to water bodies from ag-lands is very important means to maintain sustainable P management practices and to determine ecological risk of its contamination. Labile P fractions are likely to be contained in soil pore water, which is easily collected by soil solution sampler lysimeters in field. Soil water and phosphorous concentrations are influenced in a differential way in different soil types and their properties. Therefore, the sampling of soil solution and chemical concentrations in the soil require some specific methods for sampling soil for solution concentrations and their distributions in the soil. Soil solution sampler lysimeters are used as a field based technique to sample soil solution from the same position and depth repeatedly. Therefore, this method was implemented in the research field.

Soil solution P concentrations between measurements for each sampled depth in the soil profile ranged largely, showing greater variability downward the profile but generally in the same order of magnitude. This shows that soil management practices, rainfall patterns, soil temperature, and soil structure played a significant role in the P mobility in the soil profile.

Pore water concentrations P are important available resources to plant uptake. P concentrations in soil solution can increase if P fertilization is practiced in the surface soils of the research site because lysimeters at different depths in the profile showed that P mobility was high in the surface soil and it moved down to the profile in time. This dynamic of the element would probably be screened by P measurements in soil samples with conventional methods. This study concludes that P concentrations even under no fertilizer application conditions can pose a contamination risk to the eutrophication of water bodies.

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Carbon Mineralization in Mine Tailing Ponds Amended with Pig Slurries and Marble Wastes

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Abstract
Effective application of organic residues to reclaim soils requires the optimization of the waste management to minimize CO_2 emissions and optimize soil C sequestration efficiency. In this study, the short-term effects of pig slurry amendment alone and together with marble waste on organic matter mineralization in two tailing ponds from Cartagena-La Unión Mining District (SE Spain) were investigated in a field remediation experiment. The treatments were: marble waste (MW), pig slurry (PS), marble waste + pig slurry (MW+PS), and control. Soil carbon mineralization was determined using a static chamber method with alkali absorption during 70 days. Soil respiration rates in all plots were higher the first days of the experiment owing to higher soil moisture and higher mean air temperature. MW plots followed the same pattern than control plots, with similar respiration rates. The addition of pig slurry caused a significant increase in the respiration rates, although in MW+PS plots, respiration rates were lower than in PS plots. The cumulative quantities of C-CO_2 evolved from the pig slurry mineralization were fitted to a first-order kinetic model explaining 90% of the data. This model implies the presence of only one mineralisable pool (C_0). The values of the index C_0*constant rate/added C were similar for PS plots in both tailing ponds, but lower in the MW+PS treatment, suggesting that the application of marble reduces the degradability of the organic compounds present in the pig slurry. Thus, the application of marble wastes contributes to slow down the loss of organic matter by mineralization.
Keywords: Carbon mineralization, tailing pond, heavy metal, marble waste, pig slurry.

Introduction
In the Region of Murcia (SE Spain) past mining activities have generated large amounts of unconfined wastes accumulated in tailing ponds due to intensive mining activities, especially in the Mining District of Cartagena-La Unión. Although mining activity was abandoned in 1991, tailing ponds still remain in the area. The environmental impacts of such structures generally result from their low pH, high metal content, low organic matter and null vegetation (Conesa et al., 2006). High incidence of wind and water erosion events negatively affects soil, water, vegetation, fauna, and human populations in the surrounding areas (Zanuzzi et al., 2009).
Reclamation is needed to avoid environmental risks. Alkaline materials are commonly used as an amendment for ameliorating the acidic conditions of many acid-generating mine wastes and for immobilising metals such as carbonates, mitigating metal toxicity (Barker, 1997). Organic residues are also normally used as amendments because the addition of organic matter can significantly improve the physical characteristics, the nutrient status, stimulate microbial populations and possibly reduce the availability of toxic metals through complexation (Ye et al., 2002).
Soil organic matter is universally recognized to be among the most important factors responsible for soil fertility and land protection from contamination, degradation, erosion and desertification, especially in semiarid areas (). Soil organic matter plays a major role in maintaining soil quality, supplying plant nutrients, reducing soil erosion, improving soil structure and water quality, and increasing biomass and vegetal productivity (Stevenson, 1994). A correct management of the application of amendments in soil reclamation relies mainly on two aspects: efficient increase of the soil organic matter and adequate match of the release of mineral nutrients to vegetation demand. Applying organic wastes to soil could represent a useful tool in maintaining and increasing amounts of organic matter (Mondini et al., 2007). Effective recycling of organic residues in soil requires the optimization of the organic waste management in order to minimize CO_2 emissions and optimize soil C sequestration efficiency. Therefore, the knowledge of carbon mineralization dynamics in amended soils is of intrinsic interest. Since the main objective after

application of organic amendments is the permanent increment of organic matter, a thorough study on organic carbon stability and mineralization is crucial. Efforts have to be made to use amendments that release nutrients but do not mineralise so fast that organic matter disappears before an adequate development of vegetation cover.

In the current study, the short-term effects of pig slurry amendment alone and together with marble waste on organic matter mineralization in two tailing ponds were investigated in a field remediation experiment.

Materials and Methods

The study was conducted in the Cartagena-La Unión Mining District (Region of Murcia, SE Spain), where great mining activities have been carried out for more than 2500 years. The climate of the area is semiarid Mediterranean, with mean annual temperature of 18ºC and mean annual rainfall of 275 mm. The potential evapotranspiration rate surpasses 900 mm $year^{-1}$. Two tailing ponds generated by mining activities were selected, Gorguel (37º 35’ N, 0º 52’ W; 7470 m^2), and Lirio (37º 36’ N, 0º 49’ W; 14600 m^2), since they are representative of the rest of existent ponds in Cartagena-La Unión Mining District: salinity, absence of vegetation, high metal concentrations, low organic carbon content and affection by wind and water erosion.

Both tailing ponds were divided in four different field-scale plots with a surface of 25% of the total area. Thus, plots in Gorguel had a surface of ~1868 m^2, while plots in Lirio had a surface of ~3650 m^2. Soil characteristics of the plots in each tailing pond are shown in Table 1.

Table 1. Main soil properties and total heavy metals contents in the different plots established in Gorguel and Lirio tailing ponds. Values are mean ± standard deviation (n=5).

Treatment[a]	pH	EC[b] dS m^{-1}	Texture (% sand, silt, clay)	TOC[b] g kg^{-1}	IC[b] g kg^{-1}	Nt[b] g kg^{-1}	Cd mg kg^{-1}	Cu mg kg^{-1}	Pb mg kg^{-1}	Zn mg kg^{-1}
Gorguel										
MW	7.76	7.62	Loam (47, 37, 16)	13.2	3.23	0.13	24.2	188	5041	12619
PS	7.51	2.64	Sandy loam (61, 32, 7)	11.4	3.06	<dl	29.5	193	4086	12741
MW+PS	7.90	3.87	Sandy loam (57, 35, 8)	14.3	3.05	<dl	32.6	176	3642	10927
CT	7.58	3.31	Sandy loam (76, 17, 7)	11.0	3.07	<dl	32.9	223	4595	12406
Lirio										
MW	5.47	7.65	Sandy loam (67, 32, 1)	2.3	0.05	<dl	48.2.3	159	3945	6757
PS	7.25	3.40	Loamy sand (80, 15, 5)	2.3	1.79	0.01	10.2	176	4177	4912
MW+PS	4.96	2.80	Sandy loam (70, 26, 4)	3.1	0.05	<dl	34.9	159	3598	10074
CT	5.32	5.50	Sandy loam (53, 38, 9)	2.0	0.12	<dl	38.2	203	4093	11851

[a] MW: marble waste; PS: pig slurry; CT: control

[b] EC: electrical conductivity; TOC: total organic carbon; IC: inorganic carbon; Nt: total nitrogen.

<dl: below detection limit

We used two different amendments (pig slurry and marble waste ($CaCO_3$)) for reclamation purposes, in order to increase soil organic matter and soil nutrients, decrease heavy metals availability, ameliorate soil structure, neutralize potential acidity generated by sulphides, and facilitate vegetation colonization. Each plot in both tailing ponds received a different treatment. The treatments were: marble waste (MW), pig slurry (PS), marble waste + pig slurry (MW+PS), and control (CT), the latter receiving no amendment. The pig slurry came from a pig farm in Pozo Estrecho (SE of Murcia), while marble waste (formed by particles of 5-10 µm diam.) was collected from quarries at the Cehegín region (NE of Murcia). The characteristics of soil amendments are given in Table 2.

Table 2. Main characteristics of the pig slurry (PS) and marble waste (MW) used.

Parameters	PS	MW
pH	7.8	8.0
Electrical conductivity (dS m^{-1})	39.1	2.2
Density (g mL^{-1})	1.0	-
$CaCO_3$ (%)	-	98
Moisture (%)	96.0	1.0
Total N (g L^{-1})	5.1	-
NH_4^+-N (g L^{-1})	4.5	-
Total organic carbon (g L^{-1})	17.8	-

The first activity consisted of tilling the first 50 cm of the surface soil in order to prepare it for the application of the amendments (control plot was also tilled). This activity was needed because of the presence of cementing agents such as oxides and hydroxides of iron, which provoke the formation of crusting, with a thick between 2 and 20 cm, very hardened, forming a coherent mass or strongly cemented. Amendments were mechanically applied. In the MW+PS plots, we first added the marble waste followed by the application of the pig slurry. After the application of amendments, all materials were mixed to a depth of 0-30 cm to incorporate the amendments into the soil. Application of amendments was carried out on 10 September 2010 in Lirio, and on 4 October 2010 in Gorguel.

We applied 4 kg marble m^{-2} and 1.4 kg marble m^{-2} in Gorguel and Lirio, respectively. These doses were calculated using the method proposed by Sobek et al. (1978), which provides an indication of the quantity of lime required to neutralise all the acid according to the sulphides present in the soil. Doses for pig slurry were established by thresholds imposed by legislation regarding the addition of N to soil to avoid contamination by nitrates (Council Directive 91/676/EEC). We applied 3 L pig slurry m^{-2}, corresponding to 60 g C m^{-2}.

Soil carbon mineralization was determined using a static chamber method with alkali absorption (Zibilske, 1994). Soil respiration was determined using white plastic cylinders (25 cm diam., 30 cm height) inserted 2 cm into soil. A sample vial containing 25 mL of NaOH 1 N was hung in the chamber by a wire held in place by a rubber stopper. Surface area of the chamber was 490 cm^2. Five chambers were randomly set out within each plot. Chambers were placed the day of application of amendments up to 43 and 67 days for Gorguel and Lirio, respectively. Alkali traps were replaced every 2-3 days during the first two weeks, and every 7 days from that date. Experiment was interrupted when respiration rates from amended plots equalled control values. Blanks were used in each tailing pond, with vials containing NaOH at the bottom of the chamber not exposed to soil, accounting for residual CO_2 absorbed from the atmosphere. The quantity of absorbed CO_2 was determined by titration (with HCl 1N) to a phenolphthalein endpoint following precipitation of the absorbed CO_2 to $BaCO_3$ with addition of excess $BaCl_2$ (Zibilske, 1994). Soil carbon mineralization was calculated based on exposure time and soil surface area. Cumulative mineralized organic carbon was also calculated to plot these values versus time.

In order to calculate the direct effect of amendments on CO_2-C evolved from soil, the average value of CO_2-C from the control soil was subtracted from each treatment to obtain the increment data (Δ data). This approach supposes that the possible priming effect due to the enhanced decomposition of native soil organic matter will no occur or they are small compared to the mineralization of the organic amendment. Then, in each treatment, the Δ data per treatment were averaged and the cumulative values were fitted to different kinetics functions. The best fits were using a first-order kinetic model $C_{min} = C_0 (1-e^{-K\ t})$, being C_{min} the carbon mineralized from soil once the control is subtracted (as CO_2-C) in a given time, C_0 the potentially mineralizable pool of organic C, K the mineralization constant rate, and t the time. The fits and kinetic parameters were carried out using the SigmaPlot 10.0 software.

Results

The values of soil respiration rates in all plots were higher the first days of the experiment owing to higher soil moisture due to different rainfall events, and higher mean air temperature (Figure 1). In Gorguel, significant correlations were found between basal respiration rate and soil moisture (r=0.83; P<0.001) and mean air temperature (r=0.52; P<0.01). In Lirio, basal respiration rate was only correlated with mean air temperature (r=0.67; P<0.001). CT plots showed a decreasing trend starting with an average initial soil respiration rate of 0.93 and 1.53 g CO_2-C m^{-2} d^{-1}, for Lirio and Gorguel respectively, and finishing with 0.65 and 1.02 g CO_2-C m^{-2} d^{-1}, for Lirio and Gorguel respectively (Figure 1c,d). MW plots followed the same pattern than CT plots, with similar respiration rates. The addition of pig slurry caused a significant increase in the respiration rates. The highest respiration rates in PS plots were reached during the first days, when most of the easily degradable compounds were not yet depleted.

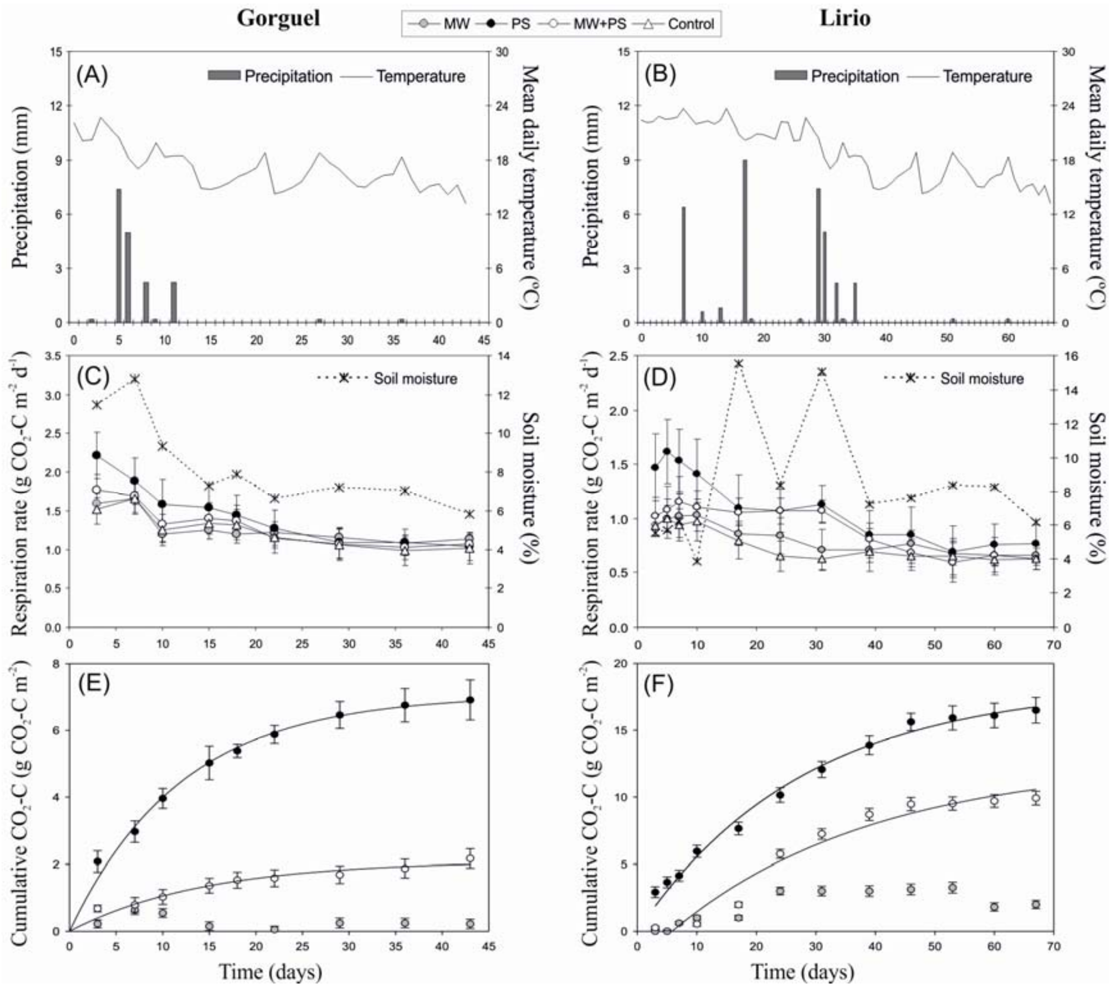

Figure 1. Weather conditions during the duration of the experiment, respiration rates and cumulative values of CO_2-C mineralised from pig slurry where control values have been subtracted (symbols are experimental data and lines represent the fitting of the first order kinetic model). Error bars denote standard deviation. MW: marble waste; PS: pig slurry.

The respiration peaks were reached the fifth day after the beginning of the experiment in Lirio (1.62 g CO_2-C m^{-2} d^{-1}) and the third day in Gorguel (2.22 g CO_2-C m^{-2} d^{-1}) to continuously decrease up to reach values similar to control at the end of the experiment (Figure 1c,d). In MW+PS plots, respiration rates were lower than in PS plots. Respiration rates were only positively correlated with arylesterase (r=0.75; P<0.001) and MBC (r=0.63; P<0.001), and negatively correlated with exchangeable Cd (r=-0.51; P<0.05), exchangeable Cu (r=-0.63; P<0.001) and exchangeable Pb (r=-0.70; P<0.001).

The cumulative quantities of CO_2-C evolved from the pig slurry mineralization (Figure 1e,f) were fitted to a first-order kinetic model explaining more than 90% of the experimental data. In Table 3 the potentially mineralisable C pools from the pig slurry estimated by the model are shown. These data are approximately equivalent to 30, 25, 12 and 4% of the organic carbon added for PS in Lirio, MW+PS in Lirio, PS in Gorguel and MW+PS in Gorguel, respectively. The mineralization constant rate (K) was higher for Gorguel plots than for Lirio. The values of the index C_0*K/added C were similar for PS plots in both tailing ponds, but lower in the MW+PS treatment, mainly for Gorguel. The cumulative quantities of CO_2-C released at the end of the experiment were positively correlated with sand content (r=0.87; P<0.01) and negatively correlated with IC (r=-0.85; P<0.01), pH (r=-0.83; P<0.01), clay content (r=-0.92; P<0.001) and total Zn (r=-0.82; P<0.01).

Table 3. Parameters of first order kinetic model ($C_{min} = C_0\ [1-e^{-K\,t}]$) fitted to the cumulative values of CO_2-C mineralised from pig slurry.

	Lirio		Gorguel	
	PS[a]	MW[a]+PS	PS	MW+PS
C_0 (g C m^{-2})	18.41	15.05	7.06	2.10
K (d^{-1})	0.0358	0.0293	0.0834	0.0697
C_0 * K/added C	0.0109	0.0074	0.0098	0.0024
R^2 adj	0.99	0.95	0.98	0.92
F	944 (P<0.001)	112 (P<0.001)	523 (P<0.001)	102 (P<0.001)

[a]PS: pig slurry; MW: marble waste

Discusion

Respiration rates were influenced by weather conditions, microbial size and availability of heavy metals, also reported in literature (e.g. Conant et al., 2000; Kao et al, 2006; Nwachakwu and Pulford, 2011). Mineralization of organic carbon was lower in Gorguel than in Lirio, despite applying the same quantity of slurry. This could be due to higher pH, higher carbonates content (expressed as inorganic carbon), lower sand content and higher clay content, inferred by the correlations study. Carbonates and clays stabilize organic carbon and make it more inaccessible for microbial attack (Bernal et al., 1991). Saviozzi et al. (1993) suggested that the use of the index C_0*K/added C is as an indicator of degradability for organic materials, being lower in MW+PS plots. Thus, the application of marble reduces the degradability of organic compounds. This is of special interest to enhance carbon accumulation in reclaimed soils, since the protection of soil C is an integral part of C sequestration (Shrestha and Lal, 2006). No differences with CT were observed in MW plots in terms of C mineralization. Thus, the application of carbonates seems to be useful to stabilize fresh and very labile organic matter, such as that supplied by pig slurries, rather than that long-term stabilized in soil. The percentages of PS mineralised C were lower than those found by Pardo et al. (2011) in mine soils (74-98% after 56 d of lab incubation), likely due to constraint climatic conditions in field experiments and higher heavy metals content. Metal binding to organic matter may offer some protection from microbial degradation (Merckx et al., 2001). Thus, despite no acidity corrections are needed, the combined application of pig slurry with marble wastes also helps to stabilize organic matter and minimize carbon losses as CO_2.

Acknowledgements

This work has been funded by the European Union FP7 Project No: CP-IP 213968-2 IRIS. R. Zornoza acknowledges a “Juan de la Cierva” contract from the Ministry of Science and Innovation of the Government of Spain. J.A. Acosta acknowledges a “Saavedra Fajardo” contract from the Fundación Séneca of Comunidad Autónoma de Murcia (Spain).

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Heavy metal dynamics and microbial activity after remediation of a mine tailing pond in SE Spain

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Abstract

In this study, the effects of pig slurry and marble waste amendments on stabilization of heavy metals and microbial activity in a tailing pond from Cartagena-La Unión Mining District (SE Spain) were investigated in a field remediation experiment. The treatments were: marble waste (MW), pig slurry (PS), MW+PS, and control. Bioavailable metals, microbial biomass and three enzyme activities were periodically monitored during 70 days. Bioavailable Cd rapidly decreased in all amended plots, being the contents lower in MW+PS plots. Bioavailable Pb and Zn decreased in MW and MW+PS plots. Microbial biomass carbon rapidly increased in PS and MW+PS plots. However, after 25 days of application of amendments microbial biomass decreased up to values similar to control in PS plot, while in MW+PS plot this parameter maintained high values during all the experiment. β-glucosidase activity also increased in PS and MW+PS plots. After 10 days, this activity started a decreasing trend, but values were always higher than in MW and control plots. The activity of β-galactosidase only significantly increased in PS plot, keeping high values during all the experiment. Arylesterase activity only increased in MW+PS plot. No correlations were found between metals contents and microbial properties. Thus, the application of pig slurry together with marble waste is the best option to reduce the mobility and bioavailability of heavy metals, and activate microbial activity. Increments in microbial size and activity are bound to increases in organic compounds coming from the organic amendment, rather than to decreases in metal mobility.
Keywords: heavy metals, microbial biomass, enzyme activities, marble waste, pig slurry.

Soil Clean Up and Remediation Technologies

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Abstract
Soil is one of the most important natural resources and has vital importance. Soil pollution is occurred in consequence of misuse soil. Soil contamination is negative affected to soil quality and fertility. In fact, soil conservation and decontamination are in needed for soil management and sustainable soil use. Several methods and technologies exist for remediation of soil properties and removal pollutants from contaminated soils. In this study, these technologies are grouped as; (i) *in situ* (on site), (ii) *ex situ* (off site) and (iii) non-commercial techniques into categories by; (i) physical, (ii) chemical and (iii) biological methods and various items. Remediation technologies are also investigated by the which they effect clean up such as; (i) heavy metals, (ii) organic and inorganic compounds, (iii) pesticides (iv) radionuclides, (v) hydrocarbons, and (vi)petroleum products. Various technologies are used for removal the pollutants from environment. There are some advantages and disadvantages of these methods in comparison with each other. It is frequently necessary to apply several techniques to soil from a particular location to reduce the concentrations of contaminants to acceptable levels because of the complex nature of various polluted soils such as; mixture of heavy metals, pesticides, organic and inorganic compounds. Secondary or toxic residue can be left during treatment by some remediation technologies. Several technologies usually work well when applied to specific type of soil contamination. No readily available standard methods are available, which can clean all types of pollutants.
Keywords: Soil pollution, clean up, remediation, contaminants, decontamination techniques.

Introduction

Soil is an extremely variable medium, non-renewable, natural, vital resource, and has vital importance for life on Earth. Soil underpins 90% of all human food, fiber, and fuel and is essential for water and ecosystem health. Soil conserves the remains of our past; it is a reservoir for genes and is an important element of our cultural heritage, through the maintenance of landscapes and biodiversity (EU-EEA, 2012). The formation of soil happens over a very long period of time. It can take 1000 years or more. As soil is the interface between the earth (geosphere), the air (atmosphere) and the water (hydrosphere), its multifunctional role is essential for life on this planet. Soil performs a multitude of key environmental, economic, social and cultural functions. These functions interact intensively and are often in competition. Some functions exclude one another, while some other functions interact intensively and can be performed simultaneously if delicate balances are respected (EU-COM, 2001; EU-COM, 2002).

Healthy and fertile soil is very important for human health and human-being because what is in the soil affects the environment. Soil contamination negatively affects soil quality and fertility. Soil pollution is occurred in consequence of misuse and out of purpose of soil. However, soil is increasingly under pressure. These pressures are threatening the long-term viability of our soils. When multiple pressures occur simultaneously, their effects tend to become even more important. It needs to be protected for sustainable development and soil management (EU-COM, 2006).

Soil contamination is a widespread problem worldwide. Several methods do exist to remediate polluted soil. In most cases, soil clean up is a very difficult operation with very high costs. Therefore, there is an urgent need for enhancing bioremediation, low-cost remediation technologies, effective and affordable technological solutions. Clean up and remediation technologies mainly help to treat and remove contaminants. Moreover, technologies that simultaneously treat and remove contaminants from mixed waste, radionuclides, metals and organics, are desired (Wenzel et al., 1999a and Wenzel et al 1999b).

Soil Remediation Techniques

In this study, soil cleaning technologies are classified in 3 main groups as; (i) *in situ*, (ii) *ex situ*, (iii) non-commercial techniques by physical, chemical and biological methods and various items (figure 1 and table 1). *In situ* (on site) technologies use soil excavating processes. These techniques are taken place on the contaminated site. *Ex situ* (off site) technologies are applied to excavated soil and/or extracted groundwater. Off site processes treat materials that have been removed from the excavated site (EPA, 1993).

Treatments and processes in these technologies can be described as five main topics (EPA, 1994a; EPA, 1994b):
(i) Biological Processes are used to contingent on the use of living organisms.
(ii) Chemical processes are used to destroy, fix or concentrate toxic compounds by using one or more types of chemical reactions.
(iii) Physical processes are used to separate contaminants from the soil matrix by exploiting physical differences between the soil and contaminant such as; volatility or between contaminated and uncontaminated soil particles such as; density.
(iv) Solidification and stabilisation are used to process immobilised contaminants through physical and chemical processes. Solidification processes are those which convert materials into a consolidated mass. Stabilisation processes are those in which the chemical form of substances of interest is converted to a form which is less available.
(v) Thermal processes are used to exploit physical and chemical processes occurring at elevated temperatures.

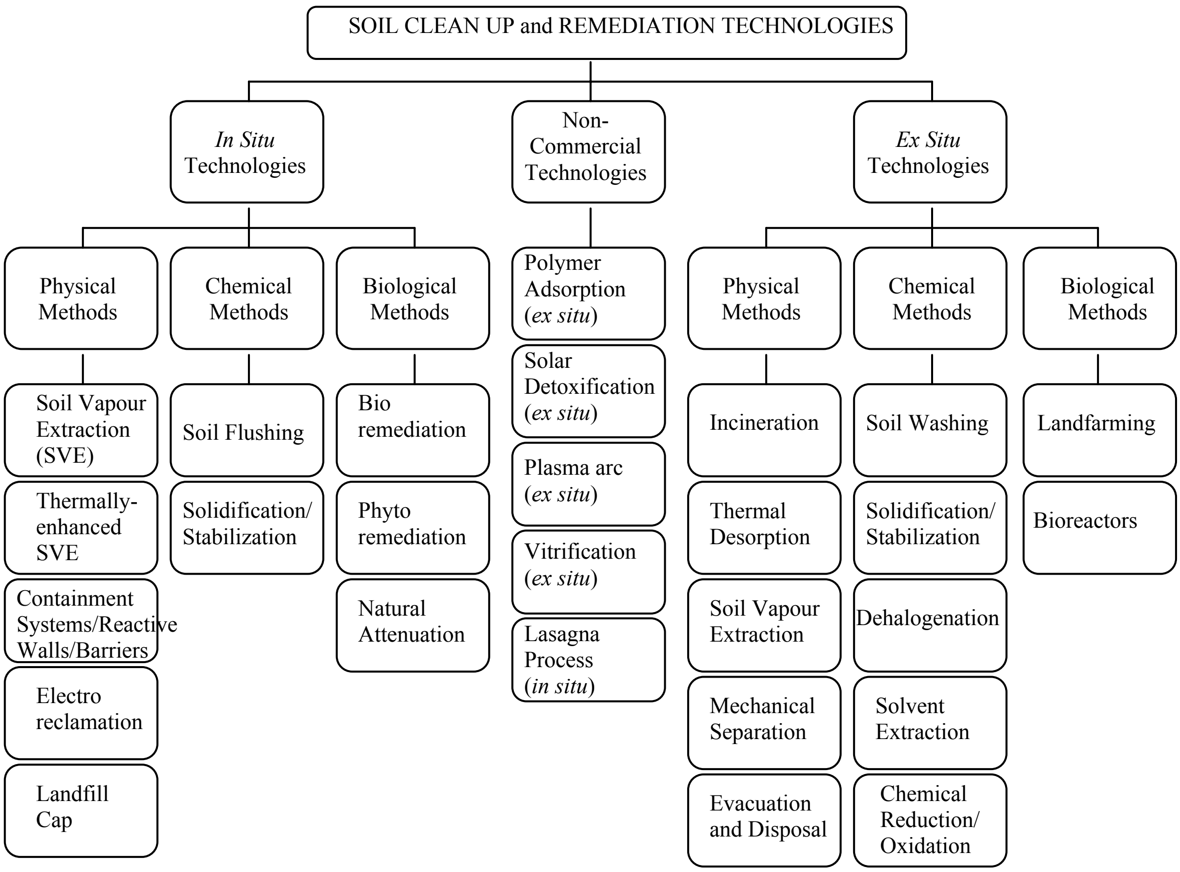

Figure 1. Three broad soil remediation technologies and methods and techniques, which they employ

Table 1. Soil clean up and remediation technologies and target contaminants.

Soil Clean Up and Remediation Technologies	**Target Contaminants**
I. *In Situ* Technologies	
A. Physical Methods	
1. Soil Vapour Extraction	Halogenated and non-halogenated volatile organics, fuel hydrocarbons.
2. Thermally-enhanced Soil Vapour Extraction	Halogenated and non-halogenated semi-volatile organic compounds.
3.ContainmentSystems/Reactive Walls/Barriers	All types of contaminants.
4. Electroreclamation	Heavy metals, polar organics.
5. Landfill Cap	Hazardous, putrescible wastes, methane, CO_2.
B. Chemical Methods	
1. Soil Flushing	Halogenated and non-halogenated volatile organics, inorganics, radionuclides.
2. Solidification/Stabilization	Inorganics, heavy metals.
C. Biological Methods	
1. Bioremediation	Halogenated and non-halogenated volatile and semi-volatile organics, fuel hydrocarbons.
2. Phytoremediation	Selected organics, heavy metals, radionuclides.
3. Natural Attenuation	Non-halogenated organics, fuels.
II. *Ex Situ* Technologies	
A. Physical Methods	
1. Incineration	All organic compounds
2. Thermal Desorption	Semi-volatile halogenated and non-halogenated organics.
3. Soil Vapour Extraction	Volatile halogenated and non-halogenated organics.
4. Mechanical Separation	Semi-volatile organics, fuels, radionuclides.
5. Evacuation and Disposal	All types of contaminants.
B. Chemical Methods	
1. Soil Washing	Halogenated and non-halogenated semi-volatile organics, fuel hydrocarbons, inorganics.
2. Solidification/Stabilization	Inorganics, heavy metals,
3. Dehalogenation	Halogenated semi-volatile organics, pesticides.
4. Solvent Extraction	Semi-volatile halogenated and non-halogenated organics, pesticides, heavy metals.
5. Chemical Reduction/Oxidation	Inorganics.
C. Biological Methods	
1. Landfarming	Non-halogenated volatile organics, fuel hydrocarbons.
2. Bioreactors	Non-halogenated volatile organics, fuel hydrocarbons.
III. Non-commercial Technologies	
1. Polymer adsorption (*ex situ*)	Heavy metals.
2. Solar detoxification (photolysis) (*ex situ*)	Volatile and semi-volatile organic compounds, PAHs, halogenated and non-halogenated compounds, dioxins/furans, pesticides, explosives and heavy metals.
3. Plasma arc (*ex situ*)	PCBs, dioxins/furans and pesticides.
4. Vitrification (*ex situ*)	Organic compounds, metals and radionuclides.
5. Lasagna process (*in situ*)	Semi-volatile and volatile organic compounds, halogenated organics and heavy metals.

Discussion

There are numerous remediation research topics and innovative techniques which are being investigated. The exceptions are for phytoremediation and electroreclamation, which are both emerging technologies holding substantial promise and which have both been applied successfully on a small scale (EPA, 1997; EPA, 2000; EPA, 2001; EPA, 2005).

Bioremediation is a biological alternative to incineration, soil washing, and land filling. This technology uses enhanced plant and/or microbial action to degrade organic contaminants into harmless metabolic products. Petroleum constituents, including the more resistant polyacrylic aromatic hydrocarbons (PAHs), as well as several synthetic compounds, such as pentachlorophenol (PCP) and trichloroethylene (TCE), can be broken down, primarily by soil bacteria and so-called white-rot fungi. Bioremediation is usually accomplished *in situ*, but polluted soil may also be excavated and hauled to a treatment site where such techniques as high-temperature composting may be used to destroy the organic contaminants in the soil (Brady and Weil, 2002).

Most remediation technologies are used for many reasons such as; to protect human health and the environment, to enable redevelopment, to repair problems, to limit potential liabilities. There are many factors for selecting an effective remediation application. These include considerations of core objectives such as; sustainable development, risk management, remediation objectives, technical practicability and feasibility, cost effectiveness (cost/benefit ratio), stakeholders' views and wider environmental, social and economic impacts.

Different technologies usually work well when applied to a specific type of soil pollution, though there is no unique treatment that can clean all types of pollutants. Due to the complex nature of many polluted soils such as; ‘cocktail’ of hydrocarbons and heavy metals, or pesticides and spilled fuels, it is frequently necessary to apply several technologies to soil from particular location to reduce the concentrations of pollutants to acceptable levels (UN-ECE, 2000).

Remediation techniques also have been categorized by the means of which they affect clean-up (table 2 and 3). Some methods can eliminate wastes through reactions which produce benign or at least less harmful products. Thermal and biological methods using bacteria are typical examples (EPA, 1983). Other methods can concentrate wastes, resulting in a mass which may be easier to manage, neutralize, or dispose of. Soil washing and vapour extraction are in this category. Another approach is to fix the contaminants in place, eliminating, or severely reducing, the risk of exposure to the public.

Whatever the method, the application of the technique must be properly controlled to minimize the risks associated with the remediation process: elimination techniques have the potential to cause undesirable reactions which may generate other harmful compounds; concentration techniques leave smaller, but still quite hazardous, waste which must be disposed of; and stabilization must be applied properly or it will be ineffective (UN-ECE, 2000).

In Situ treatments have the advantage of being performed directly on the polluted site. This reduces the chances of human and environmental exposure during excavation, transportation and remediation, and carries with it the cost saving of having to excavate the soil. However, *in situ* technologies have several disadvantages. Main among these is the heterogeneous nature of the substrate at many contaminated sites, both from the geological and pollutant distribution perspectives. The proper choice and application of an *in situ* technique can only be made with high quality site data. Pockets or zones of contaminants may require tailored treatment, and the existence of preferential flow paths for air and water can result in areas of the site receiving inadequate treatment. Also, for recalcitrant pollutants, it may difficult or impossible to achieve the desired level of clean-up with some *in situ* techniques, due to unfavourable ambient conditions.

Ex Situ treatments involve the removal and treatment of the contaminated soil a way from the site itself. This obviously requires that the cost of removal and transport not be excessive, and that the volume of materials to be transported be practical. These techniques may also have the disadvantage of serious disruption to the geologic state of the site, and possible disturbance of watercourses, both surface and subterranean. During movement of the contaminated materials it is possible that personnel involved in the work may be exposed to the contaminants. Conversely, the isolation and treatment of the contaminated materials away from the site allows numerous more sophisticated techniques to be employed which can be more effective, more rapid and safer to groundwater and to local residents (UN-ECE, 2000).

There are several new techniques related to non-commercial soil remediation technologies developed in various laboratories. Most of non-commercial which have not yet been commercialized but which appear to be promising.

Table 2. Example of technologies suitable for treating different types of contaminants (EPA, 2012).

Technologies by Type		Technologies by Contaminant
Air Sparging	Natural Attenuation	Arsenic
Bioreactor Landfills	Permeable Reactive Barriers	Chromium VI
Bioremediation of Chlorinated Solvents	Phytotechnologies	Dense Nonaqueous Phase Liquids (DNAPLs)
Bioventing and Biosparging	Remediation Optimization	1,4-Dioxane
Electrokinetics	Sediments	Dioxins
Evapotranspiration Covers	Soil Vapour Extraction	Mercury
Fracturing	Soil Washing	Methyl Tertiary Butyl Ether (MTBE)
Ground-Water Circulating Wells	Solvent Extraction	Perchlorate
In Situ Flushing	Thermal Treatment - *Ex Situ*	Persistent Organic Pollutants (POPs)
In Situ Oxidation	Thermal Treatment - *In Situ*	Polychlorinated Biphenyls (PCBs)
Multi-Phase Extraction		Sediments
Nanotechnology: Applications for Environmental Remediation		Trichloroethylene (TCE)

Table 3. Examples of technologies suitable for treating different types of contaminants (EPA, 1999).

Contaminants Treated	Suitable Remediation Technologies for Soil
Volatile organic compounds (VOCs)	*Ex situ* Bioremediation; *In situ* Bioremediation; *In situ* Soil Flushing, Soil Vapour Extraction (SVE), Thermal Desorption, *In situ* Vitrification.
Semi-Volatile Organic Compounds (SVOCs)	Thermally-Enhanced SVE; Soil Washing; Solvent Extraction; Thermal Desorption
Inorganic Semi-Volatile Organic Compounds	Soil Flushing; Soil Washing; Electrokinetic Separation; Solvent Extraction; Chemical Treatment and Phytoremediation.
Petroleum Fuel Oil	*Ex situ* Bioremediation; *In situ* Bioremediation; Soil Washing; SVE; Soil Washing;
Explosives	*Ex situ* Bioremediation; *In situ* Bioremediation; Soil Washing; Solvent Extraction; Thermal Desorption

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The effect of agricultural abandonment on soil organic C and total N in rangeland ecosystems of Chaharmahal and Bakhtiari Province in Central Iran

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Abstract

Agricultural abandonment may lead to the recovery of soil organic matter (SOM) in rangelands exposed to long-term tillage and cultivation. The aim of this study was to evaluate the influence of land abandonment on soil organic carbon (OC), total nitrogen (TN), and labile C fractions in a semi-steppe rangeland ecosystem located in Chaharmahal and Bakhtiari Province, Central Iran. Five different land uses including permanent cultivation (PC), permanent rangelands (PR), lands abandoned for 3-5 (AD1), for 10-15 (AD2) and for 30-60 (AD3) years were selected in grazing rangelands. Soil OC and TN concentrations and pools of the 0-15 and 15-30 cm depths from abandoned lands were compared to those from permanently cultivated lands and permanent rangelands. Results show that the OC and TN concentrations (g kg^{-1}) and pools (Mg ha^{-1}) at both soil depths increased significantly in AD2 and AD3 compared with PC lands. The total OC and N accumulations for the entire sampling depth (0-30 cm) in AD3 lands were 60 and 5.5 Mg ha^{-1}, respectively which were 36.7% and 28% greater relative to cultivated lands. Particulate organic C (POC), dissolved organic C (DOC) and microbial biomass C (MBC) followed a trend similar to OC, but the rates of increase in POC and DOC concentrations were higher than those of MBC and OC concentrations. The results indicate that 30-60 years of agricultural abandonment might be an appropriate time for SOM recovery to the earlier state of soil conditions in pre-agricultural levels.
Keywords: Land abandonment, Soil C sequestration, Labile C, SOM recovery, Semi-steppe rangelands

Introduction

Soil organic matter (SOM) is a major reservoir of organic carbon (OC) which is three times higher than the amount of C in the atmosphere and two times higher than that in the terrestrial biota (Lal, 2008). Since the pool of C in the atmosphere is smaller than that in the world soils, a small change in the amount of soil C will have a substantial influence on the C content in the atmosphere (Bruce et al., 1999). Thus an understanding of the changes in SOM storage and dynamics is fundamental to evaluate the role of world soils as a C source or sink (Lal, 2004). It has been indicated that agricultural practices and soil cultivation in rangelands would lead to remarkable changes in C inputs and dynamics (Guo and Gifford, 2002) that subsequently influence microbial and biochemical processes (Raiesi, 2007; Li et al., 2009; Preger et al., 2010). During agricultural practices in rangeland ecosystems, soil disturbance by ploughing, breakdown soil aggregates, increasing soil porosity and C availability for microorganisms and hereby enhancing microbial oxidation of SOM (Cambardella and Elliot, 1993; Solomon, 2000). This will weaken soil structure stability (Solomon, 2000). Significant loss of soil OC following soil cultivation is often caused by enhanced SOM decomposition (Raiesi, 2012). This has led to a decrease in C stored in soils and a net release of C into the atmosphere, which has strongly influenced atmospheric CO_2 levels and global C balances (Schlesinger, 1984). Agricultural abandonment might be an alternative management for restoring soil conditions and SOM from prolonged cultivation and agricultural practices (Post and kwon, 2000; Templer et al., 2005; Raiesi, 2012).

Land abandonment and subsequent cessation of agricultural activities occurs globally in all ecosystem types, climatic zones, and soil and vegetation types (Guo and Gifford, 2002; Raiesi, 2012). This abandonment has been largely due to the low productivity of some crops, the development of industrialization and tourism and the shortage of water as a result of drought that would all lead to soil degradation and erosion, particularly in arid and semi-arid climates (Zhao et al., 2005; Raiesi, 2012; Raiesi, 2012). There is some evidence that the abandonment of agriculture and the subsequent recovery of natural vegetation may return C and N storage to the pre-agricultural levels (Templer et al., 2005). Changes that occur in physical, chemical and biological soil conditions after land abandonment may have an important effect on soil C and N pools, microbial activity and biomass (Zhang et al., 2010; Raiesi, 2012). However, SOC is heterogeneous and contains fractions with a rapid turnover rate a swell as fractions with a slower turnover rate (Schimel et al., 1985). The labile fractions of organic C, such as microbial biomass C (MBC), dissolved organic C (DOC) and particulate organic C (POC) can respond rapidly to changes in C supply and to land use type. These components have therefore been suggested as early indicators of the effects of land use on SOM quality and as important indicators of soil quality (Gregorich et al., 1994). There has been an increasing interest in the importance of labile C fraction such as POC, DOC and MBC as the indicators of change in the soil quality (Saggar et al., 2001). Zhang et al. (2006) reported that abandoned soils showed an increase in soil OC, DOC and MBC when compared with cultivated soils. The abandonment of cultivated soils resulted in an increase in OC, MBC and DOC concentrations (Zhang et al., 2007). Li et al. (2009) revealed that cropping abandonment increased soil OC, TN and POC pools in comparison with croplands.

Abandonment of agricultural fields in grazing rangelands during the past decades has been the main interest for the restoration of rangeland soils in Central Iran. Agricultural abandonment in rangeland ecosystems occurs mainly due to low rainfall and water shortage and subsequent low income from rainfed cropping, especially wheat and barley. Following the cessation of cultivation and abandonment, land might be used for grazing or left unused over a long time period (Raiesi, 2012). However, very little is known about the changes in soil OC, TN and the labile C fractions after the abandonment of cultivated lands in arid and semi-arid soils of Central Iran. Therefore, the objective of the present study was to investigate the effects of different times of land abandonment on soil OC, TN and labile C fractions in a semi-arid rangeland.

We hypothesized that land abandonment in grazing rangelands would increase soil OC and TN concentrations and pools as well as the labile C fractions, such as DOC, POC, and MBC.

Materials and Methods

The research area is located in semi-steppe rangelands in Karsanak region, Chaharmahal and Bakhtiari Province, Central Iran, at approximately 32° 31′ N and 50° 28′ E at an altitude of around 2574 m above sea level. The climate of the region is semi-arid with a mean annual rainfall of 560 mm and mean annual temperature of 10° C. The soil of the study area is a silty loam Typic Haploxerept. In the area, landscapes are mosaic of native grazing lands covered by *Astragalus adscendense*, *Agropyron repense* and *Bromus tomentelus*-*Agropyron repense*, cultivated and abandoned lands. Rainfed cropping systems, especially wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) crops, in grazing rangelands over the past century were common and wheat cultivation still is continuing at the present time. Over the past decades, land abandonment and subsequent cessation of agricultural activities occurred in these rangelands. This abandonment has been due largely to the low productivity of wheat, the immigration of local farmers to large cities, and most likely the shortage of water as a result of drought.

Based on data and information obtained from local farmers, historical records and aerial photos, all abandoned and cultivated fields experienced similar tillage and cultivation practices in the years prior to abandonment date, and they were used for many decades (>100years) as arable lands. Five different land uses including 1) permanently cultivated rainfed wheat fields (PC) (i.e., unabandoned fields), 2) wheat fields abandoned for 3-5 years (AD1), 3) wheat fields abandoned for 10-15 years (AD2), 4) wheat fields abandoned for more than 30-60 years (AD_3) and 5) never-uncultivated rangelands or permanent rangelands (PR) as the reference site, were selected. The experiment was a completely randomized design which had five treatments (PC, AD1, AD2, AD3 and PR) with six replications. Composite soil samples were obtained at two soil depths of 0-15 and 15-30 cm in each replication of the above land uses. In total, 60 composite samples were collected, including 5 land uses, 2 depth and 6 replicates. Soil samples were air-dried and passed through a 2-mm sieve; plant fragments larger than 2 mm were removed by hand and soil samples were stored for laboratory analysis. Bulk density (the clod method), OC (the Walkley & Black method) and TN (the Kejldahl method) contents were determined following procedures described in Carter and Gregorich (2008). All reported values are expressed based on oven-dry soil weight basis (105°C). Carbon and N pools (Mg ha^{-1}) were calculated as follows:

$$\text{Pool} = \text{BD} \times \text{D} \times C \textit{ or } N / 10$$

Where BD is the bulk density (g cm^{-3}), D is the thickness (cm) of the soil layers equal to 15 cm and *C* and *N* is C and N concentrations (g kg^{-1}) of the 0-15 and 15-30 cm soil depths. Total OC and N pools were also calculated for the whole 30 cm depth by the summation of the C and N pools at each sampling depth within the soil profile. Soil microbial biomass C (MBC) was determined by a fumigation-extraction method (Vance et al., 1987). In brief, the fumigated and non-fumigated soils were extracted with 0.5 M K_2SO_4 by shaking at 30 rpm for 30 min (soil:extractant ratio of 1:4), and soluble OC in the extracts was determined by dichromate digestion method (Vance et al., 1987). The amount of microbial biomass C was also expressed as the MBC/OC ratio (microbial quotient or MQ) as an indicator of the relative availability of C for soil biota (Raiesi,2012). For dissolved organic carbon (DOC) measurement, air-dried soil samples (equivalent to 10 g oven-dried weight) were weighted into 50-ml polypropylene centrifuge tubes. The samples were extracted with 30 ml of distilled water for 30 min on a shaker at approximately 230 rpm and centrifuged for 20 min at 8000 rpm. All the supernatant was filtered through a 0.45-μm filter into separate vials for C analysis (Ghani et al., 2003; Zhang et al., 2007). The OC in the extracts was also determined by dichromate digestion method (Vance et al., 1987). The amount of DOC was expressed based on mg C per kg soil and as the DOC/OC ratio. The measurement of particulate organic C (POC) by Loss-on-Ignition (LOI) was done following the procedure of Cambardella et al. (2001). In brief, 25 grams of air-dried and sieved (2mm) soil was dispersed in 75 ml sodium hexametaphosphate (5%) for 16 h on a reciprocating shaker at 120 strokes per minute. After dispersion, the suspensions were sieved through 0.053 mm sieve to separate sand particles + POM (particulate organic matter). The collected sand particles + POM were dried at 55 °C before being weighed, and then subjected to 450 °C for 4 h to measure POC by the LOI method. The amount of POC was expressed based on g C per kg soil and as the POC/OC ratio. Mineral-associated (<0.053 mm) organic C (MOC) was estimated as the difference between soil OC and POC. Differences in soil characteristics were analyzed using two-way analysis of variance (ANOVA) with land uses, depth and their interaction as the independent variables. In case of significant main and interaction effects, differences among the means were calculated by the Fisher's LSD test. Differences were considered significant only when *P* values were lower than 0.05 ($P \leq 0.05$). All statistical calculations were carried out using the software program SAS (SAS Institute, 2005).

Results and Discussion

The soil OC and TN concentrations were lowest in PC and highest in PR land uses at both soil depths (Table 1). In 0-15 cm layer, the concentrations of OC and TN in AD3 land use were about 43% and 38% higher than those in PC land use, respectively. Similarly, AD3 soils had greater OC (35%) and TN (23%) than PC soils in 15-30 cm layer. However, there were no significant differences in OC and TN between AD3 and PR land uses in both soil layers. Similar patterns for changes in OC and TN pools were observed with agricultural abandonment in both depths (Table 1). In the 0-30 cm, PR soils had greater OC (39.1%) and TN pools (38.8%) than PC soils (Fig. 1). Soil OC pools increased by 3.53-36.7% in abandoned lands as compared with cultivated lands in the whole soil profile (0-30 cm). For TN pools, the increase was 4.71-28% in abandoned lands over PC lands (Fig. 1). Our results showed significant increasing in OC and TN concentrations and pools with the increasing time of abandonment in surface and sub-surface soils, suggesting that the re-accumulation of OC and TN may occur following agricultural abandonment in these grazing rangelands. Similarly, previous studies reported higher soil OC and TN contents in abandoned than cultivated fields (Zhao et al., 2005; Zhang et al., 2007; Li et al., 2009; Raiesi, 2012). This could be largely due to the C inputs from plant residue (Raiesi, 2012). The OC content in a soil depends on the balance between the C input rate via organic residues and output rate via microbial decomposition rates. These two factors are essentially altered by land use and abandonment (Li et al., 2009). The greater soil OC contents in abandoned lands may partly be attributed to either decreased C decomposition rate (turnover) or enhanced C inputs to the soil because a large proportion of above and below-ground biomass from natural plant community is annually added to the soil, whilst a significant portion of aboveground biomass is harvested and exported outside in agricultural fields (Li et al., 2009).

Table 1. Soil OC and TN contents (concentration and pool), and labile OC fractions as affected by different land use types in semi-arid rangelands, Central Iran (*n*=6).

Variable	0-15 cm					15-30 cm				
	PC	AD1	AD2	AD3	PR	PC	AD1	AD2	AD3	PR
OC ($g\ kg^{-1}$)	9.66^{b}	9.66^{b}	11.2^{b}	13.8^{a}	14.6^{a}	8.66^{b}	8.58^{b}	9.83^{b}	11.7^{a}	11.6^{a}
TN ($g\ kg^{-1}$)	0.93^{c}	0.96^{bc}	1.10^{bc}	1.28^{ab}	1.41^{a}	0.86^{c}	0.85^{c}	0.96^{bc}	1.06^{ab}	1.16^{a}
C:N	10.4^{a}	10.0^{a}	10.2^{a}	10.8^{a}	10.3^{a}	10.0^{b}	10.1^{b}	10.2^{b}	10.9^{a}	10.0^{b}
C Pool ($Mg\ ha^{-1}$)	22.9^{b}	23.7^{b}	26.7^{b}	31.5^{a}	32.4^{a}	20.7^{b}	21.4^{b}	25.1^{a}	28.2^{a}	28.3^{a}
N Pool ($Mg\ ha^{-1}$)	2.22^{c}	2.38^{c}	2.63^{bc}	2.92^{ab}	3.13^{a}	2.08^{c}	2.12^{c}	2.46^{b}	2.57^{ab}	2.83^{a}
POC ($g\ kg^{-1}$)	2.90^{d}	1.83^{e}	5.06^{c}	6.86^{b}	7.72^{a}	2.31^{d}	1.05^{e}	3.56^{c}	6.04^{b}	6.94^{a}
MOC ($g\ kg^{-1}$)	6.76^{a}	7.83^{a}	6.11^{a}	6.97^{a}	6.94^{a}	6.35^{b}	7.53^{a}	6.26^{b}	5.63^{bc}	4.71^{c}
DOC ($mg\ kg^{-1}$)	51.1^{d}	31.7^{e}	85.2^{c}	111^{b}	125^{a}	29.7^{d}	17.8^{e}	57.3^{c}	82.4^{b}	97.9^{a}
MBC ($mg\ kg^{-1}$)	320^{c}	307^{c}	395^{b}	446^{a}	467^{a}	275^{c}	263^{c}	365^{b}	424^{a}	452^{a}
POC:OC (%)	30.4^{c}	18.8^{d}	45.0^{b}	50.5^{ab}	53.3^{a}	27.3^{d}	12.1^{e}	36.2^{c}	52.0^{b}	59.0^{a}
DOC:OC (%)	0.53^{c}	0.32^{d}	0.76^{b}	0.81^{ab}	0.86^{a}	0.34^{d}	0.20^{e}	0.58^{c}	0.70^{b}	0.84^{a}
MBC:OC (%)	3.37^{a}	3.17^{a}	3.50^{a}	3.28^{a}	3.78^{a}	3.20^{b}	3.04^{b}	3.71^{a}	3.64^{a}	3.88^{a}
MOC:OC (%)	69.5^{b}	81.1^{a}	54.6^{c}	49.4^{dc}	46.6^{d}	72.7^{b}	87.8^{a}	63.7^{c}	47.9^{d}	40.0^{e}

OC=organic carbon, TN=total nitrogen, POC=particulate organic carbon, MOC=mineral associated organic carbon, DOC=dissolved organic carbon and MBC=microbial biomass carbon. PC=permanently cultivated lands, AD1= lands abandoned for 3-5 years, AD2= lands abandoned for 10-15 years, AD3= lands abandoned for 30-60 years and PR=permanent rangelands. Different letters indicate significant difference ($P<0.05$) among land uses at each soil depth.

Results also indicate that stratification ratios of OC concentrations and pools (the value of each parameter in the 0-15 cm soil layer divided by that in the 15-30 cm layer) were lower in the PC (1.11 and 1.10, respectively) than in AD3 (1.18 and 1.12, respectively) lands, again suggesting greater C inputs from natural vegetation with land abandonment. High stratification ratios of soil OC may also display a relatively undisturbed soil with a higher quality. This would mean that SOM stratification occurs in non-disturbed soils and the mixing of the upper 30 cm by ploughing in cultivated soils (Raiesi, 2012). As with bulk soil OC and TN, the concentration of POC fraction was 74%, 136% and 166% higher in AD2, AD3 and PR soils than that in PC soils in the surface layer, respectively. However, they had similar MOC concentrations (Table 1).

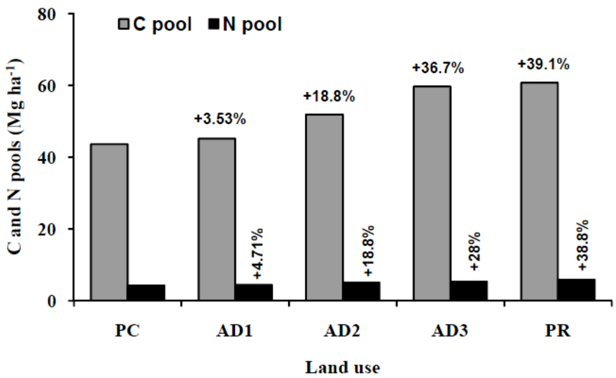

Fig.1. The C and N pools for the whole 30 cm depth from different land uses (n=*6*). Values on bars indicate changes in C and N pools over permanent cultivation. PC= permanently cultivated lands, AD1=land abandoned for 3-5 years, AD2=lands abandoned for 10-15 years, AD3=lands abandoned for 30-60 years and PR= permanent rangelands.

In the 15-30 cm layer, the concentration of POC fraction was 54%, 161% and 200% higher in AD2, AD3 and PR soils than that in PC soils, respectively, while they contained significantly different MOC concentrations. The concentration of MOC fraction was 1.43%, 12.8% and 34.8% greater in PC than AD2 AD3 and PR soils, respectively. Changes in POM are usually related to the types of land use and management that affect the balance between organic matter input from plant biomass and organic matter loss during decomposition (Cambardella and Elliott, 1993). More plant litter inputs to soil occurred under permanent rangelands and abandoned lands with re-established natural vegetation than under permanent cultivation lands (data not shown).

Agricultural abandonment resulted in an increase in soil DOC concentrations in both layers (Table 1). The DOC concentrations tended to increase with land abandonment and were 85.2, 111 and 125 mg kg^{-1} for AD2, AD3 and PR land uses as compared with the DOC concentration of 51.1 mg kg^{-1} in the PC land use in 0-15 cm layer, respectively. Likewise, the values for DOC concentrations showed an increasing tendency with land abandonment and were 57.3, 82.4 and 97.9 mg kg^{-1} for AD2, AD3 and PR land uses as compared with the value of 29.7 mg kg^{-1} in PC land use in the 15-30 cm layer, respectively. However, the DOC stratification ratio was higher in PC land use (1.72) than AD2 (1.48), AD3 (1.34) and PR (1.28) land uses. It seems that enhanced C mineralization due to disrupt of soil aggregates in cultivated lands (PC), and dissolution of microbial lysates (Li et al., 2009) may have increased the amount of DOC levels in the 0-15 cm layer compared to the 15-30 cm layer, whilst soil profile showed a tendency toward DOC uniformity with increasing time of land abandonment. Thus, DOC uniformity in permanent rangelands was the highest and stratification ratio was the lowest.

At both soil depths, abandonment of cultivated land resulted in an increase in MBC concentration (Table 1). The maximum MBC value among abandoned lands was found with AD3 land use. However, no significant difference was observed between AD3 and PR land uses. The MBC/OC ratios (MQ) at each depth showed a different response to land use types (Table 1). At 0-15 cm depth, changes in microbial quotient were not significant, while abandonment of cultivation significantly increased MQ at 15-30 cm depth and showed the following order: PC<AD3<AD2<PR. The increase in MBC and MQ values after agricultural abandonment could be indicative of a shift in the state of equilibrium of the abandoned soil systems. Saggar et al. (2011) reported that microbial biomass C and microbial quotient rapidly increased in abandoned pasture soils. Our results indicate that the rates of increase in MBC was less than those in POC and DOC (Table 1), suggesting that POC and DOC fractions might be more responsive to land use changes than MBC fraction and thus are more sensitive indicators in the study area.

In conclusion, the current study shows that land degradation due to reductions in SOM under continuous crop cultivation can be alleviated and compensated by agricultural abandonment. The results revealed that 30-60 years of land abandonment and subsequent cessation of agricultural activities might be a relatively appropriate time for SOM recovery and enhanced C sequestration in grazing rangeland of Central Iran.

Acknowledgements

The authors are grateful to Shahrekord University for providing the financial support.

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Wheat Yield and Soil Properties as Influenced by Tillage System Under Saline Condition

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Abstract: Effect of tillage methods and pre-till irrigation on the soil salinity, soil physical properties, and wheat yield was evaluated in this research. The research was performed in the form of a split block experimental design with six treatments and three replications. Main plots in this study were irrigating before tillage operation and seed bed preparation without pre-till irrigation. Subplots were tillage methods including; 1) conventional tillage method (moldboard plow, disk, and leveler); 2) minimum tillage; and 3) no tillage (direct drilling). Soil bulk density, soil hydraulic conductivity, soil salinity, wheat yield, and yield components were measured in this research. Collected data were analyzed using SAS statistics software and Duncan's multiple range tests was used to compare the treatments means. Results showed that minimum tillage increased wheat yield compared to the conventional and no tillage methods. Conservation tillage methods decreased soil salinity when seed bed preparation was performed without pre-till irrigation. There was no significant difference between the tillage methods for soil bulk density however; conservation tillage methods slightly decreased this parameter.

Keywords: Conservation tillage, soil salinity, wheat yield

The effects of p. chrysospaorum and organic inputs on soil aggregate stability

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Abstract

Soil aggregate stability can be influenced by organic matter quality and microbial population and activity. Fungi can be responsible for the resistance of soil aggregates against breakdown and slaking. In this study, the effect of a saprophytic fungus on wheat residue and potato powder decomposition, and soil aggregate stability were investigated by a short-term incubation experiment. After incorporation of 1 and 0.5% organic inputs (w/w), fungi inoculums (5% v/w) was added into soil and incubated for 30 and 60 days under a greenhouse condition. Wet Aggregate Stability (WAS) was determined by wet sieving method for five aggregate size fractions (0.25-0.5, 0.5-1, 1-2, 2-4, and > 4 mm). The results confirmed the importance of a readily available C-source for the rapid stabilization of aggregates by soil microorganisms. Application of organic inputs with the *phanerochaete chrysosporium* increased the WAS by 78.8%. Water stability of the fungal amended soil with a source of carbon (wheat residue or potato powder) was much more than the others without organic matter. The maximum soil respiration and WAS value was observed in soil treatments of 1% of potato powder.

Keywords: Organic Matter, Phanerochaete chrysosporium, Wet Aggregate Stability

Introduction

Maintenance of soil structure is an important feature of sustainable agroecosystems because of its involvement in many biological and physical soil processes (Bossuyt et al., 2000).aggregate formation and stabilization are affected by several factors, including the type and amount of organic material, clay content, and iron-and aluminum oxides (Lynch and Bragg, 1985). The main agencies of aggregate stabilization are organic materials, including: (i) decomposition products of plant, animal, and microbial remains, (ii) the microorganisms themselves, (iii) the products of microbial synthesis (eg. Polysaccharides and gums) formed during decomposition of organic residues (Lynch and Bragg, 1985; Martens and Frankenberger, 1992; Schlecht-pitsch et al., 1994). Soil microaggregates (<250 m) are bound together by organic compounds of different origin to form stable macroaggregates (>250 m). Fresh organic materials such as plant residue have many readily decomposable carbon (Schlecht-pitsch et al., 1994), and therefore result in stimulation of the microorganisms activity which increase aggregate stability. This promotion of stability is a desired effect in poorly structured and unstable soils easily susceptible to erosion (Kiem and Kandeler, 1997). There is relatively little information about the importance of a readily available C-source for the rapid stabilization of aggregate by soil microorganisms. Potato powder is an abundant source of organic matter, and could be used as an aggregate stabilizing agent in a short-term experiment.

Soil microorganisms, especially fungi, may play an important role in the formation and stabilization of macroaggregaes (Gupa and Germinda, 1988; Tisdall, 1994). Besides the physical effects of enmeshment of macroaggregates by hyphae (Tisdall and Oades, 1982), many hyphae produce extracellular polysaccharides to which microaggregates are attached and bound into stable macroaggregates by the network of hyphae (Tisdall, 1994). Fungi are possibly effective stablizers because the spread of hyphae between aggregates and into pores distributes fungal binding agents through the soil (Lynch and Bragg, 1985; Oades and Waters, 1991). Few studies focused on influences of the organic matter (readily and hardly decomposable) associated with fungal biomass to soil aggregation. The quality of organic inputs is a key factor determining the composition and activity of soil microbial biomass.

Phanerochaete is a genus of fungi. This genus includes "white-rot" fungi that are able to degrade lignin to carbon dioxide. *Phanerochaete chrysosporium* is a saprophytic fungus capable of organic breakdown of the woody part of dead plants. Therefore, plants which are in the process of dieing or dead serve as an optimal substrate for *P. chrysosporium*. Symptoms may include white patches of cellulose due to the disappearance of lignin from the plant structure. *It* releases extracellular enzymes to break-up the complex three-dimensional structure of lignin into components that can be utilized by its metabolism. The extracellular enzymes are non-specific oxidizing agents (hydrogen peroxide, hydroxyl radicals) used to cleave the lignin bonds. The first extracelular enzyme discovered to depolymerize lignin and lignin-substructured compounds *in vitro* was produced by this organism. The enzyme has been described variously as 'ligninase', 'diary/propane oxygenase' and 'lignin peroxidase' (Aitken and Irvine, 1989). This fungus is not a known pathogen of humans or animals. Our objective in this study was to evaluate the effects of a *phanerochaete* fungus and different organic inputs on aggregate stability under short-term conditions.

Materials and Methods

A silt loam soil from a field was used in this study. The soil sample was collected from Ap horizon (0-20 cm) which was previously under crops. Before starting the incubation experiments, soil samples were air-dried at room temperature for several days, afterwards was passed through 4 mm sieve for soil aggregates stability test. Soil samples were collected during November of 2010. Particle size distribution and soil organic carbon were determined by the Bouyoucos hydrometer method (Dane and Topp,2002) and the modified Walkley-Black wet oxidation procedure (Sparks, 1996), respectively.

Phanerochaete chrysosporium (F) was cultured in malt extract agar (MEA) for 1weeks at 30 C in darkness, then tubes washed with physiological serum to obtain spores and count the number of them, 9×10^3 spores was used to provide inoculum in 50cc Malt yeast extract broth, on a shaker with a setting of 140 rpm for 3 days in an incubator.

Organic inputs were including wheat residue (W) and potato powder (P). Wheat residue was ground into 1-2 mm particles. Organic carbon contents of them were measured by the modified Walkley-Black wet oxidation procedure. Organic inputs were incorporated soil in ratio of 0.5 and 1% (w/w), then fungi inoculums (5% v/w) was added into mixture of soil and organic matter for each pot individually. Experiments were conducted in three replications. Pots were incubated for 30 and 60 days under a greenhouse condition. After incubation periods, soils from each plot was air dried then 200 gr of soils were placed on a set of sieves including 0.25-0.5, 0.5-1, 1-2, 2-4, and > 4 mm sieves, and sieved by gently moving by hand. Wet Aggregate Stability (WAS) was determined by wet sieving method (Kemper and Rosenau, 1986). The sieving took place in water at 35 oscillations per minute (along 1.3 cm amplitude) for 3 minutes duration in each aggregate fraction in three replications.

Result and Discussion

The results showed that organic matter had a significant effect (P<0.01) on WAS of all aggregate size fractions (Tables 1). WAS of aggregates in the diameter class of >4 mm and 2-4 mm were significantly different (P<0.01, P<0.05, respectively) between the two microbes treats (soils without fungi and with *Phanerochaete chrysosporium).* Time factor only had no significant effect on aggregates 1-2 mm. WAS of aggregates size class >4mm was affected significantly (P<0.05) by the interaction of organic matter and microbes as well. Interaction of organic inputs and time had a significant of effect on aggregates >4mm in 0.01 level and on aggregates between 1-2mm in 0.05 level.

Table 1. Variance analysis (mean squares) of Wet Aggregate Stability of aggregates in the diameter classes

Sources of variation	df	>4 (mm)	4-2 (mm)	2-1 (mm)	1-0.5 (mm)	0.5-
Organic matter	4	8323.574**	4653.042**	2787.867**	1682.410**	1535.706**
Microbes	1	1014.522**	544.360*	529.930^{ns}	400.955^{ns}	103.673^{ns}
Time	1	687.176**	28.924^{ns}	675.233*	5347.529**	9996.861**
Organic matter* Microbes	4	142.897*	215.267^{ns}	251.128^{ns}	202.030^{ns}	327.603^{ns}
Organic matter* Time	4	283.542**	251.382^{ns}	389.127*	428.331^{ns}	300.381^{ns}
Time* Microbes	1	174.751^{ns}	178.725^{ns}	33.318^{ns}	55.074^{ns}	96.918^{ns}
Organic matter*Microbes*	4	11.708^{ns}	146.808^{ns}	70.108^{ns}	59.142^{ns}	46.610^{ns}
Total error	40	50.628	119.738	146.141	167.704	129.746

In the control soil, there was no formation and stabilization of water-stable aggregates larger than 4 mm in two sampling time. Adding organic inputs increased WAS of all aggregates >4mm, but this expansion was highest in soil amended with potato powder, especially in 1%P treats at one month treatments. Less WAS in F+1%P and F+0.5%P could be resulted from competition between domestic microorganisms and *Phanerochaete chrysosporiumin* in treated soils. This may be confirmed by decrease in WAS of soil with 1% of P after rapid utilization of carbon source at second month.

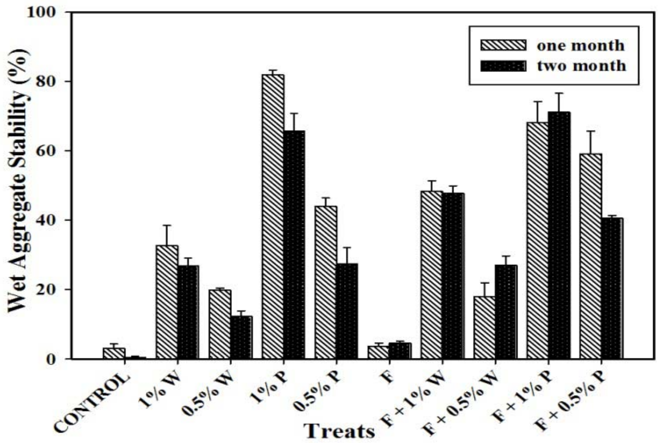

Figure 1. WAS of >4mm aggregates of 10 treats amended with organic inputs and *Phanerochaete chrysosporium*. (W: wheat residue, P: potato powder, F: fungi)

Same trend have been observed between two levels of organic inputs at the first and second sampling dates. Except F+0.5%W and F+1% P, WAS of treats was declined over time. Golchin et al. (1994) elucidated that aggregate stability is due to mucilages and metabolites produced by microbes that permeate the coatings of mineral particles and thus stabilize whole aggregates, and that aggregate stability decreases after readily available C-sources have been utilized and production of microbial glues stopped (Figure 1).

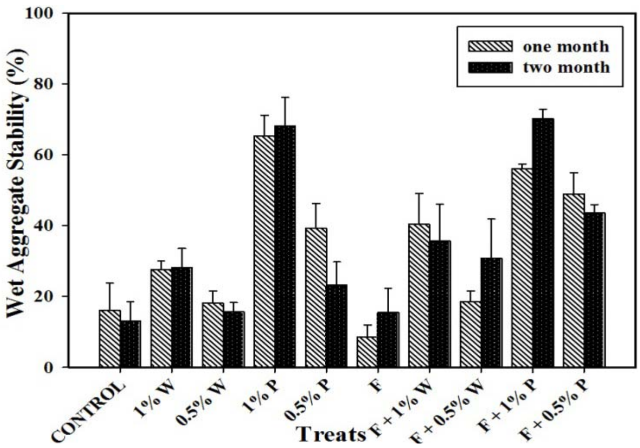

Figure 2. WAS of 2-4 mm aggregates of 10 treats amended with organic inputs and *Phanerochaete chrysosporium*. (W: wheat residue, P: potato powder, F: fungi)

Same tendency could not have observed in WAS of 2-4 mm aggregates of first and second month. Decrease of WAS of 1%W+ F treat in second month could be occurred because of sufficient growth of fungi in first month. Ability of *Phanerochaete chrysosporium* to decomposition hardly available C source could have seen in comparison between wheat residue treats, with and without it (Figure 2).

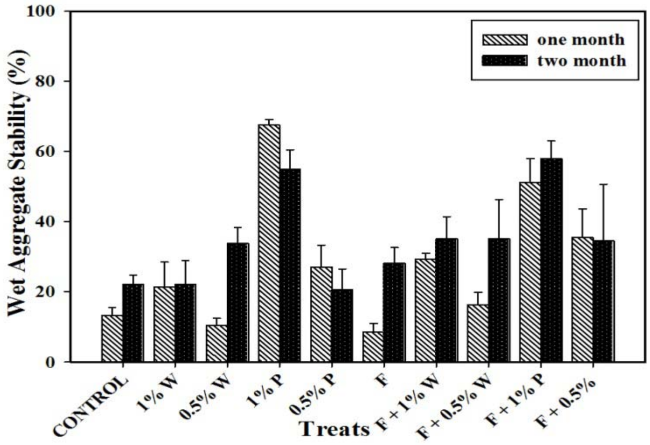

Figure 3. WAS of 1-2 mm aggregates of 10 treats amended with organic inputs and *Phanerochaete chrysosporium*. (W: wheat residue, P: potato powder, F: fungi)

Generally, the amount of WAS in 1-2 mm aggregates were less than two larger fractions. Influence of native microorganisms on WAS of 1 and 0.5% wheat residue treatments was significantly smaller than those amended with *Phanerochaete.* Both WAS of 1 and 0.5% of potato powder were lessened in this fraction at second month. A possible explanation is that diminishing of this source result in declining microbial biomass and also living hyphae among aggregates. However more research is needed for obtain more accurate results (Figure 3). Hence, it appears that the filamentous organisms may have created the larger aggregates, but other factors induced by the microorganisms were involved in the stabilization of the smaller aggregates.

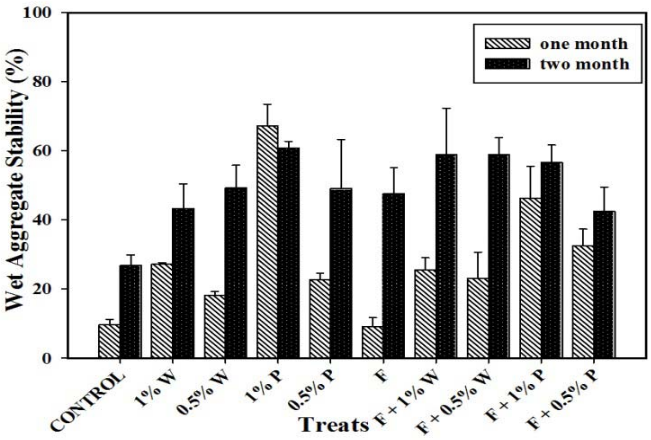

Figure 4. WAS of 0.5- 1 mm aggregates of 10 treats amended with organic inputs and *Phanerochaete chrysosporium*. (W: wheat residue, P: potato powder, F: fungi)

An expanding course could be observed between WAS of 0.5-1 mm aggregates of first and second month, except 1% of potato powder. As describe above, after reducing easily available C-source in second month, WAS decreased probably because of decline in microbial populations. WAS of control soil in this class fraction aggregates was growth after 2 month, this may be explained by interparticulate cementation during aging of the soil (Utomo and Dexter, 1981). Interestingly, WAS of soils with fungi (without any organic matter) was higher than control and was increased after two month. This observation is consistent with the strategy of fungi to explore new substrates. Fungal hyphae actively grow towards and into small microhabitats and decompose the available organic C sources (Coleman and Crossley, 1996). Difference betwixt WAS of 0.5-1% levels of wheat residue treats became less in contrast of one and second month after incubation. It could be occurred because of sufficient growth of fungi in two month, particularly in *Phanerochaete* added treats (Figure 4).

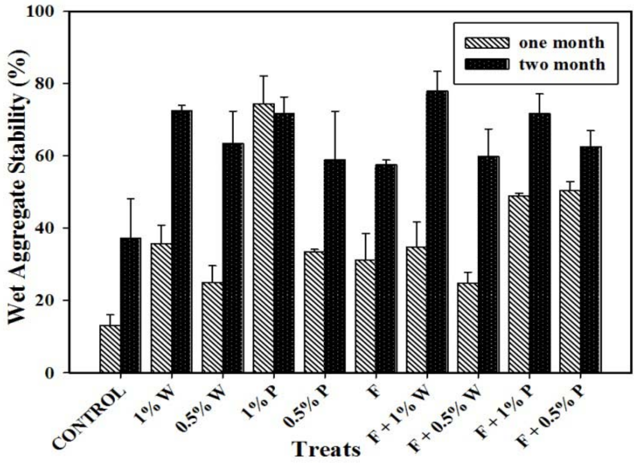

Figure 5. WAS of 0.25- 0.5 mm aggregates of 10 treats amended with organic inputs and *Phanerochaete chrysosporium* (W: wheat residue, P: potato powder, F: fungi)

In 0.25-0.5 mm aggregates, same trend have been observed between two levels of organic inputs at the first and second sampling dates. Except 1% P, all WAS were enlarged with time, this enlargement was more significant in wheat residue treats. This finding verified the special role of potato powder as an easily available C-source in supporting a fast stabilization. This contrast with high molecular weight substrates with gives a slower improvement in water stability (Tisdall and Oades, 1982; Schlecht-Pietsch et al., 1994). The fungal hyphae entangle soil particles, which are considered to be a key process in the formation and stabilization of macroaggregates (>0.25mm) (Tisdall and Oades, 1982).

Several conclusions can be made regarding the influence of residue quality and soil microflora on aggregate stability. In supporting earlier work, our laboratory experiment showed that fungal growth towards substrates sources lead to filamentous entanglement of primary particles and microaggregates which in turn forms and stabilizes macroaggregates.

In overall, this study confirms the formation of macroaggregates out of microaggregates and it shows the importance of fungi in the formation of macroaggregates. It is useful to investigate all the factors that may influence the formation and stabilization of aggregates because of the importance of these soil processes in order to maintain a good soil structure, which is desirable in sustainable agroecosystems.

Acknowledgements

The authors gratefully appreciate all the advice from M. Soltani, A. zolfaghari during laboratory work.

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Changes in Penetration Resistance of a Clay Field with Organic Waste Applications

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Abstract
Effects of manure (M), hazelnut husk (HH), tobacco (TW) and tea (TEW) wastes on penetration resistance (PR) values in a clay field were determined after 8 months of organic wastes were incorporated into soil at four different rates (0, 2, 4 and 6 %) in a randomized plot design with three replicates. While bulk density (BD), relative saturation (RS) and PR values decreased, mean weight diameter (MWD), total porosity (F), gravimetric water (W) and organic matter (OM) contents of the clay soil increased with increasing the application rates of organic wastes. While the lowest PR (0.72 MPa) was determined in the highest application rate of HH, the highest PR (1.72 MPa) was in the control. According to the control treatment, decreases in mean values of PR by the organic waste applications were in the following order; HH (52.10%) > TEW (42.07%) > TOW (30.73%) > M (25.17 %). PR values gave significant negative correlations with F (-0.551**), W (-0.439**) and MWD (-0.509**), and significant positive correlations with BD (0.550**) and RS (0.374*). Total porosity showed the highest direct effect (62.39%) on PR. The higher indirect effects of the other properties on PR were also obtained via F. Applications of the same doses of different organic wastes had different effects on the PR values with changing the structure of clay soil.
Keywords: penetration resistance, agricultural wastes, soil physical properties.

Introduction
Intensive agricultural practices have significant effects on soil degradation through loss of soil organic mater, decline of soil structure, resulting soil compaction and root growth (Usowics and Lipiec, 2009; Busscher and Bauer, 2003). Dexter (2004) reported that a measure of soil microstructure can be an index of soil physical quality that is consistent with observation on soil compaction, on effects of soil organic matter content and on root growth. Soil compaction, occurs usually loss or reduced in size of the largest pores, increases soil bulk density and soil strength, and decreases macro porosity, soil water infiltration and water-holding capacity (Dexter, 2004). Soil compaction also affects root penetration and consequently crop production (Hakansson et al. 1988). Penetration resistance is an empirical, easy and cheap measurement technique of soil strength, and widely used to assess soil compaction and the effects of soil management (O'Sullivan et al., 1987; Castrignanö et al., 2002). Numerous studies indicated that soil compaction depends on several factors such as; compressing loads of heavy machinery, type of parent materials, soil texture, moisture content, organic matter content, structural stability, sodicity and salinity (Soane, 1990; Baumgart and Horn, 1991; Barzegar et al., 1996; Hamza and Anderson, 2005). In this study, effects of manure (M), hazelnut husk (HH), tobacco (TW) and tea (TEW) wastes applications on penetration resistance (PR) in a clay field were investigated, and direct and indirect effects of the soil properties on PR were determined.

Material and Method
A field experiment was conducted at the Experimental Field of Agricultural Faculty in Ondokuz Mayıs University, Samsun in Nowember, 2001. Four different organic wastes, manure (M), hazelnut husk (HH), tea waste (TW) and tobacco waste (TOW), were incorporated within 0 - 15 cm soil depth as 0, 2, 4 and 6% treatment rates (0, 36, 67 and 100 ton ha^{-1}) with three replications in a randomized plot design. Some chemical and physical characteristics of the soil were determined in soil samples as follows; particle size distribution by hydrometer method, bulk density (BD) by undisturbed soil core method (Demiralay, 1993), soil pH, 1:1 (w:v) soil:water suspension by pH meter, electrical conductivity (EC_{25^oC}) in the same suspension by EC meter, organic matter content by Walkley-Black method and exchangeable cations by ammonia acetate extraction (Kacar, 1994). After determining the BD, total porosity (F) was calculated using the equation; F=1-BD/2.65. According to the soil physical and chemical properties given in Table 1, the results can be summarized as; the textural class is clay, none saline, neutral in pH, high in organic matter (Soil Survey Staff, 1993).

Table 1. Some physical and chemical properties of the soil

Sand, %	18.94	$EC_{25°C}$, mmhos cm^{-1}	0.65
Silt, %	24.82	K, me/100g	1.15
Clay, %	56.23	Na, me/100g	0.21
Texture class	Clay	Ca, me/100g	34.87
Organic matter, %	3.85	Mg, me/100g	8.13
PH	6.95		

After eight months, soil samples were taken from each plot for the analyses. Penetration resistance (PR) in 0-15 cm depth was measured in each plot with five replications using a standard cone penetrometer which had a cone with a semi-angle of 30º, a base area of 2 cm^2 (Bradford, 1986). The mean weight diameter (MWD) of the soil samples was measured by dry sieving method, and calculated by the sum of the mass fraction recovered for each sieve multiplied by the average size between two adjacent sieves (Kemper and Rosenau, 1986). After volumetric water content (θ) values were determined multiplying natural moisture (gravimetric water, w) content of soil samples by the bulk densities (θ=w.BD), the relative saturation (RS) values were calculated dividing volumetric water contents by total porosity values (RS= θ/F).

Statistical analysis of the results was done by standard analysis of variance, pairs of mean values compared by least significant difference (LSD) (Yurtsever, 1984), and correlations between the soil properties, and direct and indirect effects of soil properties on PR were determined with path analysis using TARIST statistics program.

Results and Discussion

Effects of Organic Wastes on Soil Properties

The application of agricultural wastes increased organic matter content in the 0-15 cm soil layer (Figure 1a). The highest OM content (8.91%) was determined in 6% of M treatment. The increments in mean values of OM content with the application rates were significantly different from the control (P<0.01). The mean values of soil OM contents by the waste treatments ordered as follows; TEW (6.46%) > M (6.01%) > TOW (5.67%) > HH (4.72%). There are numerous studies indicated that application of organic residues into soil increased soil organic matter content (İç and Gülser, 2008; Candemir and Gülser, 2011). Increments in the application rates of organic wastes significantly increased MWD values (P<0.05). The MWD values increased with increasing the application rates of TOW, HH and TEW, but, decreased with increasing the application rates of M (Figure 1b). The mean values of MWD resulted by the waste treatments ordered as follows; HH (1.96 mm) > TEW (1.87 mm) > TOW (1.84 mm) > M (1.81 mm). Gülser (2006) reported that increasing organic matter content in a clay soil by the different forage treatments increased MWD values according to the fallow control treatment.

When the bulk density values reduced, total porosity values increased with increasing the application rates of the treatments significantly (P<0.01) (Figure 2 a, b). The lowest bulk density (0.63 g/cm^3) or the highest total porosity (76.38%) value was determined with the 6% of HH treatment. The increments in total porosity with the application rates were significantly different from the control application (P<0.01). In many studies, it is reported that addition of organic wastes into soils reduces bulk density and increases total porosity (Anikwe, 2000; Marinari et al., 2000; Candemir and Gülser, 2011).

Although the gravimetric water contents (W) generally increased according to the control, the volumetric water contents (θ) decreased due to reducing bulk densities by the application of organic wastes (Figure 3 a, b). While the highest θ content (39.79%) was determined in the control, the lowest θ content (28.48%) was determined in 6% of TEW treatment. Addition of organic matter to soils increases water holding capacity (Gupta et al., 1977; Candemir and Gülser, 2011). The relative saturation values also decreased with increasing the application rates of organic wastes (Figure 3c). Generally, increments in the total porosity caused decreases in the RS. Although the highest moisture content (52.50%) was determined in 6% of HH treatment, the lowest RS value (40.69%) was also found in the same treatment due to having the highest total porosity.

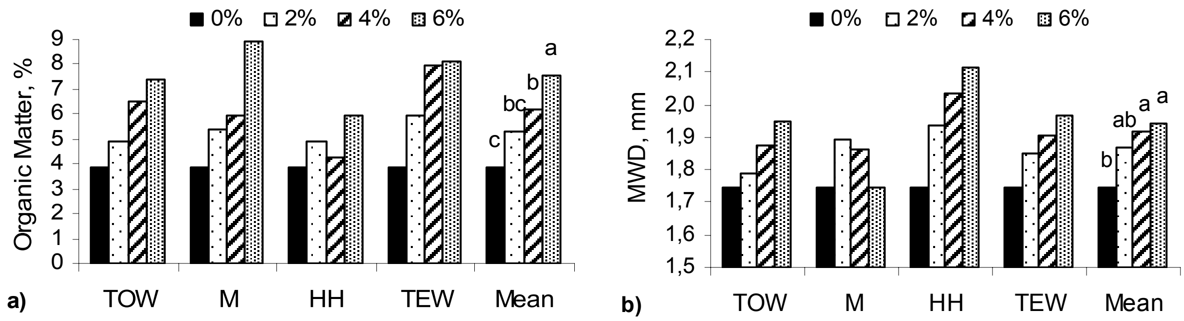

Figure 1. Effects of organic wastes on a) organic matter content (LSD:1.258) and b) mean weight diameter (MWD) of the soil (LSD:0.144). M:manure, HH: hazelnut husk, TOW:tobacco, TEW:tea wastes

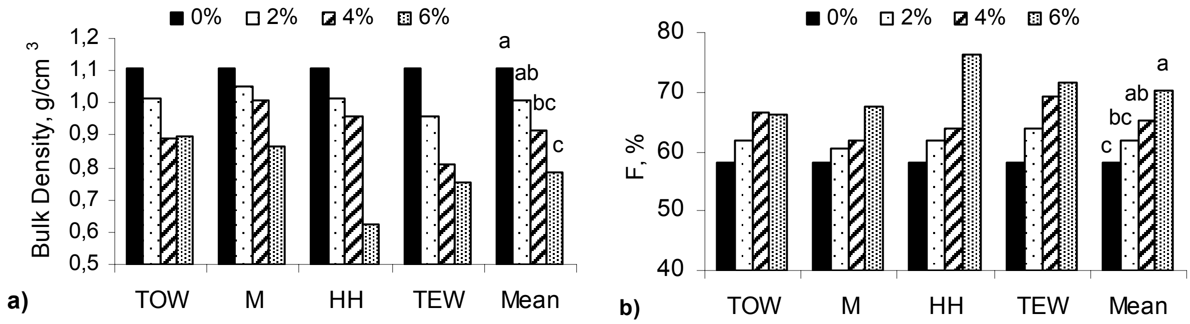

Figure 2. Effects of organic waste treatments on a) bulk density (LSD:0.145) and b) total porosity (F) of the soil (LSD:5.470). M: manure, HH: hazelnut husk, TOW: tobacco, TEW: tea wastes

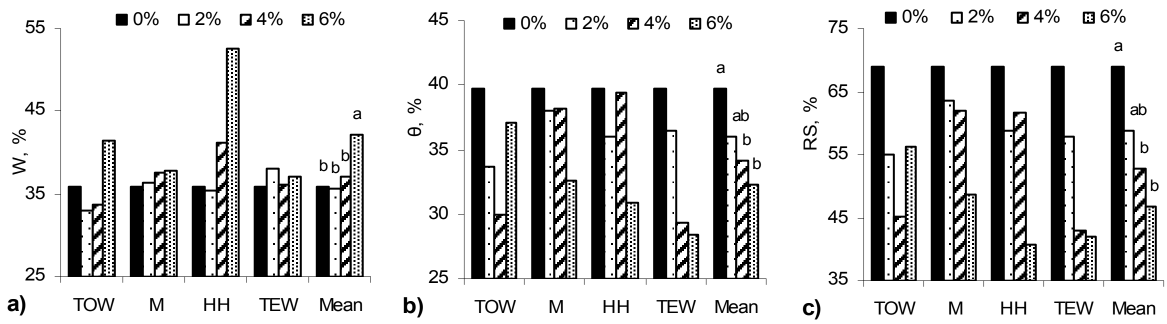

Figure 3. Effects of organic waste treatments on a) gravimetric water (W) (LSD:4.977 at 5%), b) volumetric water (θ) contents (LSD:4.596 at 5%) and c) relative saturation (RS) (LSD:13.431 at 1%). M:manure, HH: hazelnut husk, TOW:tobacco, TEW:tea wastes

Increasing the application rates of organic wastes significantly decreased the PR values according to the control treatment (Figure 4a). While the highest PR value (1.72 MPa) was determined in the control, the lowest PR value (0.72 MPa) was obtained wit the 6% of HH treatment. The mean PR values with the applications of HH (1.04 MPa) and TEW (1.17 MPa) were significantly lower than that with the applications of TOW (1.32 MPa) and M (1.39 MPa) (Figure 4b). According to the control treatment, decreases in mean PR values by the treatments were obtained in the following order; HH (52.10%) > TEW (42.07%) > TOW (30.73%) > M (25.17 %). On the other hand, the application rates of treatments significantly decreased the mean PR values in the following order; control (1.72 MPa) > 2% (1.17 MPa) > 4% (1.06 MPa) > 6% (0.98 MPa) (Figure 4c). It has been suggested that the critical PR value for optimum root growth should be vary between 1.7 and 2.0 MPa (Canarache, 1990; Arshad et al., 1996). In this study, PR values in organic waste treatments varied between 1.42 MPa with 2% of M and 0.72 MPa with 6% of HH application (Figure 4a). When comparing with the control, the PR values obtained by the organic waste treatments were found to be lower than the suggested critical levels for root growth.

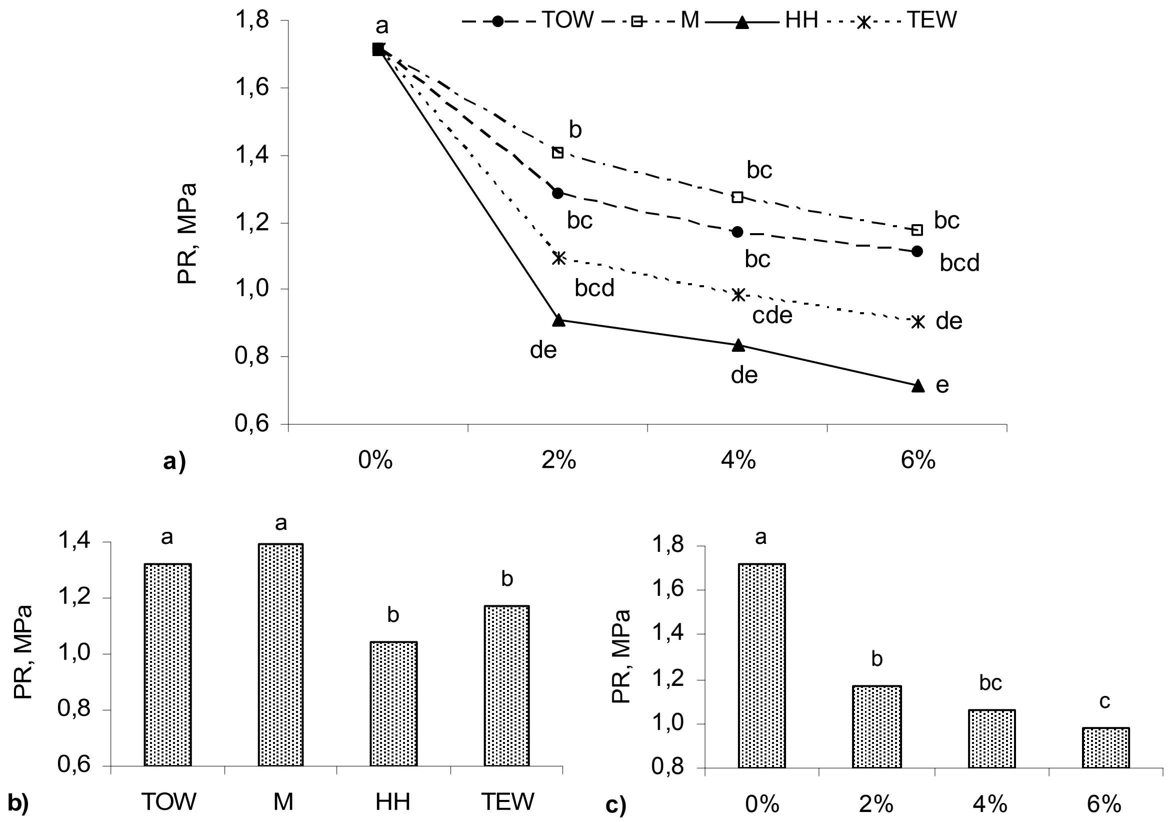

Figure 4. Effects of organic waste treatments on penetration resistance (PR) a) Interactions between treatments and doses (LSD:0.203 at 5%), b) Organic waste treatments (LSD:0.136 at 1%) and c) Application doses (LSD:0.136 at 1%). TOW:tobacco waste, M:manure, HH: hazelnut husk, TEW:tea waste

The Relationships among the Soil Properties and Penetration Resistance

Soil organic matter content gave the significant positive correlation with F (-0.419**) and significant negative correlations with BD (-0.419**), θ (-0.390*) and RS (-0.433**) (Table 2). Increasing soil organic matter content by the organic waste treatments caused decreases in BD, θ and RS with increasing the total porosity. Gülser (2004) found that increasing organic matter content in the soil due to crop treatment increased total porosity with decreasing bulk density. The highest positive correlation (0.961**) was found between RS and θ content. PR values had significant positive correlation with BD (0.550**), RS (0.374*) and significant negative correlation with W (-0.439**), F (-0.550**) and MWD (-0.509**). PR values decreased with increasing W, F and MWD values by the organic waste treatments. Gülser (2006) found that MWD increased by the forage cropping treatments over the control had significant negative correlations with BD and PR values. Veronese-Junior et al. (2006) reported that decreases in soil moisture content increased penetration resistance in soil. In another study, Gülser et al. (2011) studied spatial variability of PR values in a cultivated soil and reported that PR values had negative correlations with gravimetric water contents.

The correlation coefficients between PR and the soil properties were divided into direct and indirect effects by path coefficients. The percentages of direct or indirect effects of the variables on PR were determined according to the path coefficients (Table 3). Most soil properties were significantly correlated with PR. However, according to the path analysis, total porosity had the strongest direct effect (62.39%) on the PR. Direct effects of the other soil properties on PR were in the following order; MWD > W > RS. The other soil properties had also higher indirect effects on PR mediated by F. Although the soil properties significantly correlated with PR, the result of path analysis showed that F and MWD were more effective properties on PR than W and RS. Gülser (2006) reported that increasing macroaggregation in a clay soil due to forage cropping caused increases in MWD and decreases in bulk density and penetration resistance.

Table 2. The correlations among the soil properties.

	OM	BD	F	W	θ	RS	MWD
PR	-0.170	0.550**	-0.550**	-0.439**	0.234	0.374*	-0.509**
OM		-0.419**	0.419**	-0.004	-0.390*	-0.433**	-0.104
BD			-10.000**	-0.411**	0.752**	0.886**	-0.394*
F				0.411**	-0.752**	-0.886**	0.394*
W					0.253	0.021	0.316
θ						0.961**	-0.149
RS							-0.251

** Correlation is significant at the 0.01 level,* Correlation is significant at the 0.05 level. PR: penetration resistance, OM: organic matter, BD: bulk density, F: total porosity, W: gravimetric water content, θ: volumetric water content, RS: relative saturation, MWD: mean weight diameter.

Table3. Direct and indirect effects of soil properties on penetration resistance.

	Direct Effect, %	Indirect Effect, %			
		F	W	RS	MWD
F	62.39	-	5.53	18.35	13.72
W	26.65	50.73	-	0.85	21.76
RS	24.36	65.04	0.33	-	10.27
MWD	50.57	35.71	6.18	7.54	-

F: total porosity, W: gravimetric water content, RS: relative saturation, MWD: mean weight diameter.

Conclusion

Addition of organic wastes into the clay soil decreased PR and increased F by reducing bulk density and increasing MWD. According to the control treatment, decreases in mean values of PR and increases in mean values of F by the different treatments were generally in the same order as follows; HH > TEW > TOW > M. The results indicated that total porosity was one of the most important soil properties that affected PR directly in the clay textured soil. Indirect effects of the other soil properties on PR were also mediated by F. The different organic wastes had different effects on PR of clay soil due to changing soil structure with increasing MWD and F. It can be concluded that all organic waste application had positive effects on improving soil properties; the same application rates of different organic wastes had different effects on the PR values with changing the structure of clay soil. The effects of HH and TEW on PR were more effective than TOW and M treatments in clay soil.

Acknowledgment

We gratefully acknowledge the financial support of the State Planning Organization of Turkey (DPT).

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Assessment of Land Degradation in North Western part of Karnataka, India

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Abstract
A nationwide mapping of land degradation adopting a uniform methodology was initiated and coordinated by National Remote Sensing Centre, Hyderabad in a consortium mode involving a number of institutes among which University of Agricultural Sciences Dharwad was one of the partners. The paper herein presents the results of that exercise pertaining to five contiguous districts of north western Karnataka in southern India. The objective of the study was to generate land degradation data base of the country for the base year 2005 on 1:50,000 scale using IRS LISS-III satellite data. The study area includes four agro-climatic zones consisting of northern dry zone (zone-3), northern transition zone (zone-8), hill zone (zone-9) and coastal zone (zone-10) with rainfall ranging from 500 mm to 3000 mm. The extent of land degradation was highest in zone-3 constituting 33 % of the zone area followed by zone-8 (21%). In other two zones it was at 13%. In all the zones sheet erosion constituted single largest type of degradation. Rill erosion predominated only in zone-3 followed by zone-8 to some extent and was nearly non-existent in other two zones. The degradation is more in drier areas, dominated by Vertisols, compared to humid areas due to forest cover despite heavy rainfall. In zone-10, rocky waste constituted 2% of zone area which was due to stripping of top soil from plateau surfaces. The spatial database, when compiled for the entire country, would help in planning reclamation programmes.
Keywords; Land degradation, Remote Sensing, Agro-climatic zones, Vertisols, Karnataka

Introduction
Land degradation is one of the main causes for declining productivity and is a concern for administrators, planners, scientists and farming community. Productivity loss attributable to erosion-caused soil degradation is estimated at 272 million tonnes -for the world (Lal 2000). To address this low availability of reliable data on the extent, type and degree of degradation, both spatially and temporally is a prerequisite. According to the National Commission of Agriculture about 175 million ha of land constituting 53.3 per cent of total geographical area of the country is subject to various kinds of degradation. There is no agreement on the extent of land degradation reported by different sources mainly due to different approaches followed and spatial approximations at the scale of mapping adopted. Eswaran et. al. (2001) reported that, different estimates shows wide variations because of different methods and criteria used, and highlights the importance of developing uniform criteria and standardizing methods of assessment of land degradation. Remote sensing has the greatest comparative advantage when the scale is small, because it can provide data for a large area at one time (Van Lynden and Kuhlmann 2002), and it is, in principle, an ideal methodology for regional or global degradation assessments. Bai et.al. (2008) reported that, Land degradation and improvement have been assessed by remotely sensed indicators of biomass productivity**.** Remote sensed data are being operationally used to derive information on degraded lands using multitemporal data in India by Venkataratnam and Ravishankar (1992) and a number of others. Therefore, a nationwide mapping of land degradation adopting a uniform methodology was initiated and coordinated by National Remote Sensing Centre, Hyderabad in a consortium mode -involving a number of institutes among which University of Agricultural Sciences Dharwad was one of the partners. The paper herein presents the results of that exercise pertaining to a portion of Karnataka state in southern India. The objective of the study was to generate land degradation data base for the base year 2005 on 1:50,000 scale using IRS LISS-III satellite data with a view to create uniform digital data base for the whole country based on NNRMS (National Natural Resources Management Systems) standards.

Study area
The study area comprised of five contiguous districts of Gadag, Haveri Dharwad, Belgaum and Uttara Kannada in north western part of Karnataka with a total geographical area of 817346 ha. The area represents four agro-climatic zones viz., Northern Dry zone (zone-3), Northern

Transitional zone (zone-8), Hill zone (hill zone-9) and Coastal zone (zone -10), the salient characteristics of which are given in Table 1.

Table 1. Salient characteristics of the agro-climatic zones constituting the study area

Property	Zone-3	Zone-8	Zone-9	Zone-10
Rainfall (mm)	505-748	619-903	1176-2457	3209-4146
Predominant soils	Calciusterts	Rhodustalfs and Ustorthents	Paleustalfs and Haplustalfs	Kandiustalfs and Ustifluvents
Crops	Sorghum, Chickpea	Soybean, maize	Paddy, pulses	Paddy, arecanut
Geographical area (ha)	1140507	1167872	1016900	425439

Methods

The procedure for generating land degradation database is outlined in a manual (NRSA 2007) prepared for uniform adoption by all partner institutions. Satellite image data of Resourcesat LISS-III covering three seasons (rainy, winter and summer) were used to address spatial and temporal variability of land degradation. Later, on-screen visual interpretation of different land degradation classes on satellite data FCC was done adopting standard visual interpretation techniques. Sample points were identified for various land degradation classes from interpreted map for ground truth collection and for accuracy assessment. Soil samples were collected from 0-15 and 15-30 cm depths and analyzed in the laboratory. During the field work the relationship between image elements and tentatively identified land degradation classes were established that are delineated during preliminary interpretation. The preliminarily interpreted land degradation maps were finalized in light of ground truth data and soil analysis data as also ancillary data on forests, wastelands, salt affected soils, biodiversity, land use/land cover to arrive at the final map. The minimum mapping polygon size was 2.25 ha.

Results and Discussion

Among the four zones, the extent of total land degradation was highest in zone-3 -constituting 33% of the total geographical area (TGA) followed by 21% in zone-8 (Table 2). In other two zones the area was at 13 %. Sheet erosion is the dominant type of soil degradation in all the zones - constituting about 12% of the area in zone 9 and 10, and about 17% in zones 8 and 3. The extent of rill erosion is of equal magnitude as that of sheet erosion in zone-3 equalling 33% of the zone area, which stands out from the other zones. The area mapped under rill erosion constituted 4% of zone 8 and in other two zones it was very low to non existent.

Table 2. Extent of soil degradation in different agro-climatic zones of the study area

Class	Description	Zone-3	Zone-8	Zone-9	Zone-10	Total
Wsh	Sheet-erosion	198055	197314	128399	47590	571358
Wri	Rill erosion	172560	48207	592	--	221359
Wgu	Gullies-severe	651	1046	112	15	1824
Lsp	Surface ponding	118	--	149	476	743
Ssa	Saline	506	256	43	8	813
Sso	Sodic	872	--	--	--	872
Sss	Saline-sodic	217	123	--	3	343
Hmd	Mining	251	133	608	53	1045
Tbs	Rocky/stony waste	5941	3519	2278	6937	18675
--	Others	12	61	16	225	314
Total		379183	250659	132197	55307	817346
%TGA*		33	21	13	13	22

*TGA = Total geographical area

The data supports the hypothesis that soil erosion is more intense in semiarid regions than in sub humid and humid regions (Hudson, 1971). The high forest cover (about 80 %) in zones-9 and 10 protects the soil surface thus reducing the erosion. Zone-3 predominantly has Vertisols and Vertic subgroups of Inceptisols and hence is vulnerable to erosion as the soils are exposed most of the period due to single cropping, especially to the very intense pre-monsoon rains during May. The damage caused by sheet and rill erosion is presented in Fig.1. There are also serious (20%) productivity losses caused by erosion in Asia, especially in India, China, Iran, Israel, Jordan, Lebanon, Nepal, and Pakistan (Dregne, 1992). In South Asia, annual loss in productivity is estimated at 36 million tons of cereal equivalent valued at US$5,400 million by water erosion, and US$1,800 million due to wind erosion (UNEP, 1994).

The extent of rocky wasteland is one of the highest in coastal zone observed on plateaus of hills along constituting about 2% of the zone area (Fig 2). This is due to the exposure of laterites due to shipping of top soil due to heavy rainfall and deforestation. These are planted with fast growing *Acacia auriculiformis* with limited success. The salt affected soils are understandably confined mostly to zone 3 and to some extent to zone 8 due to lesser rainfall as also due to faulty irrigation. Even on 1:50000 scale, the salt affected area may be under estimated for the simple reason that salinity showed up best only when the surface soil had more than 8 dS m-1 of ECe , secondly the patches were not large enough to be resolved and finally some areas were cropped during summer. Degradation due to mining affected all the districts uniformly and can be considered minimal. However, the environmental damage of mining activity has been a menace due to transport of ores, dust and other ills.

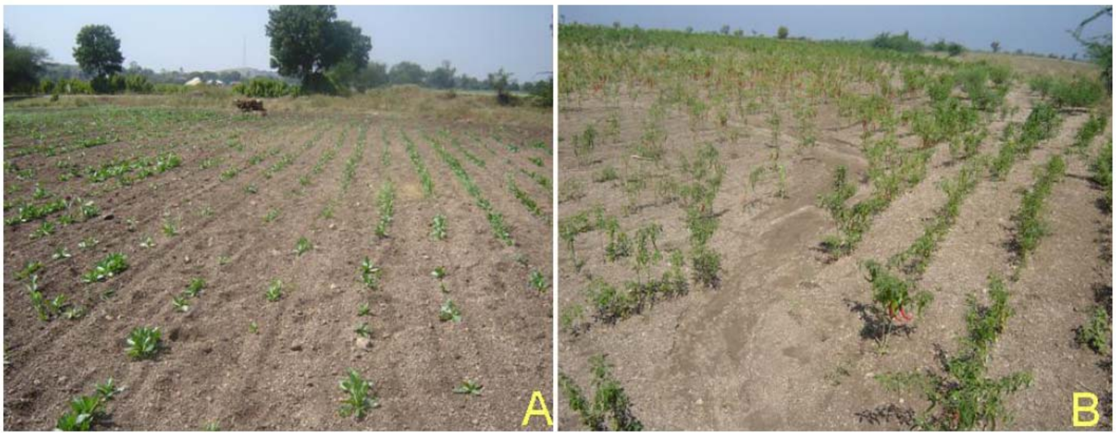

Fig 1: Pictures showing sheet (A) and rill (B) erosion in vertisols of zone-3 (Note the poor crop stand)

The information generated by all the partners when compiled by NRSA will provide spatial database on land degradation on 1:50000 scale for the entire country for planning reclamation programmes at district level. Karnataka state has pioneered itself in watershed development programmes and an estimated 3.6 million ha is treated under various programmes so far (Lele et al. 2008). It is not precisely known to what extent –the degradation is arrested due to watershed development initiatives. The digital information so generated can be used to monitor the impact of such programmes besides assessing the spread or otherwise of land degradation over time and formulating policies to arrest degradation.

Conclusion

The degradation was more in drier areas dominated by Vertisols compared to humid ones. The digital database so generated from different partners will be compiled at the national level help to plan the reclamation measures at district level. It also serves as primary database for regional/global environmental studies and works as a useful database for different ministries involved in rural development activities.

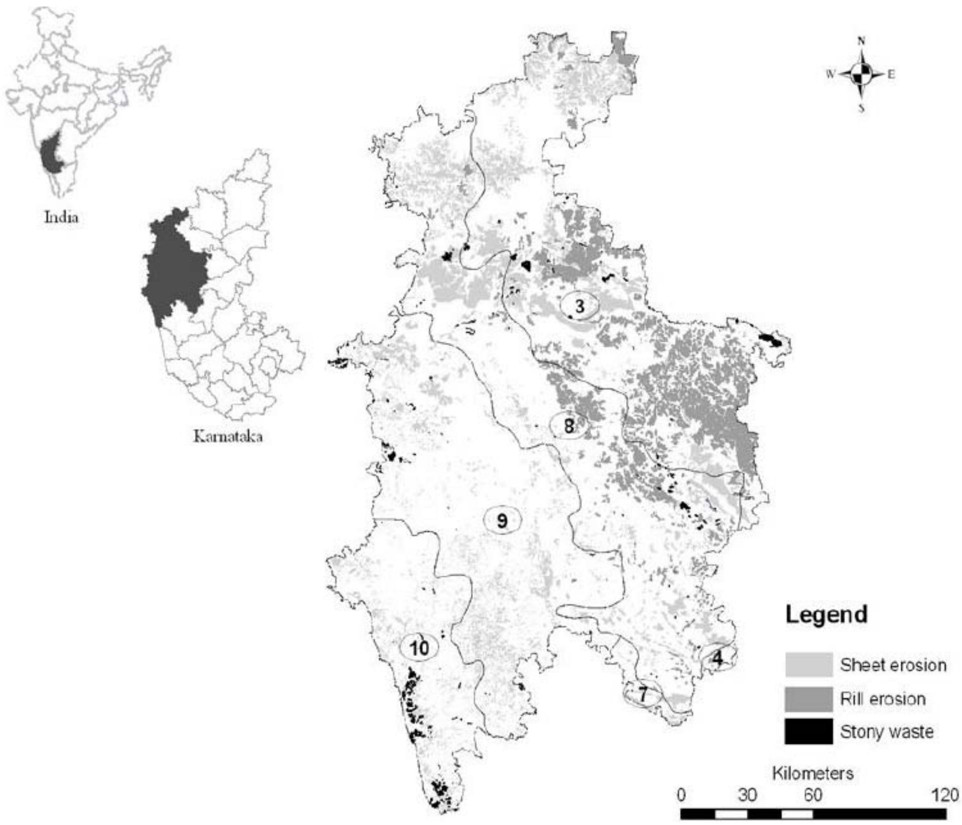

Fig.2 Index map showing the location of study area as also the major degradation types in the study area in different agro-climatic zones (shown as numbers within circles)

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Tillage Practices Terminology Structure

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Abstract
Understanding tillage practices lexicon is very important for both students and others involved in this field of interest. Aiming to better understand technical terms of the aforesaid field it is necessary to know word formation basics and determination of their functions which, in turn, result in words meaning recognition being the main goal of all interested in dealing with the above mentioned. Thus, the paper deals with tillage practices terminology analysis from several aspects.
Key words: tillage practices, structure, terminology

Introduction
The paper aims at clarifying the meaning of the terms dealing with tillage practices. We also observe the lexical categories that make up the tillage practices terminology. The corpus consisted of nouns, verbs and adjectives. Putting the terms in the below-mentioned fields enables easier and proper vocabulary acquisition since in this way students learn complete semantic fields of tillage practice terminology that, in turn, leads to better communication ,on the aforementioned topic, in English – being our main goal.

Materials and Methods
The most representative terms related to the tillage practices have been taken mainly from the book Opća proizvodnja bilja (General plant production) by Mihalić (1988), dictionaries and other sources quoted in the References. We classified them by the semantic fields such as **, Action, process, phenomenon; Characteristics, state; Disciplines, branches; Specialists; Instruments, tools, machines (or part of them); Substances, materials ; Chemical elements; Place ; Soil and soil-related terms; Measures and related terms; Plant and plant-related terms; Organisms** This terminology should be known by all study level students.

Results and Discussion
The terms (some of them are synonyms) encompassing tillage practices have been grouped into the semantic fields as follows:
Action, process, phenomenon: abrasion, absorption, acclimatization, accumulation, adhesion, adsorption, aeration, amortisation, analysis of variance (ANOVA), application, assimilation, breaking ,broadcasting of fertilizer, circulation, compression, conductivity, conservation, conventional soil tillage, decomposition, deep tillage, defrosting, degradation, denitrification, desertification, desorption, diffusion, dispersion, distribution, drainage, drill, drowning, emergence, emission, evaluation, evaporation, evapo-transpiration, extensive agriculture, fall of rain, fertigation, fertilization, field cultivation, filtering, fixation, flooding, foliar application, forming, formulation, four-year, fragmentation of farm holding, germination, growth development, hand hoeing, handling, harvest, hoeing, homogenization, husking, immobilization, inoculation, intensive farming, intercropping, inter-row cultivation, inter-tillage, investigation, irrigation, land reclamation, leaching, levelling, manipulation, measurement, melioration, mineralization, minimum tillage, mulching, no-tillage, observation, one-year rotation, operation (activity), farming, organization, penetration, photosynthesis, planting, ploughing, pollution, precipitation, prevention, productivity, protection, research, resorption, respiration, retention, ridging, ripening, rotation, seeding, shaping, shattering, side dressing, soil loosening, soil reaction, soil tillage preparation, soil tillage, sowing, stripping, structure, sub-soiling, tilling, top dressing, transportation, treatment, two-year rotation, vegetation, warming, water logging, watering, weather, wind.
Characteristics, state: aberration, abiotic, absolute humidity, adaptability, adoption, air moisture, alluvial soil (fluvisoil), annual, arable, arid soil, heavy soil, at ground level, atmosphere, available, average, balance, basic, biodiversity, bottom soil, clay (land), cold, colour, compact, compacted,

compactness, composition, compressed, , contamination, convex, curve, deficiency, deformation, dehydration, dense, depth, deviation, disease (infection), dormancy, drained (land), drought resistance, dry, effective sunshine hours, efficiency, elasticity, equilibrium humidity, excessive soil moisture, exothermic, experience, extensive, fallow, favourable, fertile soil, fertile, fertility, firm (hard), frequency, frost free period, frost, general agronomic (characteristics), good agricultural (practices), grainy, granular, growth stage, hard, hardness, heavy soil, heavy textured soil, heterogeneous, high fertility, humid, impermeable subsoil, insufficiency, integral, intensity, intensive (crop), length, light- textured soil, loose and porous (soil), loosened, marly soil, mechanized, mellow, microclimate, moisture, non-arable land, optimal conditions, organic (matter), physical properties, ploughable, pollution, power, pressure, rooting depth, rooting zone, rough, rural, sandy soil, saturation, scientific, shallow, shatter resistance, silt loam, slope, smell, soil density, soil moisture, solid, sorption, strength, sustainability, tight soil, top soil, uncultivated, underground, variety, velocity (speed), vigour, viscosity, water, waterlogged, weediness, wet.

Disciplines, branches: agricultural mechanization, agriculture, agritechnics, agro chemistry, agronomy, arable farming, biology, biotechnology, botany, ecology, economy, farming, mechanization, meteorology, microbiology, pedology, soil science, technology,

Specialists: agrarian, agriculturist, agronomist, depositor, farmer, field technician, harvester, landholder, ploughman, rancher

Instruments, tools, machines (or part of them) : accessories, aggregate, apparatus, belt chisel, cultivator, damper, deep cultivator, deep ripper, densimeter, disc, disc harrow, drain gauge, drill, engine, equipment, farm machinery, fertilizer distributor, fertilizer injector, gauge plough, grubber, hammer, harrow, harvester, hoe, hygrometer, implements, lysimeter, machine, machinery, manure distributor, multifurrow/ multishare plough, multi- task tractor, multi-tiller, no–till drill, no-hill seeder, no-till planter, one-bottom plough, pick, planter, plough beam, plough, ploughshare, plow, power-take-off (PTO), reservoir (tank), roller, roll-over plough, rotary cultivator, rotary hoe, roto-cultivator, scarifier, rotary cultivator, seeder, shaker, shovel cultivator, shovel, sowing machines, spade, spreader, standby equipment, sub-soiler, tool (implements), tools, vibrator, wheel, wind gauge

Substances, materials: agrochemicals, farmyard manure, fine dust, fuel, green manure, herbicide, humus, liquid fertilizer, macronutrient, manure, marl, mulch, nutrients, solid fertilizer, steel, wood

Chemical elements: carbon, nitrogen, phosphate, phosphorus

Place: country, experimental station, extension service, faculty of agriculture, farmyard garden, landscape, region, territory, test field

Soil and soil-related terms: Earth, furrow, land, plot, sand, texture,

Measures and related terms: acre, are, diagram (chart), dose, parts per milion (ppm), pH value, ratio, square meter, measure

Plant and plant-related terms: arable crop, botanical name, cereal, cover crop, cropping plan, cycle, leaf, maize, monoculture, plant, residues, root, row crop, secondary crop, seed furrow, seed, seedbed, seedling, shoot, stubble crop, tobacco,

Organisms: bug, insect, micro-organism, mole

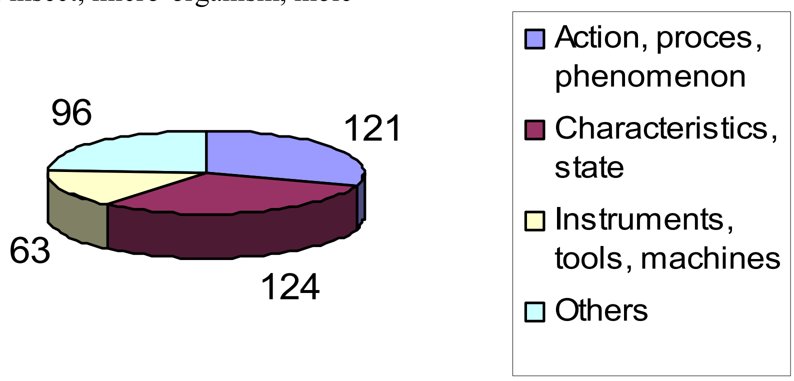

Figure 1. Semantic fields of the tillage practices terms

Some of the words can be repeated if combined with another word such as arable crop, cover crop, row crop etc.

As shown in the Figure 1 the most important fields of the tillage practices include:

-characteristics, state

- action, process, phenomenon

-instruments, tools, machines

The classification of the semantic groups indicate that students or others interested in this field of interest should have primarily knowledge on the *characteristics* of all items relative to tillage practices ; *activities* which should be conducted and *instruments, tools* and *machines* used while doing certain operations.

As for the word formation, there are *derivatives* , *compounds* and *abbreviation.*

Derivatives are words formed from other words by a process of derivation- in this case, addition of suffixes and prefixes (Chalker& Weiner, 1994:110).

In our corpus the most frequent **suffixes** ,their meanings and origin are as follows:

*-**ion*** (amortisation, conservation, diffusion, inoculation, distribution etc.) = action, process, L

- **ing** (warming, water logging, tilling, farming, mulching etc.) = action, process OE

-**ity** (stability, biodiversity, sustainability, conductivity, productivity, velocity = abstract meaning – state, property, quality F

-ness (hardness, =characteristics, state ME

- **ency** (frequency, efficiency, insufficiency) = status, condition, quality (unknown etymology)

-er, ME, -or L (farmer, rancher, harvester, planter, spreader (a man& machine), damper, landholder, *fertilizer*; injector, vibrator, depositor, tractor, distributor) = machines, devices, doer of the action, *substance*

-ist, man (agronomist, agriculturist, ploughman) = person, specialist in doing something OF

-ance & ence (balance, experience, emergence) = abstract meaning-process, state F

The most interesting **prefixes** are as follows:

No- no-tillage, non-arable land, no –till drill, no-hill seeder, no-till planter= not

De- defrosting, degradation, denitrification, desertification, desorption = reverse action

Re- research, resorption, retention = again, back

Inter- inter-cropping, inter-row cultivation, inter-tillage =among, between

Sub- sub-soiling, sub-soiler =below, under

Bio- biotechnology, biology =referring to life, organically produced

Compounds found in the corpus are as follows:

*multi*furrow/ *multi*share plough, *multi*- task tractor, *multi*-tiller

one-year rotation, two-year rotation

evapo-transpiration

There are two **abbreviations** found in the corpus

- power-take-off (PTO) mechanical joint on a machine enabling all directions moving.

- analysis of variance (ANOVA)

Here we should mention **collocations** which are ‘the habitual juxtaposition of a particular word with other particular words ‘(Chalker& Weiner, 1994:70)

They are important in acquiring terminology since “learning more vocabulary is not just learning new words, it is often learning familiar words in new combinations” (Michael Lewis, 2000)

Collocations are, as expected, related to the words given below:

Soil loosening, *soil* reaction, *soil* tillage preparation, *soil* tillage, heavy *soil*, arid *soil*

Arable *crop*, cover *crop*, row *crop*, secondary *crop*, stubble *crop*

Conventional soil *tillage*, deep *tillage*, minimum *tillage*,

By analysing our corpus it is obvious that most of the terms account for actions (121), characteristics (124) and instruments (63). It is in harmony with our assumption that the most frequent aforementioned groups of terms refer to very important aspects of tillage practices. Namely, experts in the field, we dealt with, should be familiar with characteristics and conditions of soil that will be tilled including machines, tools and other related devices required for the cultivation activity.

Conclusion

All of the terms reflect the field people are interested in, its experience and practice. The most frequent terms indicate essential point’s experts or others - dealing with soil tillage - should be aware. These are activities, characteristics and equipment demanded to fulfil the task of soil cultivation.

Another very important implication of the paper is that students have:

- the most important vocabulary referring to soil tillage
- word formation necessary to find out the vocabulary functions
- corpus of words required for conversation on the tillage practices

All the above mentioned will bring about easier communication on tillage practices in English which is the main goal of the paper.

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Significance of Carbon in the Development of Soil Structure

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Abstract
Since the green revolution chemical fertilizers, pesticides, tillage, irrigation and improved seed use has increased agricultural production. However, the increase in yield has been the cause of the decline of soil quality. Recently more farmers are aware of soil quality and its implication to productivity. The major reason for the decline of soil quality is the decreasing organic carbon content of the soils. The high temperatures and mismanagement of the land, namely excess tillage and irrigation and burning of straw after harvest for the next crop, reduce soil organic carbon (SOC), and in turn the physical and biological quality of the soil. The AMF hyphea network is the main asset to be negatively affected by mismanagement, followed by the grave consequences as the destruction of the soil microbial biomass and soil structure.

Appropriate soil and crop management may affect many soil properties, such as enhancing the soil organic carbon (SOC) pool, the development of the soil structure and the transfer of atmospheric CO2 to terrestrial landscapes.

Soil can be a sink for atmospheric carbon, thus reducing the net CO2 emissions normally associated with agricultural ecosystems, and mitigating the 'greenhouse effect'. Vegetation also plays a major role in reducing the CO2 emissions in the atmosphere and improves the physical, chemical, and biological properties of soils via the rhizosphere. Moreover, enhanced biomass production which is the prime denominator of soil physical fertility and sustainability increases the soil microbial dynamics with a consequent increase in the development of soil structure. Carbon sequestration and saving carbon in the aggregate has recently been the burgeoning topic in soil science with an increasing interest on the effect of mycorrhizal hyphae (glomaline as the by-product), together with humic substances enhancing aggregate stability.

Moreover, the results of several long term experiments have manifested the significance of the appropriately programmed organic and inorganic fertilizer treatments in sequestering SOC and inducing aggregate development, which stand for sustainable agriculture and food security. The objective of this study was to evaluate the effects of carbon in development of soil structure.

Keywords: Aggregation, Carbon, Carbon Sequestration, Mean Weight Diameter, Mycorrhizae Nitrogen, Soil Organic Carbon; Water-Stable Aggregates

Landslide hazard zonation on the in the Khiyav Chay watershed using analytic hierarchical processes (AHP) using Arc GIS (Azerbyjan -Iran)

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Abstract

Landslides several times in the past created damage and hazard in study watershed. Due to steepness' of slopes, high weathering ratio via geliflution, vast unresistant soil formation on the slopes, intensive rainfall and impact, study watershed is very prone to mass wasting especially in the form of soliflaction and landslide. Landslide zonation one of the ways that can help to identify critical areas in the environmental planning with utilizing Landslide hazard zonation maps. This paper has utilized from Analytic hierarchical processes (AHP). This Model can be used as one of the applied methods to Landslide hazard zonation in the Khiyav Chay watershed in Ardabil province of Iran. This hazard will exist into the future and all land use decisions should consider the potential destruction that may result. The effective factors in the landslide of the components are then weighted to give each level is determined by their role in landslides. The results of research showed that factors such as slope, altitude, lithology, rainfall, distance from the river, geology, land use, slope aspect and faults have a important roll in the slip zone. Then, using the software Arc GIS for all layers via AHP model into digital form and the Spatial Analytic using the Reclassified layers. According to the weighting the four classes between 1 to 100 are divided. Then from the menu to combine layers of the Raster calculator are deploying all the layers together in the output map of our basin area is classified. In the out pout maps whole watershed area were classified to low risks, medium, high and very high risk zone.
Keywords: landslide Zonation, AHP, Khiyav Chay watershed, unresistant formation, slope instability.

Introduction

Land slide zonation one of the ways that can help identify critical areas and in the environmental planning utilized from risk zonztion maps. In this paper, hierarchical analytic (AHP) can be used as one of the methods applied and the case in the basin, Khiyav Chay watershed has been used in the Ardabel province. While in the study watershed mass movement has an important roll in instability of mountain slope and thereat human live, this subject has been studded. Also about the subject of Landslide prediction has concerned many studies over the last decade (; Glade and Crozier, 2005; Van Westen et al.,2006; Van Asch et al., 2007; Fell et al., 2008). It involves the concepts of susceptibility, i.e. the spatial distribution of Material from landslides can be transferred to the channel network if the landslides are connected with channels. According the mass movement environmental hazardous and exerting high damage on the construction and human live, many researchers have especial attention to study phenomena. For example) Varnes,1996, Liu & et al 2004 ؛ Francesco & et al 2004؛ Gelbet & et al ,2004؛ Aayala, 2004, Tomáš et al (2010), Chang (2010, 2008 Netra et al (2010) and etc has been done quantitative and applied study about mass movement especially landslide. Landslide in the study watershed have dame in the past and important hazards for road and residual area.

Materials and Methods

This paper has utilized from Analytic hierarchical processes (AHP). This Model can be used as one of the applied methods to Landslide hazard zonation in the Khiyav Chay watershed in Ardabil province of Iran. In this present article, the AHP as one of the methods used and applied has been used in the case Khiyav Chay watershed basin located in the Zanjan province. The most important factors in the landslide occurrence in study basin respectively were identified: slope%, height, litology, distance from river, faults, land use, rainfall, and geology and slope aspect. Then, using the software Arc GIS for all layers via AHP model into digital form and the Spatial Analytic using the Reclassified layers. After the layers and weighted them on the final map was produced in ArcGIS. the final results from this study show that the weight of the nine criteria respectively: is 0.38, 0.2050, 0.1515, 0.1012, 0.634, 0.368, 0.265, 0.0187, 0.0155 to the have the slope of the highest weight of (role) and the slope of the least weight. Finally was prepared the landslide map in four groups with very high risk, high risk, medium risk and low risk.

Study area and cause of landslide

The Khiyav Chay river watershed with an area of 338/945 km^2, 410 mm annually precipitation is located on the north east of the Meshkin city. From topographic view point the minimum and maximum height of watershed respectively is 900 to 4700 meter with average gradient of %17/3792 is considered roughens watershed. more than fifty percent of them have 40 to 90% and very prone to slope instability and mass movement. The investigation of Jay and Jimmy, (2009) indicated topography has effective roll in the size and form of landslide. As you can see in the gradient (slope %) map (1) and topographic map (2) and fig (3). Rotational landslides in the elevation range of 2000 to 2500meter are dominated in the study watershed in contrast to translation and slab or flak slides are more occurred. An other form of mass movement in the some slopes of study watershed solifluction. Solifluction all most in the elevation range of 2500 to 3200 meters due to existing unresistant soil with high water content and hard layer under them, are dominated.

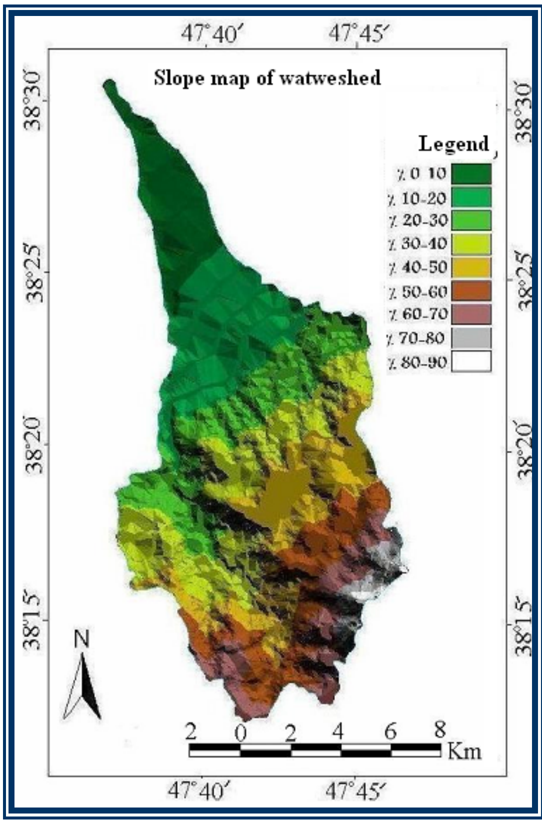

Fig 1. Gradient (slope %) map of study watershed

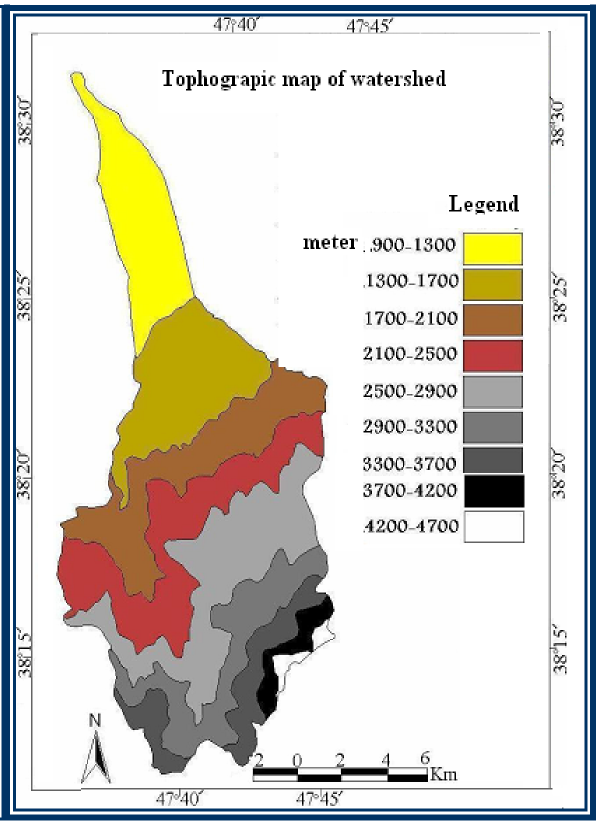

Fig 2. Topographic map of study watershed

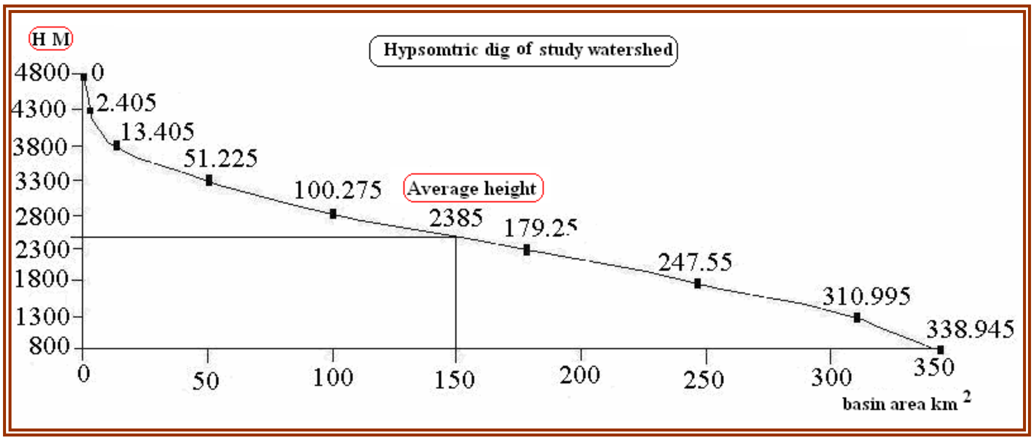

Fig 3. Hypsometric dig of study watershed

Lithology and landslides

As you can see in the lithology map (1) most outcrop lithology formation has including from Cenozoic to quaternary in the study watershed.

Due survey result, more rotational landslide in the depth regolithe any deeply and weathered tiny soil formation, mainly to the stream or river undercutting pointes occurred. In the spring season due to intensive rainfall, soil saturation, water seepage form slopes, hat water spring and river bank undercutting are very effective in occurrence of slump and rotational and also transformational landslide. In contrast most landslides in the west side of slopes occurred. West side of slopes very prone to landslide occurring due to the high rainfall and high weathering and high ratio of pendogens. Human influence is one of the major factors causing landslides world-wide. Road-cuts are usually sites of anthropologically-induced instability. Landslides may occur on the slopes adjacent to the roads (Pachauri and Pant, 1992; Pachauri et al., 1998; Ayalew and Yamagishi, 2005, Ching and She, 2010, Abedini, 2011).

According to the lithology map (4) and contrasting that with landslide zonation map you can see the lithology has very important in landslide occurring beside the topography factor. As we indicated in the landslide zonation map (5), high risk zone has very conformed to unresistant lithology and main stream cutting zones in slopes. But low and specially un risk zone has indicated very conform low gradient slope and also with resistant lithogy formation. In addition most of study watershed landslides in the river valley slopes by bank erosion and undercutting are take place. Landslide zonation map(5) have provided by using lithology, gradient or slope%, green cover and soil lyres in the Arc GIS soft ware. Of course whole geology formation from point of lithology classified and indicated in the table (1).

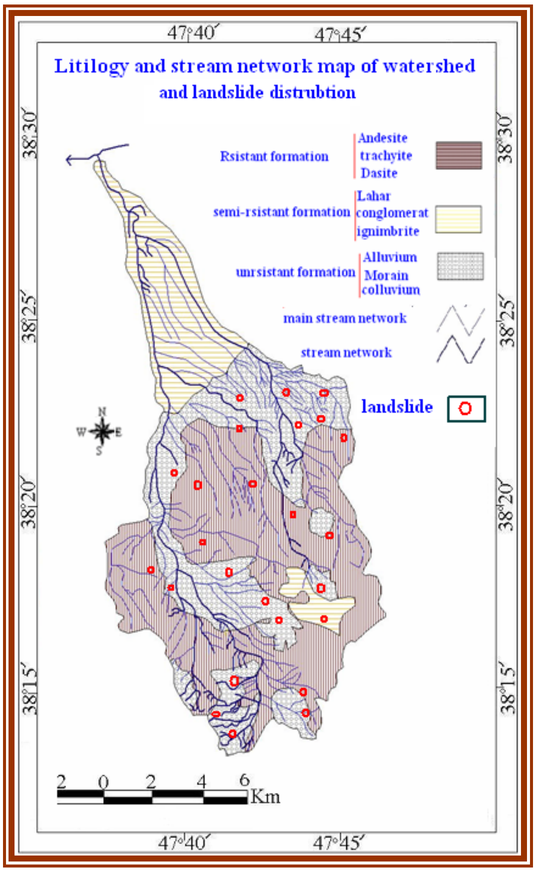

Fig 4. Lithology map of the study watershed

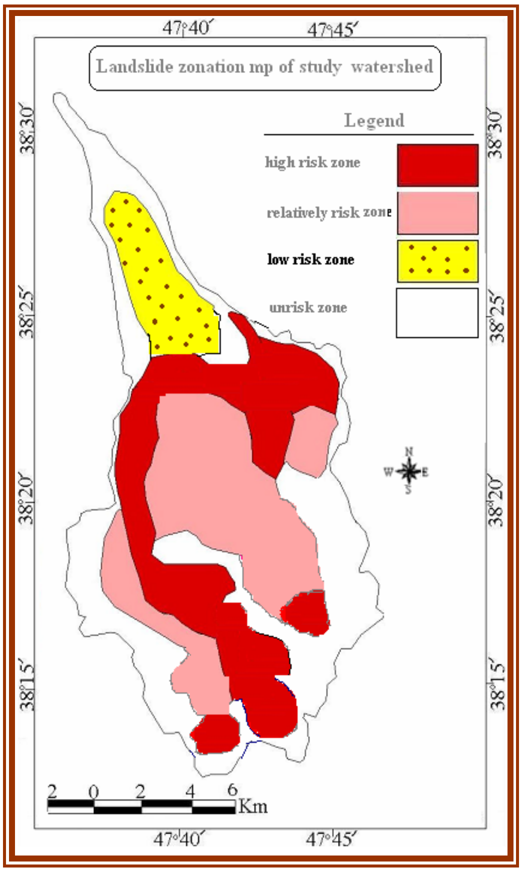

Fig 5. Topographic map of study watershed

Table 1 classification of landslide occurrence sensitivity due to lithology factor

Class or order	Sensitive to landslide	Lithology
1	Very high	Regolith, colluvium's and Alluvium's
2	Medium	Lahar, conglomerate
3	low	Andesite,trachyite,Dasite

Landslides are geomorphic instabilities that mobilize substantial amounts of sediment The interface or connectivity between hillslope instability and channel processes appears in different forms (Korup, 2005), and the efficiency of the connectivity exerts a major control on the magnitudes and rates at which sediment is transferred from the hillslopes to the channel network. Landslides which exist or potentially may occur in an area, and hazard, which includes the probability of landslide occurrence within a given period of time, (Sanjit et al, (2009, 219). According to the survey and field work results, the most slope failure and slump and landslide in the west and north side of slopes or valley side occurred. Undercutting the slope toe by stream and river bank erosion led to unstably slope in form of mass wasting, landslide occurrence and soil erosion in the Khiyav Chay watershed. In addition the case of creating landslide in study watershed generally classified in the two categories as blow:

Internal factors: These factors such as lithology, tectonic, soil conditions and geo internal effect to the chancing topographic condition. The result of much research from view point of tectonic indicated Khiyav Chay watershed is active (Abedini and rahimi, 2011). Also dominating preglacier erosion system condition average 6 to 7 month's in the year, outcrop rocks shattering via Geilifation phenomena, soil formation ratio in form of regolith is very high.

External factors: These factors caused to decrease of resistant of slope structures. Such as road construction cutting, mining, any intensive exploitation, inaccurate agriculture, rainfall and so on in the watershed.

The Khiyav Chay watersheds consists of a series of steeply sloping valleys (with some slopes steeper than 70°) that extend from Sablan summit or crests(4811meter height) down to the medium section of watershed. Slopes consisting primarily of colluviums, and residual soils and completely weathered materials are susceptible to rainfall-induced failures.

The objective of this study is to assess the shallow landslide susceptibility of slopes in the watersheds of eastern to western areas of Khiyav Chay watersheds under extreme-rainfall. Landslides are the most important denudation process affecting watersheds dominated by steep slopes almost in the west and north slopes of watershed.

The failure surface is generally the contact surface between the soils (colluviums or regolith) and the bedrock. Landslides which exist or potentially may occur in an area have hazard, which includes the probability of landslide occurrence within a given period of time. Landslides are geomorphic instabilities that mobilize substantial amounts of sediment led to filling dam reservoir in the study area. Observation showed intense rainfall triggered shallow landslides that transform into debris flows including soil, vegetation, and loose weathered bedrock that flow rapidly down hillslopes or stream channels.

Results

As a result of dominating preglacier erosion system, runoff erosions, high rainfall, slope steepness, and so on, mrophodynamic phenomena such as landslide, debris flow, rock fall, slope failure, solidification greep, caused the remove of slope materials, and soil erosion of the study watershed.

Landslides in the study watershed have occurred in the past and activity continues. Also landslides occurrence occasionally have damaged some roads and agricultural lands in the north ward of watershed. A possibility exists of landslides damming the North Khiyav Chay, which could cause potential serious problems to communities downstream and caused to increasing sediment yield and decreasing reservoir dam utilizing economically. Some Landslides led to damage and hazard several times in the past. This hazard will exist into the future and all land use decisions and environmental planning and this watershed management should consider the potential destruction that may result. the final results from this study show that the weight of the nine criteria respectively: is 0.38, 0.2050, 0.1515, 0.1012, 0.634, 0.368, 0.265, 0.0187, 0.0155 to the have the slope of the highest weight of (role) and the slope of the least weight. Finally was prepared the landslide map in four groups with very high risk, high risk, medium risk and low risk. Ultimately the whole watershed area to four zones such as, unrisk, low risk (slight), moderate risk and high risk zones for future planning and water she management.

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Utilization of wastes in agriculture and legal regulations in Turkey

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Abstract: Wastewater and sewage sludge utilization has become a promising alternative and innovative approach by using of the existing source in irrigation and soil. The opportunities of waste applications are that it provides convenient disposal of waste products and has the beneficial aspects of adding valuable plant nutrients to soil that is the reason why re-utilization of waste resources in agriculture are becoming widespread. However, metals in soils exert a decisive impact on the quality of soil and its use in food production. In order to avoid undesirable side effects due to salinity and toxic concentrations of metals from the application of wastes to soil, it is necessary to have some restrictions. The way of the economic and sustainable waste recycling without giving an environmentally hazard on agricultural lands have been investigated and some legal regulations accepted by the countries. In this study, the positive and negative effects of waste utilization on soil properties evaluated and the restrictions of the waste utilization in agriculture and legal regulations in Turkey have been discussed and compared to other countries.

Keywords: Waste water, sewage sludge, soil properties, Turkey.

1. Introduction

Global water cycle, land management and food security are intimately linked. Global food system has responded to the doubling of world population by more than doubling food production during the past five decades. Feeding a growing and wealthier population with more diversified diets poses significant challenges for food security and environmental sustainability in the coming decades (Abdullah, 2006). Producing more food requires more water; richer and more nutritious diets require even more water. The scope for expansion in cropped or irrigated area as in the past decades remains limited. Much of the additional food production must come from the intensification of land and water systems (FAO, 2003; Khan et al., 2006). But this would exert unprecedented pressure on ecosystems that provide a range of benefits to mankind including food, fiber, timber, fuels, climate regulation, biodiversity conservation and regulation of water flows and quality.

With the increasing pressures on natural water resources, new problems related to the long-term health of the soils have emerged. These concerns are reflected in the soil and water management programs in Turkey as in almost all countries.

Turkey has a total land area of 780 000 km^2, which currently accounts for a population density of 96 people/km^2. The mean annual rainfall is of about 643 mm, with a wide variation from region to region. It is estimated that the total exploitable (technically and economically) surface and ground water potential of Turkey is 112 billion m^3, with 95 billion m^3 of this coming from internal rivers, 3 billion m^3 from external rivers and 14 billion m^3 from ground water resources. Hence, Turkey can be classified as a "Water Stress" country, with total exploitable water resources being around 1 500 m^3 per capita, which is high for the Middle East except for Iraq. This figure is expected to drop down to 1,125 m^3 per capita by 2023. With the projects developed primarily by the General Directorate of State Hydraulic Works (DSI) and other institutions engaged in the water resources development, actual current water consumption in Turkey has reached 44 billion m^3, which corresponds to only 39% of economically exploitable water resources (DSI, 2011). Most of the water is consumed through irrigation, which is not only the largest component of water consumption in Turkey but also the greatest consumer of funds allocated for water resources projects (Yapanoglu, 2010).

In Turkey, according to the results of municipal water and wastewater statistics in 2008, population served by drinking water networks has a share of 82% and population served by sewerage systems has a share of 73% in Turkey population. Rate of population served by drinking water treatment plants and rate of population served by wastewater treatment plants in Turkey population was 41% and 46% respectively. In municipalities, amount of water abstracted for drinking water network was 215 liters/capita-day and amount of wastewater discharged by sewerage network was 173 liters/capita-day (TUIK, 2011).

2. Waste utilization in agriculture

Sustainable land and water management are contextualized as a sub-goal to achieve overall environmental sustainability. Approaches and policies to address the waterlogging and salinity issue as a facet to sustainable land and water management are explored first through an overview of experiences around the globe. It is widely accepted that interest in environmental issues is constantly increasing. At the same time, environmental issues have gradually been broadened with concepts, such as sustainable development, which implies not only ecological, but also economic and social responsibilities.

The handling of sewage sludge and wastewater is one of the most significant challenges in waste management. Improving land and water management in agriculture and the livelihoods of the regional communities require mitigating or preventing land degradation. Degradation of land and water resources is commonly reported problems in large-scale irrigation system (Khan and Hanjra, 2008). Widely reported data suggest that about 1/3rd of global irrigated land has lower productivity due to poorly managed irrigation causing waterlogging and salinity. Annually about 10 million hectares (Mha) are lost to salinization of which about 1.5 Mha are irrigated lands. Global productivity loss due to land degradation over three decades has been estimated at 12 per cent of total production from irrigated, rainfed, and rangeland or about 0.4 per cent per annum cumulatively (World Bank, 2003). Unsustainable water management practices have implications for the sustainability of food production and of terrestrial and aquatic ecosystems and the services they provide to the humanity (Tilman et al., 2002; Gisladottir and Stocking, 2005).

Sludge and wastewater contain organic materials that are often rich in nutrients such as nitrogen and phosphorus, and contain valuable micronutrients (EPA, 2000). This give them unique fertilizing benefits, since those elements, contained in sludge and wastewater, are essential to plants for growing. However, they may contain at the same time various other elements, which can be harmful when entering in human food chain, such as heavy metals (Fytili and Zabaniotou, 2008). The long-term goal should be to utilize the nutrients and organic matter in sludge and wastewater through land application. Although the recycling of the organic matter and nutrients contained in wastewater and sludge through land application is a worthwhile objective, presence of heavy metals like lead (Pb), cadmium (Cd), chromium (Cr), copper (Cu), zinc (Zn) and mercury (Hg) and pathogens in sludge pose risks to human health, agricultural productivity and ecological health (Harrison et al., 1999). Pollution problems may arise if toxic heavy metals are mobilized into the soil solution and are either taken up by plants or transported in drainage waters to associated water supplies (Zufiaurre et al., 1998).

Often the potential adverse impacts of wastewater irrigation and sewage application to the soil are not due to wastes per se, but due to inadequate institutional and management responses such that many of these can be addressed with effective policies and programs. But the links among sustainable land and water use practices and ecosystem services on one hand and policies that can make these practices more sustainable on the other hand remain poorly understood and applicable.

2.1. Legal Regulations of Sewage Sludge Utilization in Agriculture

Sewage sludge is the solid, semi-solid, or liquid residues generated during the treatment of domestic sewage in a treatment works (National Research Council, 2002). Wastewater sludge disposal is a major urban environmental problem (Parkpain et al., 2000). In the past, incineration and landfilling were common practices for disposal. However, limited landfilling areas and the increasing cost of landfill disposal as well as the phasing out of other environmentally unacceptable disposal options, such as ocean disposal, are the reasons encouraging increased use of sludge in agriculture. The fact that the debate on sludge disposal and recycling is constantly increasing across Europe shows that the relationship between farmers and their customers, the food industry and retailers are of vital importance for accepting sludge use in agriculture.

The utilization of sewage sludge as a soil improver has positive effects on soil physical and chemical characteristics but on the other hand the heavy metals in the sludge cause some concerns about its utilization. Because of these concerns, the use of sludge in agriculture should be strictly controlled by regulations. The land application of wastewater sludge is regulated by U.S. EPA 40 CFR 503 in USA, 86/278 EEC in EU and Domestic and Industrial Sewage Sludge Utilization in

Soil Regulation (SSR) in Turkey. The aim of all these regulations is the safe recycling of sludge and an enhancement of its characteristics.

All member states of Europe have a chance to adapt more stringent standard values according to the 86/278/EEC directive. The countries in which the limitations on heavy metal concentrations are the most stringent are Denmark, Finland, the Netherlands, and Sweden. Greece, Luxembourg, Ireland, Italy and Spain have set limit values similar to those in the directive. (National Research Council, 2002).

Regulations on the use of sludge specify limit values for heavy metals in soil that are similar in most cases. Some countries have defined limit values for several categories of soil pH or limit the maximum load of heavy metals to agricultural lands on a 10-year basis (National Research Council, 2002).For example, maximum quantities of sludge that can be applied on land have been set between 1 metric ton by the Netherlands for grasslands and 10 metric tons by Denmark per hectare and per year (Ozsoy, 2006)

2.1.1. Turkish Regulation of Treated Sewage Sludge in Agriculture

The standards related to the land application of sludge in Turkey had set under the name of Soil Pollution Control Regulation (SPCR) and put into effect in December 2001. This regulation had 21 articles defining the technical and administrative principles of sewage sludge use in land application and 7 annexes declaring standards for the heavy metal concentrations in soil according to pH, maximum allowable heavy metal concentrations in sludge which is applied to soil, and maximum load of heavy metals applied to soil on a 10-year basis, limit values for pollutants other than heavy metals (SPCR, 2001). In 2010, the regulation has re-considered and the restrictions on agricultural application of the sludge designed under the regulation of Domestic and Industrial Sewage Sludge Utilization in Soil (SSR).

Table 1: Limit Values for Heavy Metals in Sewage Sludge (SSR, 2010)

Heavy Metals	Limit Values (mg/kg DS)
Pb	750
Cd	20
Cr	1200
Cu	1000
Ni	300
Zn	2500
Hg	16

SSR of Turkey differs from regulations in U.S. and EU in several aspects. The main difference in Turkish regulation from the US regulation is the absence of the limits for pathogen densities. (Ozsoy, 2006). Turkey has adopted similar limit values with the EU 1986 Directive for the heavy metal concentrations in soil according to pH, maximum allowable heavy metal concentrations in sludge that is applied to soil, and maximum load of heavy metals applied to soil on a 10-year basis except for Chromium that is not regulated in EU 1986 Directive. Some heavy metals are regulated stricter in EU (Cu, Cd, Hg and Zn) and others in USA (Pb). United States regulations include three more metals (As, Mo, and Se) regulated in addition to the metals regulated in EU.

Table 2: Limit Values for Amounts of Heavy Metals That May Be Added Annually to Soil, Based on a 10-Year Average (SSR, 2010)

Heavy Metals	Annual Pollutant Loading Rate Limits (mg/kg DS)
Pb	15
Cd	1500
Cr	1200
Cu	300
Ni	3000
Zn	10
Hg	15

2.2. Legal Regulations of Wastewater Utilization in Agriculture

Farmers using wastewater in developing countries are often limited by adopting safe guards for human, animal and environmental health control and in improving beneficial use of water and nutrients. Guidelines on wastewater recycling and reuse are essential. They help protect public health, increase water availability, prevent coastal pollution and enhance water resources and nature conservation policies (Kamizoulis et al., 2003).

The existence of such guidelines means an important step in the planning and implementation of safe use of reclaimed wastewater for irrigation, because it contributes to sustainable development of landscape and agricultural irrigation. Guidelines for reclaimed wastewater use for irrigation must clearly define what is allowed and what is forbidden to execute (Shatanawi et al., 2003). This can be defined in great detail or in a broad manner, but must take into account some important specific local conditions, such as the quality of reclaimed wastewater, soil, climate, relevant crops and agricultural practices (Helena et al., 1996; Papadopoulos, 1997).

There is not a common regulation of wastewater reuse in the world due to various climatic, geological and geographical conditions, water resources, type of crops and soils, economic and social aspects, and country policies towards using wastewater influents for irrigation purposes (Fatta et al., 2005).

Some countries and organizations have already established reuse standards such as US.EPA, California, WHO and FAO. Most of the developing countries have adopted their own standards from the leading standards set by either FAO, WHO, California, etc. Most countries where wastewater irrigation is practiced have public health regulations to protect both the agricultural workers and the irrigated crops consumers (Fatta et al., 2005).

Some countries have taken the approach of minimizing any risk and have elaborated regulations close to the California's and US.EPA criteria, but because these criteria are strict, expensive and take specific conditions into account, other countries adopted the wastewater criteria based on the guidelines of (WHO, 1989), which are more flexible. But some guidelines were not sustainable and would lead to reduced health protection, because they would be viewed as unachievable under local circumstances. According there was a particular need to conduct a review of these guidelines, so the WHO published the volume of the guidelines for the safe use of wastewater, excreta and grey water (2006), so many countries can adopt or adapt them for their wastewater excreta use practices (WHO, 2006; Fatta et al., 2005, Shatanawi et al., 2003).

Case studies from Ghana, Bolivia, Pakistan, Tunisia and Mexico are used to illustrate the complex factors that influence the use of wastewater by farmers. Limitations are identified as: nutrient management, choice of crops, irrigation methods, health risk regulation and land and water rights (Martijn and Redwood, 2005). In some cases, the most viable approach is to acknowledge irrigation as a land-based treatment method, which requires sharing of costs and responsibilities between wastewater producers, government institutions and farmers.

2.1.2. Turkish Regulations of Wastewater Use in Agriculture

Wastewater treatment applications are recent issues in Turkey. Municipality Bank initiated related technical preparations for wastewater treatment during the 1980s and put the first deep-sea discharge in Yalova and Cinarcik in 1983 and the first wastewater treatment facility in Ilgın in 1984 into operation. There is a great increase in wastewater treatment plants due to application of the 1988 Water Pollution Regulation (Cakmak and Apaydın, 2010).

Where water for irrigation is scarce, it is recommended to use treated wastewater with water quality indicators which meet the standards for irrigation in Turkey. Turkey already approved its irrigation water quality standards on 1991 covering five quality classifications. These indicators are found out jointly by State Hydraulic Works, Bank of Provinces, and Rural Affairs of Ministry of Agriculture. Treated wastewater is assessed for use in irrigation according to these indicators. They can be arranged like total dissolved solid concentrations and electrical conductivity, sodium concentration, relative to other salts, concentrations of boron, heavy metals and other toxic substances, calcium and magnesium concentrations, total solids, organic substances and floating substances such as oil, grease and pathogenic microorganisms (Cakmak and Apaydın, 2010).

The type of use of wastewater for irrigation in agriculture is given in Tables 4 and 5. Table 4 describes the basic principles and technical limitations to be applied when re-using wastewater in irrigation. Table 5 presents the same when industrial wastewater is used.

Table 4. Principles and technical limitations for using wastewater in irrigation (Official Gazette, 1991)

Type of agriculture Technical limitations	Type of agriculture Technical limitations
Fruit and grape production	Sprinkler irrigation is prohibited. Fruits that have fallen down should not be eaten. Fecal coliform numbers should be less than 100/1000 mL.
Fiber plants and seed production	Surface or sprinkler irrigation can be applied. Biologically treated and chlorinated wastewater can be used in sprinkler irrigation. Fecal coliform numbers should be less than 1000/100 mL.
Fodder, flower plantation, oil plants	Surface irrigation can be applied using mechanically treated wastewater.

Table 5: Suitability of wastewater from different types of industries for irrigation (Official Gazette, 1991)

Suitability	Industries
Appropriate for irrigation	Brewery, winery, malt, yeast, potato, vegetable processing, marmalade, fruit processing, dairy, potato starch industries.
Appropriate for irrigation only if the water is treated so as to comply with the values of providing quality criteria in law	Sugar, rice and cereal starch, tan- nery-glue, animal-glue, slaughter- house, meat-packing, margarine, pulp and paper, textile, fish, metal industries.
Not appropriate as irrigation water	Soap, inorganic heavy chemical, dye stuffs and intermediates, pharmaceutical, metal, cellulose, pyrolisis plant, fuel and oil, coal washing, steam power plants, explosive industries.

3. Conclusion

In order to reduce the environmental and health impacts of wastewater reuse and sewage utilization in agriculture, countries have adopted several standards and guidelines that differ from each other. Practice of waste reuse mainly depends on a country's economy, infrastructural status covering wastewater treatment capacity and capability, educational level, climate, water supply, balance between water requirement and demand, intensity of agricultural activities, population. Therefore, legal regulations should be compatible with a number of related sectoral or sub-sectoral policies such as national water management and irrigation policy, national health, sanitation and sewage policy, national agricultural policy and national environmental protection policy.

Even though the national irrigation water quality standards has been active since 1991in Turkey, reuse of treated wastewater for irrigation has not been considered consciously till now as the country has not yet experienced severe water shortages. In the nearest future, wastewater reuse will be one of the most important environmental issues in Turkey. Therefore, detailed surveys need to be extended. As an initial step towards effluent use in irrigation, it is important that the farmers are informed on the safe use of effluents in irrigation and in soil, if done under serious control and monitoring of the effluent quality. Public awareness and training is another important issue that should be considered by the legal local and/or governmental related authorities.

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Evolution of the Nile Delta Coast Line During 20th Century

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Abstract
Some morphological changes of the Nile delta coastline are recognized during last century, especially in its promontories of Rosetta, Burullus and Damietta are being eroded and some of these sediments are being deposited in other locations. The study area is located on the northern coast of the Nile Delta, between Rosetta and Damietta mouths. It has a length of about 170 km. The major objective of this study would be to understand the regional evolution of the Nile Delta coast during the last century. The morphological changing of the Nile Delta shoreline were determined by the following methods: comparing satellite images, aerial photographs and historical maps, field observation of the study units, samples will be collected for sediments characteristics analysis, include sediments size, sediments color, organic matter, carbonate contents and grain size analysis and finally analyze the collected data by GIS techniques.
Key Words: Climate Changes, Rosetta promontory, Damietta promontory, Nile Delta.

Introduction

The natural Nile cycle of flow and sediment discharge has been disrupted by human intervention during last century including closure of Low and High Aswan Dams; this intervention has resulted some morphological changes.

The study area

The study area extends along the northern Nile Delta coast from Rosetta to Damietta mouths. The generally smooth coastline is interrupted by promontories at Rosetta mouth, Burulus langoon entrance and Damietta mouth (Figure 1). Some morphological changes of the Nile delta coastline are recognized during last century, especially in its promontories of Rosetta, Burullus and Damietta are being eroded and some of these sediments are being deposited in other locations. The study area is located on the northern coast of the Nile Delta, between the Delta mouths; it has a length of about 170 km (Figure 1).

Objective

The aim of this study was to evaluate temporal beach changes along the northern Nile Delta coast on the basis of analyses of historical maps and satellite images that span 100 years. Another objective is to establish the relationships among position of shoreline changes and longshore sediment transport patterns, as well as understanding the regional evolution of the Nile Delta coast during the last century as an impact of the following factors:

1. Global sea level rise as a result of climate changes.
2. Decreasing the annual discharge of the Nile River.
3. Tilting subsidence of the northern Nile Delta coastal region at rates of up to 0.5 centimeter/ year.
4. Roll of Mediterranean Sea western marine currents on sediments transportation toward the east.
5. Human activities such as: construction of both Aswan High and low Dams and some barrages along the Nile River.

Previous work

Several publication have been carried out to study shoreline changes along the Nile delta using remotely sensed data, among these phase are: Klemas and Abdel Kader (1982); Frihy (1988);Elwany *et al*. (1988); Fanos and Khafagy (1989); Stanley and Warne, (1993); Fanos, 1995; El-Raey *et al*. (1995). Recently, Ahmed *et al*., (2001) and El Raey (2005).

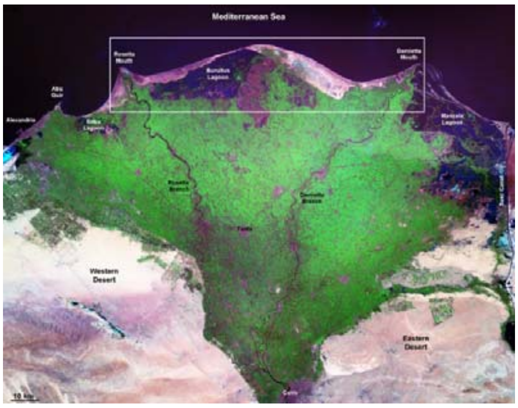
Materials and Methods

Data used:

1. Topographic map of the study area scale 1:50,000 published in 1925.
2. TM Data (7 bands - Thematic Mapper) in dates (1984, 1987, 1990, 1993)
3. ETM Data (9 bands) in dates (1997, 2002, 2003, 2004)
4. Field surveying of coast line by use GPS every 60 days betwean March – August, 2007.

Software used

1ERDAS Imagine 9.1 package.   2-ARC GIS 9 package.



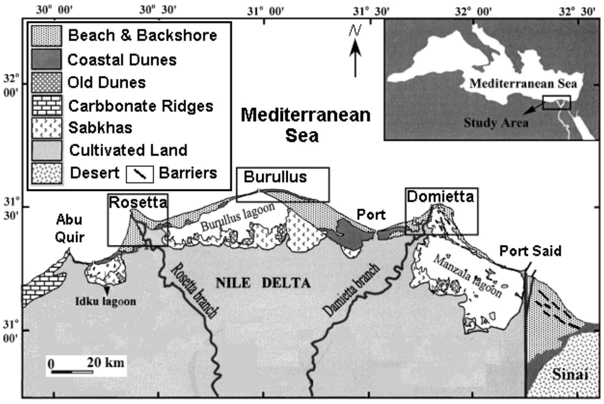


Figure1: Location of the study area

Figure 2: Major geomorphic units of the northern portion of the Nile Delta

Methods

Rapid changes, natural and anthropogenic, across the Nile Delta coastline have been analyzed by undertaking comparisons of satellite image data, in the following dates: 1978, 1983, 1990, 1993 and 1995. These images were utilized in addition to a series of topographic maps; to cover 82-year monitoring period in the following steps:

1. The methods used in this study depend on the main application of both of RS and GIS techniques such as using comparative multi-dated remote sensing images and topographic maps as well as field measurement.
2. The measurement of the geomorphic changes of the coast line between multi-dates images by using unsupervised classification and recoding analysis.

Results and Discussion

In the beginning last century every year before construction of the Low and Aswan High Dams, water flooded from Nile during August-October through its branches (Rosetta and Damietta), but after building it a huge amount of water and alluvial sediments storage behind the Dam specially since 1964, the mean annual amount of Nile water is reduced from 34 billion cubic meters to less than ⅓ it's amount before construction the High Dam, the sediment load is reduce too from 60-180 million tons to less than 15 million tons after building it , which was the main source of accretion on the coast line and the two promontories of Rosetta and Damietta, but it has removed gradually from this date (Sharaf El Din, 1977). The present study shows that there are some morphological changes of the geomorphic units of the northern portion of the Nile Delta depicted as a result of construction of both Low and High Aswan Dams (Figure from 2 to 6 & Table1):

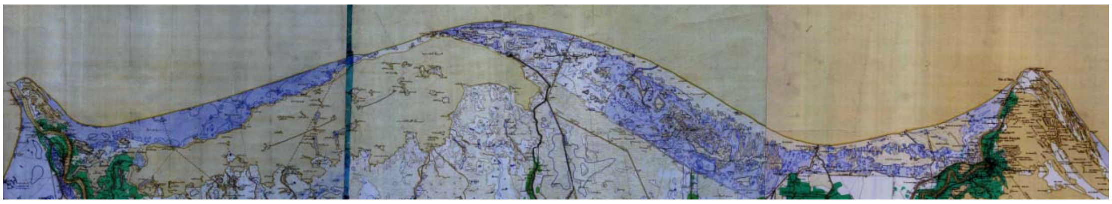


Figure 3: Morphological characteristic of The Nile Delta coastal region in 1925 (from topographic map)

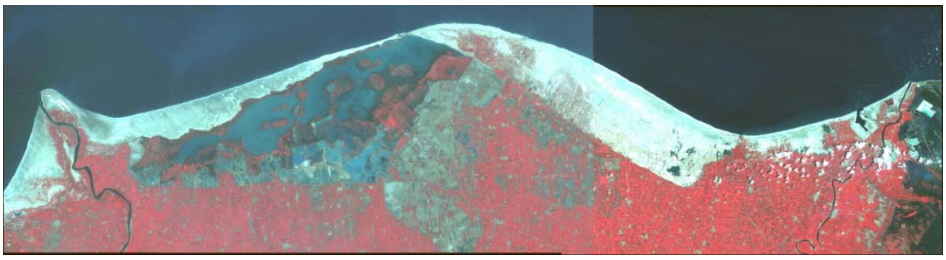


Figure 4: Morphological characteristic of The Nile Delta coastal region in 1984

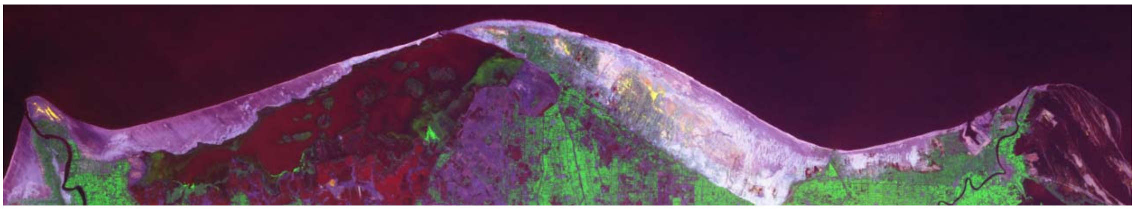


Figure 5: Morphological characteristic of The Nile Delta coastal region in 1990

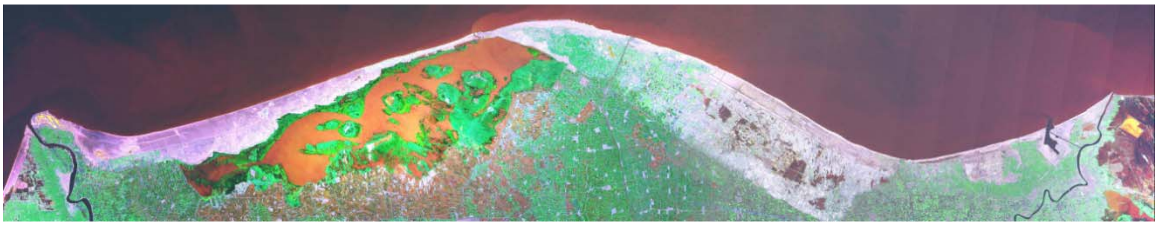


Figure 6: Morphological characteristic of The Nile Delta coastal region in 2001

Table 1: The evaluation of the major topographic units between 1925 and 2001(km3)

Topographic Unit	1925	1970	1984	2001
Data Source	Topographic Maps		Landsat TM images	
El Burullus lagoon unit	8658.5	5674.7	553.4	489.8
Lagoon islands unit	43.7	65.6	317.2	292
The coastal dunes unit	1085.6	704.3	1032.8	567
The coastal sabkhas unit	1173	736.4	265.1	59

The mouths unit of Nile Delta braches in Rosetta and Damietta

1-Erosion of the Rosetta promontory began about 1900 after construction the Aswan Low Dam, the western and eastern sides of the mouth lost between 1900 – 1964: 879 and 1282 meters, it's average rate about 13.7 and 20 m/yr. The storage of water Nile started on 1964 at Lake Nasser in the front of the High Dam, it increased the erosion rate between 1964-2006 to 95.3 and 124.8 m/yr (Table 2 & Figure 7).

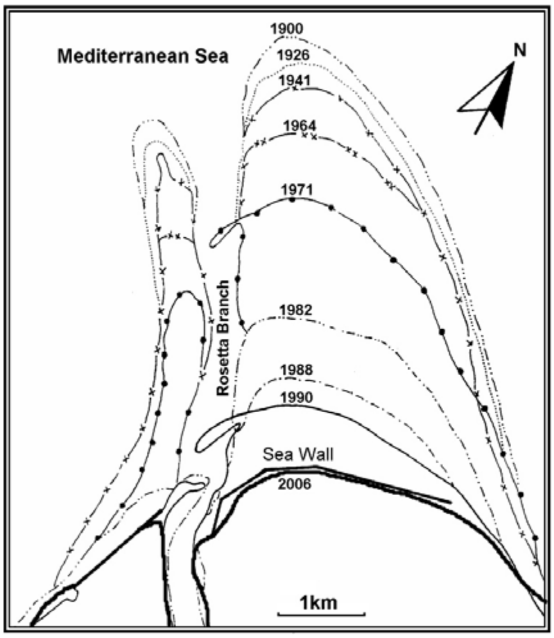


Figure 7. Morphological changes of The Rosetta mouth from 1900 to 2006 (After: Fanos, 1995)

Table 2 Annual rates of erosion on both western and eastern sides of Rosetta mouth (promontory) between 1900 and 2006.

Period		Western Side		Eastern Side	
		Erosion distance (m)	Erosion Rate (m/yr)	Erosion distance (m)	Erosion Rate (m/yr)
Before construction of the Aswan High Dam	1900-1926	243	9.3	396	15.2
	1926-1941	191	12.7	298	19.9
	1941-1964	445	19.3	588	25.6
	1900-1964 Sub Total	**879**	**13.7**	**1282**	**20**
After construction of the Aswan High Dam	1964-1971	826	118	1555	222.1
	1971-1982	2796	254.2	1652	150.2
	1982-1988	381	63.5	826	137.7
	1988-1990	0	0	318	159
	1990-2006	0	0	890	55.6
	1964-2006 Sub Total	**4003**	**95.3**	**5241**	**124.8**
Total Period		**4882**	**46**	**6523**	**61.5**

2-Coastline changes of Damietta promontory are similar to those of the Rosetta area. Erosion of the Damietta promontory started about 1900 too, it lost about 3.7 km between 1900-1991 averaged 40.7 m/yr. The average rates of the western and eastern sides between 1900 and 1973 was about 35 and 40 m/yr, but it increased to more than 100 m/yr after construction of The High Dam, although some protected walls and groins have been constructed during this period (Fig.8,9&10). The W/E currents accreted a 4.5 km long spit near the eastern side of the Damietta promontory, that spit appeared on 1983 aerial photos witch observed and recorded by (Frihy, 1988).

El Burullus lagoon unit: it is one of five shallow lagoons along the coastal plain of the Nile Delta (Maryut and Idku to the west of Rosetta Branch, El Burullus in the middle Delta coast and finally El Manzala and EL Bardawil to the west of Damietta Branch. The total area of El Burullus lagoon is reduce during last century from 5600 km^3 (1925) to 317.2 km^3 (1984) then to 197.8 km^3 (2001) as a result of the human activities and land reclamation projects, specially after construction of the High Aswan Dam. Some years ago depth of that lagoon was varies between 0.5 and 3 meters, but now it becomes more shallow as a result of sediments accumulation by geomorphic processes and human activities. The total area of the lagoon islands is increase from 65.6 km^3 (1925) to 292 km^3 (2001) due to accumulate the deposits on the lagoon bottom.

The coastal plain unit: The Nile Delta coastal plain wasted by erosion more than 30.86 km2 between 1925 and 2001, most of these areas lies in the western sides of The Rosetta and Damietta promontories. The average of erosion increased from 91.4 during the period (from 1925 to1984) to130.8 acres/yr during the modern period (1984-2001) as a result of storage the Nile water in Lake Nasser. In the other hand the coastal plain extended by accretion processes not more than 24.43 km2 from 1925 to 2001, and the average reduce from 93.7 acres/yr before 1984 to less than 30 acres/yr (Table 3).

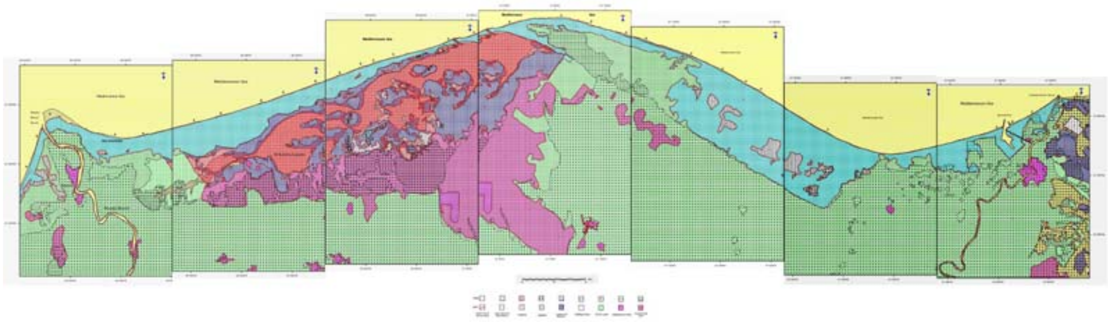


Figure 8 Morphological changes of the Nile Delta coastline between 1984-2001

Table 3: Morphological changes of the Nile Delta coastline sectors between 1925 - 2001 (in Acres)

Accretion		Erosion		Sectors
1984-2001	1925-1984	1984-2001	1925-1984	
-	-	1682	2952	Rosetta mouth
270	1381	-	-	East of Rosetta mouth
152	1338	-	-	East of El Burullus lagoon
-	1126	-	-	West of El Burullus lagoon
-	-	541	2450	Damietta mouth
-	1572	-	-	West of Damietta mouth
83	114	-	-	Separated areas
505	5531	2223	5402	Sub total
29.7	93.7	130.8	91.6	Annual rate
6036 Acre= 24.43 k.m.2		7625 Acre= 30.86 k.m.2		Total

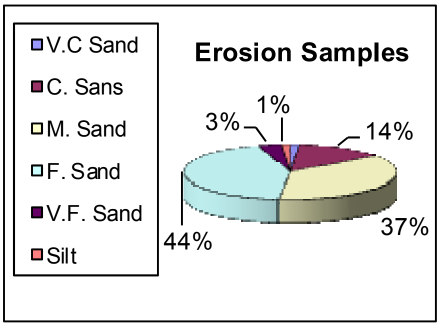
The coastline has been divided into seven sectors from west to east (Figure 5), witch show morphological changes of coastline between 1984 and 2001. The Nile Delta coastline is generally convex shape in three promontories at The Rosetta mouth, Burullus lagoon neck and The Damietta mouth, they separated with two concave wide bays, as a result of action of the NW prevailing wind, and W/E longshore currents effects, the eastern sides of these promontories are retrograded by coastal erosion, but accretion took place to the outer eastern sides of these promontories and bays.

Grain Size analysis

14 beach samples were collected for grain size analysis, nine samples got from erosional beaches and five samples collected from accretional beaches. The statistical data (Tab.4 and Fig. 9 &10) shows that most of the study area beaches are composed from coarse to very fine sand, but erosional beaches are contained more finer grains than accretional beaches, because the dynamic processes can transport fine grains more easy than coarse grains.

Table 4 Results of grain size analysis of beach samples

Beach type	Sample No.	Weight % of fractions					
		V.C Sand	C. Sans	M. Sand	F. Sand	V.F. Sand	Silt
		-1:0	0:1	1:2	2:3	3:4	>4 Φ
Erosion	1	0.21	1.92	8.67	74.88	13.53	0.79
	4	0.19	3.63	14.15	69.52	11.93	0.58
	5	0.24	4.22	12.75	69.35	12.85	0.59
	6	0.28	3.95	13.94	66.52	14.83	0.48
	7	0.36	3.48	13.17	68.94	13.63	0.42
	8	0.25	3.21	12.28	66.99	16.74	0.53
	9	0.31	3.07	13.43	66.84	15.84	0.51
	10	0.21	2.86	14.53	68.19	13.67	0.54
	14	0.28	3.75	13.85	67.23	14.38	0.51
Average		**0.26**	**3.34**	**12.97**	**68.72**	**14.15**	**0.55**
Accretion	2	0.79	14.52	39.31	41.68	2.52	1.18
	3	1.38	13.84	35.83	44.52	3.17	1.26
	11	1.53	12.73	34.58	46.15	3.29	1.72
	12	1.72	13.17	36.37	42,98	4.17	1.59
	13	1.83	13.73	37.51	42.30	3.39	1.24
Average		**1.45**	**13.60**	**36.72**	**43.66**	**3.31**	**1.40**



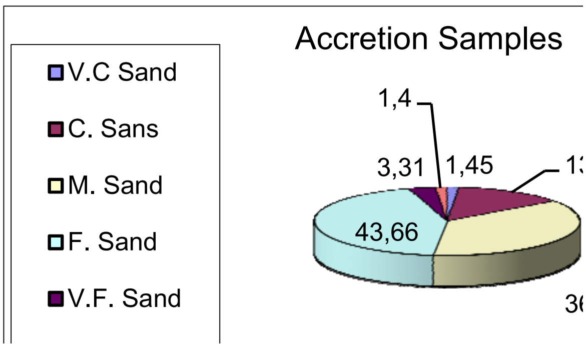


Figure 9.Size fraction of erosional beach samples Figure10. Size fraction of accretion beach samples

Conclusions

The Nile Delta coast was determined by comparing satellite images and historical charts with present-day conditions. The analyses identify into two patterns: erosion and accretion shorelines. These two patterns are influenced by transport processes, including sediment provenance from different sources: eroded Nile delta coast, relict sediments from the former Nile distributaries and mouths, and sediment supply by land valleys and from wind-blown sand.

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Antropogen Effects in Repeat Salinization of Soils

(as an example of the soils along Araz in Nakhichevan AR)

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Abstract

The soils that are good for sowing are mainly situated in the inclined plain zone of the Nakhichevan Autonomous Republic.
Studying an effect of the antropogen activity is set as an object in use of these soils because of spreading of the soils on the rocks by old sea- lagoon origin (under, middle, upper) according to the geologial structure.
The water –building work, reservoirs construction, irrigative canals creation in the zones along Araz beginning from 60 th years of the 20th century, improve water provision on the other hand the leakages from them and as a result of irrigation by means of a primitive torrential level of the subsoil waters, approached the surface and bogging has happened in some places. Especially, while leakage waters contact with the rocks in sea-lagoon origin, both mineralization of the subsoil waters increases and bogging is a reason for repeat salinization for a short time.
Changing of the ecomeliorative state occurs under an influence of the antropogen factors in the zones along Araz: reservoirs which have been built aside river-bed, leakages flowing from irrigative canals, not working collector drainage nets, a water loss (till 40%) because of the irrigation by a method of primitive torrential in the soils on the rocks by sea-lagoon origin and etc.
Interesting things have been got by the researches which investigate antropogen factors separately (these factors create repeat salinization).
Keywords: Nakhichevan, Araz, irrigation, soil, ecological.

Introduction

The soil reform in Nakhichevan Autonomous Republic, assimilation of the new soils, building of the hydro technical installations on the sea-lagoon original rocks of the riverside water storehouse and etc. is a cause for a change of ecological and meliorative condition in the irrigative soils of the foothill zone and along Araz during improvement of the water supply. The river of Araz plays role of a natural drainage for infiltrative waters before the work of water economy which is fulfilled in the region. The underground water regime changed in the surrounding zones after «Araz water unit» was given for use on the river of Araz in 1971, the productivity of the agricultural plants reduced along the bank, the fertile soils exposed to bogging and repeated salinity. Being way out of a situation since 1976 large-scaled collector-drainage nets (CDN) have been built along Araz soils and begin to returned to tillage rotation setting free soils from harmful salts.
The research zone has a continental climate. Here the absolute maximum temperature is 40-43^{o}C in summer, the absolute minimum is -32^{o}C in winter. A quantity of the average annual rainfall is 215-276 mm, and possible evaporation is 1200-1400. In a hot period the possible evaporation forms 60-70 % of the annual possible evaporation, and this is the highest parameter in Caucasus. Because of reducing of the river waters during irrigations the water insufficiency is felt in the autonomous republic. The depth of the underground waters ranges between 1,2-26 m, mineralization is 0,8-12,3 g/l (Babayev S. 1999, Guliyev A. 2007).
Active land tenure system, almost half of the area land on earth is accompanied now by appreciable anthropogenous and dynamics of landscapes, scale disturbances of a natural vegetative integument that leads to losses of soil, its fertility and desertification. The ploughed land which is a zones of insufficient humidity, and its promotes erosion, aggravation of droughts and offensive sand.
In droughts subtropical regions, scale erosion of soils gets irreversible character. Rate of desertification in the world has now reached 5-7 million in hectare, a year. Besides, annually 20 million more hectares loses its efficiency because of desert offensive. Every minute, 40 hectares of the fertile soil are destroyed. The most part of the area of modern deserts has an anthropogenous pacentage, it was already made even to the arable land area.
All over the world water is the most valuable natural resources. Economically the effective utilization of water is the main demands of modern agriculture.
In most part of the territory of Nahchyvan it is located deserted and semidesertic at a continental, natural climatic zone.

Materials and Methods

The irrigated soils in Nakhichvan lowland which is located in difficult environmental conditions with the limited water resources and small amount of precipitation within the range of (220-250 mm) with high evaporation level, between (1400-1600 mm a year). Therefore agriculture, without water irrigation is almost impossible. For todays irrigation water is used about 0.8 billion cubic meter of water a year. Appreciable requirements for water becomes very important, the expense of the rivers and its part are used substantially, chinks and Kyariz systems.

Problems of water deficiency have been forced to research for an exit, from the current situation. On one hand it was necessary to provide agriculture with water for an irrigation, without restraining thus household needs, of water requirement in the industry, and on the other hand - for maintenance of food and safety of the nation.

For maintenance with irrigating water and agricultural crops (during the period 1960-2005гг.) water basins was constructed in series on the river Araz (1.35 billion m^3) between Iran, and the river of Arpa river (Arpa chay 150 million m^3), the river of Nakhchivanchay (G.Aliev, 100 million m^3, Sirab (12 million m^3), Uzunoba (9 million m^3), the river of Alindjachay (Bananiyar 19 million m^3), and from above 20 reservoirs with small volumes was developed (Guliyev A. 2010).

The expense of water increases more than three times, and the agricultural production volume remained practically at the same level. Under the influences of anthropogenous factors, samples are taken from waters for an irrigations and, failure emanated as a result of deterioration fertility of the soils, and occurrence bogging the secondary salinization soils in Nahchyvane. Has shown that, the today's irrigation demands the systems of water which the systems united in a single whole and distribute the submitted water, the system of irrigation and, systems of automatic control and management, both the monitoring system of environment and its adjustment. The effective use of irrigating waters, and the prevention of secondary salinization soils.(Azizov 1999)

Results from research shows - that in the autonomous republic watering is carried out primitively. Here modern water sprinklers aren't used yet to the right degree, repairs and clearing of the open and closed drains system isn't resulted, the standard of farming is low, the lay-out of fields isn't made, therefore irrigational erosion is observed, and there is an intensive food of ground waters at the expense of irrigation (Mammadov, 2004).

In Nakchevan republic, the part of irrigation canals has no concrete facings, in which filtration of stocked ground water are lost in irrigating system, when the filtration fill up it stocks the ground waters and causes lifting of level of ground waters. If the ground waters rises to such a depth that capillary lifting reaches the surface, evaporation of ground waters will occur at secondary salinization soils. Rate of lifting of ground waters depends on efficiency of irrigating system. On the other hand it depends on discipline, a way of an irrigation and size of irrigating norm. Here initial depth залегания level of ground waters and conditions of a natural drainage also influences on the secondary salinization soils. Than conditions of a natural drainage or closed drainage, are worse than depression or lowland) and the more loss of irrigation waters on irrigating system, the more intensively lifting of level of ground waters at an irrigation (Guliyev, 2009).

The Principal causes of secondary salinization, soils are without a drainage irrigation, water losses at filtrating channels and on fields, application for an irrigation of the mineralized of water.

The soils development effusion of water regimen. The salted soils differ on degree and a chemically salinization of soils, and various plants unequally react to concentration of salts.

As a result of ours researches it shows that, only 40% of channels in autonomous republic have concrete facing, old channels are not meeting modern demands:

In the territory of water basins and its limits, there is a bogging and secondary salinization soils. Such situation occurs in different reservoirs in autonomous republic, for example to augumentation of distance from a water basin of Uzunoba on 50, 100, 150, 350, 800m the mineralization of soil waters increases simultaneously from 1.6 to 2.36; 2.68; 6.96; 18 g/l. In process of excision from a water basin saline process more intensively develops. Such phenomenon is a characteristic of water basins in Negram, and is frequent coast of a water basin of Araz, etc.

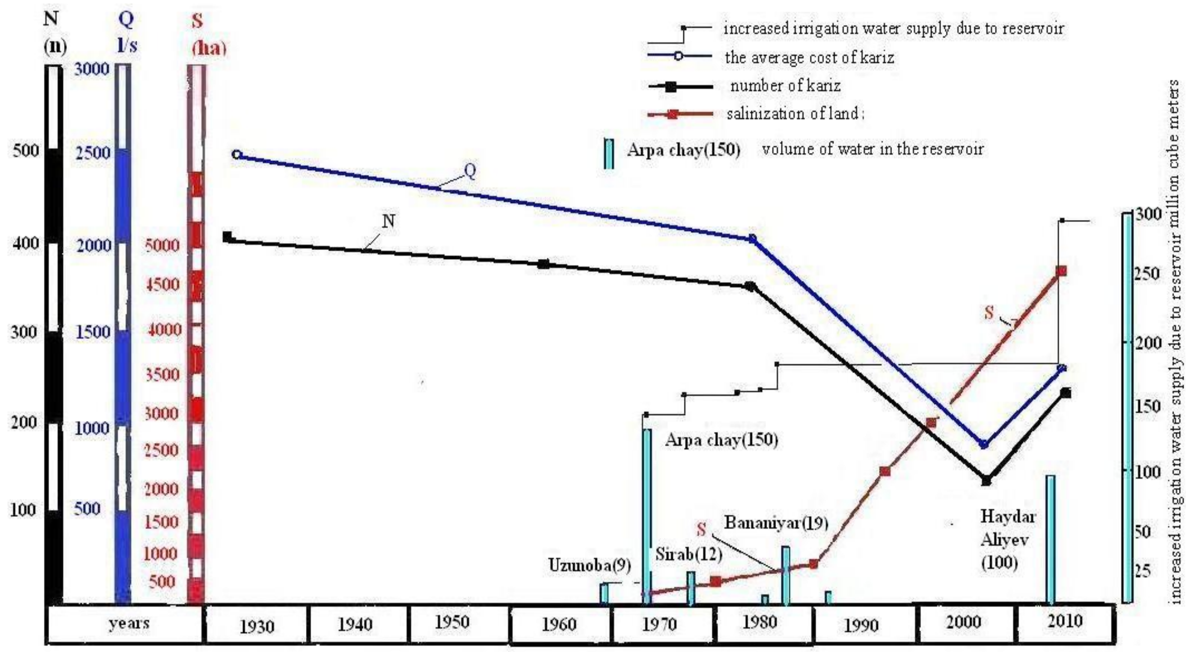

Figure 1.The graph small difference of irrigated land and water availability uhudschenie their states in the Nakhichevan Autonomous Republic

The System widely used, long since by the population кягризов original underground water pipes, served as a deep horizontal drainage. In 1961 in autonomous republic existed 407 kyariz, the general extent of their systems made 130 km, an output that is more than 2.0 m^3/width. In connection with building of water basins and irrigating networks Kyarizes have appeared.

The introduction of new operations on lands which is on the basis of canals irrigation and water basins bogging and processes secondary salinization soils has begun. Irrigation carrying out under which lie Sea-lagoons deposition adjournment with rich stocks of salts deteriorate the fertility of soils. Here infiltration which waters is leached saliferous breeds, influenced augmentation a mineralization of waters operations in kyariz and has reached 1.85 to 2.26 g/l. The irrigating waters leads repeated on salinization soils (Guliyev, 2011).

Result and Discussion

It is taped that under the influence of anthropogenous factors to occur processes on secondary salitiztion. It causes following factors:

Insufficient level of the standard of farming, disturbance of technics of watering, and irrigation, the big norms that involves an intensive food of ground waters:

The existing irrigating network is constructed for a long time and doesn't meet modern demands, filtrational losses make of it about 40 to 45 %.

-Some water basins (Uzunoba, Negram, Sirab, etc.) are constructed by Bananiyar on lagunno-sea adjournment, filtrational losses of them make a significant amount, these waters dissolve on the way in the process it form salts which call underlaying territories.

-Now level of ground waters of a low part rises, which result to salinitization of the soils.

-Infiltration losses from water basins and an irrigating network raise in mineralization kyarizs the waters used for watering and drinking, at a long irrigation secondary salinization soils is ocure.

The salted soil gained improvement with a long and average mechanical structure, with high filtrational ability, not necessarily carrying out capital washings of soils. But such soils can be used under winter grain at the speeded up waterings with the big norms.

For land reclamation in the conditions of Nakhichevan AR building of collector-drainage network is necessary. The drainage takes away the mineralized ground waters from territory, supports level of ground waters on necessary depth below critical, regulates a water-salt regimen soils, forming conditions for reception of high and stable crops.

At building of water basins on lagunno-sea adjournment actions for filtration prevention are obligatory.

The irrigation regimen should exclude damp land and a siccation of soils. An irrigation that are necessary agriculture plants, strict observance of technological norms. Necessary organization of constantly operating control service on irrigating systems with a view of monitoring water-salt regime, irrigated soils, their structural and conditions for prevention of degradation of irrigated soils and maintenance of their high fertility.

In order to avoid losses of water irrigation and secondary soil salinization is recommended.

Recommend

1) The closed network of channels excluding filtering waters;
2) The drainage constructions providing deduction of salty ground waters on depth aren't closer 1.5 to 3 m;
3) Capital washings of soils if they are salted, for excision of salts from root zone soil;
4) Regular vegetative watering with drainage systems.

Acknowledgments

I would like to acknowledge the Science Development Foundation under the president of the Republic of Azerbaijan.
This work was supported by the Science Development Foundation under the president of the Republic of Azerbaijan
Grant № EIF-2011-1(3)-82/43/2

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Fertility Restoration of Man-Caused Soils In Dry Steppe Zones

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Abstract
The results of studying fertility restoration methods of the man-caused destroyed soils are in the article. Progressive degradation of the soils at oil and gas production areas leads to a deterioration of the environment and whole ecosystem sustainability.
Analysis of current status of man-caused destroyed soils in the dry steppe zones and modern researches have shown the ability to solve environmental and remediation issues associated with the restoration of the soil fertility. Self-healing of damaged ecosystems in terms of aridity and low nutrients is very slow, which in turn requires a human intervention.
Application of farming and agricultural techniques, that are performed in a specific combination and sequence leads to the accumulation of organic substance, enhancement of water-air and nutrient regimes of the soil substrate. Salt-resistible crops with high phyto-meliorative effect were found. The cultivation of fito reclaiming culture with the complex of agrotechnical and biological methods revealed the possibility to restore these soils up to the ecologically safe level. The basis of the fertility restoration of man-caused destroyed soils should be systematic approach, as medium of balanced and stable function of newly forming ecosystems.
The gradual development of man-caused soil by sowing fito reclaiming cultures which adapted to local conditions and applying of reclamation agents demonstrate the perspective of given reclaiming technique. We can recommend subshrubs and trees landing in the sequel to organic substance growth of soil and to enrich overground and especially underground mass with decomposed deciduous.

Keywords: man-caused soils, dry steppe zones, soil fertility, biological reclamation, fito reclaiming culture.

Introduction
Conservation of prosperity of the environment provides economical development of countries. Soil fertility is one of the main economical resources. Progressive degradation of the soils at oil and gas production areas leads to a deterioration of the environment and whole ecosystem sustainability. It is noted a trend of desertification processes in the areas of more than 66% of the Republic of Kazakhstan territories in current time. Environment, especially soil mantle and its fertility are affected to degradation describing by their different characteristics. These trends appear in oil regions of the Western Kazakhstan and Torgay plains were created major sources of petrochemical pollution of soil, soil salinization with industry sewages and man-caused transformation of the soil layer (Eleshev, Saparov, 2008).
The basis of the fertility restoration of man-caused destroyed soils should be systematic approach, as medium of balanced and stable function of newly forming ecosystems. Successful remediation of destroyed ecosystems is developing only in the presence of beneficial combination of soil and environment factors. Despite of developing a complex of agricultural techniques towards fertility restoration of man-caused destroyed lands, we must follow general principle: do not impair ecosystem than that has already been done by pollution (Ismailov, Pikovskii, 1988).
Analysis of the current status of man-caused destroyed soils in the dry steppe zones have shown the ability to solve environmental and remediation issues associated with the restoration of the soil fertility. And it was revealed that in man-caused destroyed soils, sodium content is increasing, shifting pH toward alkalinity and content of top soil is decreasing.
The purpose of research is study soil-environmental properties of man-caused destroyed land, with a possibility of fertility restoration and involvement these lands to the economic and biogeocenotic turnover.

Materials and Methods
These studies were conducted in dry steppe zones on the man-caused destroyed lands with unfavorable edaphic conditions. The object of our study was a part of oil fields in Western

Kazakhstan, where land emitted with residual oil and hydrogen sulfide ingrained underground saline clay. Emergency emission has led to radical changes in ecosystems and their components. As a result of the powerful emission, initiated by accident at the well site, an area of 53 hectares was covered by a continuous layer of clay and turned into a man-caused desert. Dark brown soil was buried by contaminated saline and calcareous clay layer with 10-100 cm thicknesses. To segregate spread of contamination, the territory was baked alone perimeter of pollution (protective berm).

The thickness of sediment is mainly determined by micro-relief of the buried surface. In the centre of the site, it reaches 90-100 cm, on the outlying areas the sediment thickness reaches 70-80 cm and thickness at the perimeter of banked zone is 5-10 cm. Alluviums with heavy mechanical composition, high silt content (up to 30 and more %) and physical clay (up to 72%) is dominate pollution agent at this site.

In accordance with a staging of the research, experimental work was carried out in the follow step: route-field, fixed-field, micro-field, industrial and laboratory-analytical methods. The experimental plots laid by the following scheme:

I. Virgin soil: Ia - alluvium with thicknesses up to 30 cm, there observes a natural overgrowth, projective cover is 20-60%; Ib - alluvium with thicknesses more than 30 cm, the natural overgrowth is absent;

II. Reclaimed plot with application of mineral fertilizers, organic manure and phosphor-gypsum; IIa - without sowing crops; IIb - with sowing perennial plants (*Agropyron pectinatum, Elymus sibiricus, Bromopsis inermis, Onobrychis sativa*); IIc - sowing of perennial plants under the barley cover.

III. Dark brown soil on peripheral plots.

Climate of this territory is continental. It is characterized with high temperatures, air dryness and unstable rainfall, temperature difference at day and night-time, at winter and summer, fast transition from winter to summer with the short spring period.

The benchmarks to description and analysis were surface formations, which differs in alluvium thicknesses, vegetation degree and on-going remediation activities. For each soil profile we take a sample and made morphological description. Also we determined their physical and chemical properties according to conventional methods.

Land preparation for cultivation was carried out in the summer-autumn period. The main processes, application of compost, phosphate, potash fertilizers and phosphor-gypsum were conducted in august-october. Nitrogen fertilizers are applied in the spring time before crops planting due to their rapid dissolution and evaporation. For crushing lumps and cradles held milling at depth of 10-15 cm and blade cultivation at depth of 18-20 cm. Fito reclaiming culture, used in remediation, adapted to local condition. Culture sowing was performed with applying organic and mineral fertilizers ($N_{60}P_{45}K_{30}$).

Results and Discussion

Emitted clays have been affected by different natural and man-caused factors on the surface and eventually they turns into the parent material of new forming soil.

In justification the means of fertility restoration on a given object, the relative youth of soil substrate was considered. Since youth soils are more dynamic and susceptible to changes in their properties, the main propose of reclaiming activities is directed to creating favorable edaphic properties for plant growth and development in forming ecosystems.

The state of biocenoses of man-caused destroyed land provides valuable information about environmental conditions. It may contribute to choose directions, means and methods of reclamation and estimation of biocenoses and soil recovery rate. The response of vegetation to environmental changes is initially serial and then sustainable communities of vegetable canopy adapted to new conditions of soil-forming processes.

Adverse conditions for growing (mechanical factor, lack of nutrients, pollution, salinity, etc.) and arid climate makes difficult to self-healing of plant cover and occupation ecotope by organisms.

Natural vegetation growth appeared on the peripheral territory, where alluvium thickness does not exceed 25-30 cm. It is obvious that soil-forming processes, as a result of complex of natural biotic and abiotic factors, provide necessary conditions for natural vegetation growth and development.

Herbage is represented mainly with weed sorts, which have good vital capacity, hardiness and adapting to negative condition of environment. Firstly they fix in lower side of rig and after they occupy all territory. The basis of the vegetation comprises a one-year anemochore which breeds seeds by wind, growing in dark brown soils of the peripheral areas. Gradually they establish a niche to perennial herdbs: *Calamagrostis arundinacea*, *Sonchus arvensis*, *Cirsium arvense*, *Lactuca tatarica*, *Tripleurospermum perforatum* and others. These herbs form a sod layer and achieve buried dark brown soils by their roots and create the stable vegetable canopy.

Despite the ongoing process of partial restoration by natural vegetation and overgrowth of the peripheral part of site, the main area remains lifeless and required implementing remediation activities.

To natural healing of anthropogenic affected soil cover takes dozens or even hundreds of years. It requires a long-term impact of combination biotic and abiotic factors, which transforming and reorganizing minerals and organic substances in the surface of paternal layer. According time limitation reclaiming techniques, transformation underground saline clay to zonal soil mantle is a big challenge.

That's why; the aim of reclaiming technique is remediation of the main ecological function of soil mantle by means of creating a closed canopy. At the same time creation of vegetable canopy conducts logical activation of soil forming processes and leading to accelerated generation of the soil horizons. To speed up this process, it is necessary to develop special bioremediation methods taking into account specific peculiarities to the given object.

During the 10-year period, a new 10-12 cm horizon formed on alluviums surface, which is constantly under influence of temperature, sunlight and water-air factor. The presence of elemental soil structure, low pollutants concentrations, low salinity of this horizon was prerequisites for possibility to plant crops on them, of course, on condition of applying meliorants improving water and air, nutrition and salt regimes of the root zone.

Middle layer 10-100 cm thick located beneath surface layer, is characterized by very low gas and water permeability, cloddy structure and high density. Whiting salt crust is occurred on the alluviums surface while drying. There have been areas of stagnant water in the upper and middle part, which is not dry out even in the summer.

The lower layer 3-5 cm thick is in direct contact with the buried dark brown soils. It is observed the processes of penetration humus particles up and wash alluvial elements down. Thus, layer is forming a transitional horizon.

Buried deep dark brown soil is not changed apparently in past times after emission. They have a typical zonal structure and consist of three main horizons: the humus-accumulative (A+B1), transitional (BC) and the parent material (C). Appreciable transformation observed only in the buried humus horizon: a dark color, compactness, vane-nutty structure and glossiness. Water stagnation and the prevalence of anaerobic condition have led to transforming the top of layer into clay horizon. Below the buried brown soils, morphological properties of layer do not differ much from the zonal dark brown soils (Fig. 1).

Fig. 1 - Cross-section of man-caused destroyed land

The results of these studies show the differentiation of alluviums to 3 layers by mechanical composition which is consistent with the morphological description. The top layer of alluvium is characterized by a slight depletion of clay particles (<0,001 mm) compared to the middle layer. Low horizons of alluviums, which are close to buried dark brown soils, are characterized with lightweight mechanical composition. It is a result of the initial differentiation of the mud-water flow.

Application of the complex of agro-technical and agrochemical techniques leads to the accumulation of organic substance, enhancement of water-air and nutrient regimes of the soil substrate. The first results of the optimization of physical properties of soil substrate were obtained after two years of cultivation, applying minerals, organic manures and phosphor-gypsum. Under the influence of the recultivation the following optimization of the soil physical properties has occurred: density decrease from 1,45 to 1,28 g/cm^3, the increase in total porosity up to 50-53%, improving the structural composition of the alluviums (Table 1).

Table 1 – Physical characteristics of the upper 0-20 cm layer of clay alluviums

№№	Indicators	Ia	Ib	IIa	IIb	IIc	IIIa
1	Layer density, gr/cm^3	1,45	1,34	1,39	1,34	1,27	1,23
2	Total porosity, %	45,9	41,6	47,7	47,6	50,8	51,2
3	Macro-aggregate content (>10 мм), %	53,2	37,1	50,6	45,2	40,2	22,1
4	Meso-aggregate content (10,0-0,25 мм), %	29,9	47,9	34,6	43,7	47,8	67,8
5	Structural coefficient	0,43	0,92	0,53	0,78	0,92	2,11

Among the physical properties, particular importance is the structure of the soil, i.e. capacity of the soil to aggregate and decompose at a relatively stable separates. Non-recultivated areas are distinguished by notable cloddiness that consists of 42-54% with particle size more than 10 mm. The effect of the ongoing recultivation activities can be seen in reduced cloddy plowed horizons and an increase of agronomical valuable aggregates (1,5 times). Improvement of the structural condition of destroyed soils was provided mainly by reducing of particles more than 10,0 mm. But full recovery of the physical properties of man-caused disturbed soils as a result of various activities will not occur within 2-3 years.

The chemical properties of soils are largely determined by lithological features of alluviums in which they are formed. The carbon content of organic matter in alluviums ranged from 0,69 to 3,2%, whereas absorption capacity from 7,0-15,0 mg to 100 gr of the soil. Analyses have shown no alkalinity and salinity in the upper 10 cm alluvium layers. In the lower alluvium layers (30-100 cm) the amount of salt is increased from 0,75% to 1,054%. The reaction of soil solution is 7,2-9,2. In the alluviums, it is indicated a very low supply of nutrients. Nitrate content in the range of 0,97-37,7 mg/kg of the soil, the mobile forms of phosphorus is 3-15 mg/kg and potassium is 100-320 mg/kg. The level of man-caused residual substances is largely determined by the nature of the distribution of alluvium. There are significant differences in the distribution of residual oil in the profile of the soil substrate. The maximum concentration is observed in the middle of the alluviums and in the buried top soil horizons of dark brown soils. Pollution with residual oil products is reduced in low horizons, and its value reduces up to 18 mg/kg of the soil. The content of residual oil in the surface soil alluvium layers ranged from 8,6 to 403,2 mg/kg. In some cases, in the upper alluviums horizons (0-5 cm), it was observed an excess of maximum permitted concentration (1,2-3,0 times) of the mobile forms of heavy metals such as nickel, copper and lead.

Better physical-chemical properties of the soil substrate are formed in perennial plant's crops seeded under a barley cover. The positive effect of perennial plants is a result of its extensive root system. They contribute to the improvement of gas-air regime and enrichment of soil organic materials that formed from the roots and stubble of plants. Perennial plants by mobilizing calcium contribute to the exchanging displacement of sodium resulting in slowing the development of processes of salinity and alkalinity. Well-developed root systems of perennial plants strengthens the surface soil layer, gradually penetrating and thus improving the aeration, which speeds up the

weathering and decomposition of pollutants in the deeper layers. Phyto-meliorative crops gradually reduce polluting elements in soil and improve soil properties due to natural processes of self-purification. Part of pollution elements from the soil plants bring out plants themselves, the other part washed out outside of root inhabited horizons.
Nutritious value of harvest, obtained on the recultivated areas is determined by the content of fat, cellulose, nitrogen free extract substances, protein and forage units which corresponds to the zonal indexes.
The results of chemical analyzes show that the concentration of heavy metals in barley grains and vegetative parts of perennial plants do not exceed the level and are not dangerous for feeding purposes.
A comparative study of fito reclaiming cultures has shown the possibility of restoring the fertility in sequence cultivation with applying organic and mineral fertilizers and phosphor-gypsum.
In the first year of development barley should be sown as unpretentious and drought-resistant crops. Barley, with fibrous root system that penetrates to a sufficient depth of soil horizon, loosening the soil, improves the structural-aggregate composition (Fig. 2).

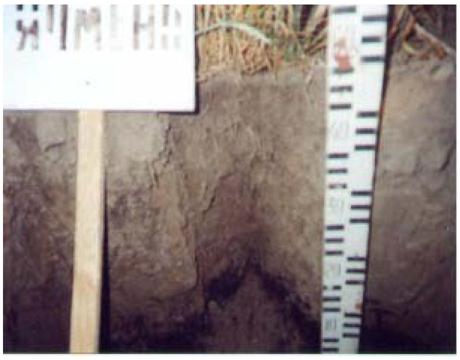

Fig. 2 - Cross-section of man-caused destroyed soil after reclaiming technique

After the barley, in the following years, perennial plants can be cultivated, enriching the soil with root residues improving soil properties. Selection of crops should be carried out in accordance with their phyto-meliorative effect and resistance to adverse climatic conditions.
Under the influence of recultivation, it is observed increased level of elements that make up soil fertility. Organic fertilizers not only improve properties of ploughing horizon, but also create a screen with sufficient moisture and biological activity of bacterium as rich complex minerals and organic substances applied along with organic fertilizers. Application of mineral fertilizers promotes circulation of macro- and micro-elements that is required for plants.
Meliorants, their residues, as well as root and crop residues of previous crops influence the formation and development of soil fertility, which eventually leads to increase the yield of grain crops.
Restoration of vegetation layers on man caused disturbed soils is not practical due to economic inefficiency and huge expenditures. Therefore, it is important to consider environmental issue beforehand.
One of the key indicators of the recultivation efficiency is the creation of root horizons of at least 20-30 cm - the first of the genetic horizons of young soils. It determines the level of resistance of vegetative cover and enhances soil-forming processes in the newly emerging ecosystems. Over time, we should expect the formation of soils as genetic entities that can take the appropriate ecological niche. The process of decomposition of vegetable substances and top soil accumulation causes a considerable degree of development and transforms into a maturity soil.
The gradual development of man-caused soil by sowing fito reclaiming cultures which adapted to local conditions and applying of reclamation agents demonstrate the perspective of given reclaiming technique. We can recommend subshrubs and trees landing in the sequel to organic substance growth of soil and to enrich overground and especially underground mass with decomposed deciduous.

Acknowledgements

According to results of conducted researches, the following findings were made:

1. It is noted signs of physical degradation and chemical pollution on the man-caused destroyed soils.
2. Self-healing of damaged ecosystems in terms of aridity and low nutrients is very slow, which in turn requires a human intervention;
3. As a result of reclaiming techniques, there observes accumulation organic components and optimization physical and chemical properties of top layer of the man-caused destroyed substrate.
4. The gradual development of man-caused soil by sowing fito reclaiming cultures which adapted to local conditions and applying of reclamation agents demonstrate the perspective of given reclaiming technique.

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Effect of Biochars on Salinity Stress on Germination and Seedling Properties of Drum Wheat (T. *Drum* Desf.)

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Abstract

Impacts of four different Biochars were evaluated on seed germination and seedling growth of drum wheat under six levels of electrical conductivity (EC) (0, 2.5, 5, 7.5, 10 and 12.5 dS/m). An experiment was conducted using 9 cm-diam petri dishes in incubator condition. The results indicated that by increasing salt (NaCl) concentration, seed germination decreased in all 5 treatments (without biochar (WB) and 4 different biochars, cotton stalks (BCS), corn cobs (BCC), olive pulps (BOP) and tobacco stalks (BTS)). The lowest germination percentage was obtained in WB with the highest EC level. The highest germination was observed in BCC and BCS with 0 and 7.5 EC levels, respectively. The highest value in shoot length was observed in BTS with 0 EC level. The highest root length was obtained in BTS with 5 EC level and the lowest was in WB with 12.5 EC level. Increasing salt concentrations adversely affected shoot and root fresh weights in each treatments. The lowest values were observed in BOP with 12.5 EC level. Differences in shoot and root dry weights were significant in treatments; the highest root fresh weight was found in BTS with 5 EC level and the highest value was in BCC at 0 level for soot fresh weight. Comparing of seed germination and growth between with and without biochar treatments indicated that using biochars can significantly increase germination success in saline conditions. The BTS under 12.5 EC level gave the best result. However, the worst result was obtained from WB with same salt level. This result might be a sign for using the biochars as amendatory materials in salt-affected soils.

Keywords: Biochar, Germination percentage, Seedling growth, Salinity, Drum wheat

A Decade of Change in Land Use and Development of Sinkholes in Karapınar, C. Anatolia

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Abstract
The land use changes 21st century is more devastating than the ones throughout the history due to technological developments particularly in agricultural managements since high yielding cash crops require high amounts of water and heavy machinery. As for today human shaped land area is roughly 50% of the global terrestrial areas. Degrading land use changes are more evident in arid and semi-arid zones as in the Karapınar of Central Anatolia. Following the introduction of deep ground water pumps and cash crops in late 80s in Karapınar, the land use shifted from rainfed to intensively irrigated. The local income significantly increased with irrigation which was 4 to 5-folds at some cases. But, following the start of intensive irrigation the depth of groundwater in Karapınar region decreased approximately 20 meters since 1980s. Moreover, another environmental issue is the increase of formation of sinkholes within Karapınar region which was also accelerated since 1980s. The 10 years of land use change effect on water depth and formation of sinkholes are evaluated for manifesting effect of excess natural resource consumption and a physical land use model based mainly on traditional managements is suggested.
Keywords: Land use, groundwater, sink hole, Karapınar, anthroscape

Introduction
Humans are modifying/shaping lands according to their needs (Eswaran et al. 2011). Land use changes dramatically accelerated with the intensification of agriculture (DeFries et al. 2004) and reached its maximum in 20th century (Bondeau et al. 2007). Majority of the land use changes especially in Mesopotamia, Central America and Indus valley resulted severe environmental problems (Kapur and Akça, 2005a). But, all land use changes did not degrade environment. The olive and terraces of Mediterranean and paddy fields of Asia proved to be sustainable land management systems since millennia (Kapur and Akça, 2005b). Anatolian anthroscapes are also sustainable land management systems since they are adapted to the availability of natural resources alike rainfed cereal production and small ruminant grazing of Central Anatolia, olive terraces of Aegean region and pistachio orchards of Southeastern Anatolia (Kapur and Akça, 2005b). Unfortunately excess population pressure on natural resources particularly for cash crop production since mid 1960s caused severe land degradation processes in Anatolia (Cangir et al. 2000). Karapınar set a unique example in Turkey not only for land degradation but also for its desertified lands in 1960s (Çevik, 1972). Overgrazing, excess machinery use and removal of vegetation cover for fuel caused desertification processes in Karapınar in 1960s. And with efficient conservation and mitigation project the lands as well as vegetation cover of Karapınar recovered within 20 years (Büyük et al. 2010). However, since 1980s with the sharp land use change groundwater abstraction is increased via more than 90.000 wells in Konya Great Basin out of which 50.000 is illegally operated (Yılmaz, 2010). Geologically, sinkhole formation in Karapınar region is a common hypogenic karstification process (Bayarı et al. 2008). Yılmaz (2010) reported formation of 33 sinkholes between 1979 and 2009, the last 13 formed in three years from 2006 to 2009. Thus, when the excess water

abstraction due to agriculture coupled with geological processes the formation of sinkholes in Konya Great Basin has accelerated (Yılmaz, 2010). The study evaluates the land use change in 10 years in Karapınar and suggests a physical model, anthroscape, for sustainable land management in Karapınar region.

Materials

Karapınar is located in Central Anatolia of Turkey at an elevation of roughly 1000m from seal level with a semi-arid continental climate (Fig. 1). The annual precipitation is 285mm with a potential evaporation of 1300mm (DMİ, 2012). The area simply classified into 3 major geological units namely lacustrine plain, limestone terraces and volcanic outcrops. Soils vary from Entisols to Inceptisols (Soil Survey Staff, 2010) with sandy, gypsic and vertic types. Karapınar also is gene center for than 120 steppe plants most of them are fodders (Okur, 2010).

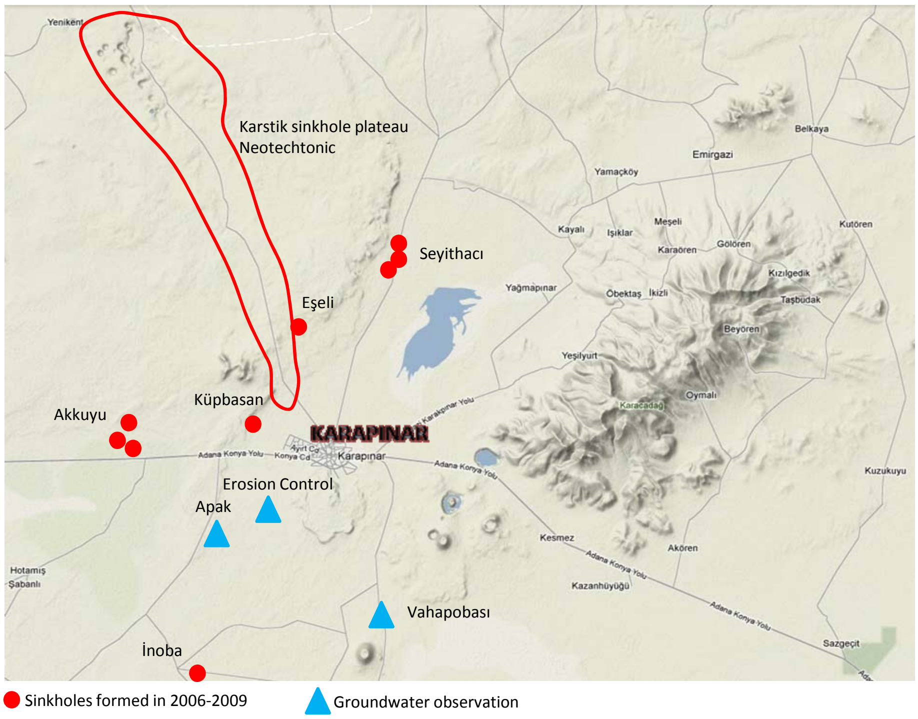

Figure 1. The study site and location of sinkholes (modified from Yılmaz, 2010)

Methods

Landuse Landuse data was acquired from https://lpdaac.usgs.gov/products/modis_products_table/land_cover/yearly_l3_global_1km2/mod12q1 which uses Terra Satellite images obtained via Modis instrument. Images from 2001 to 2009 were used. Modis bands of 1 to 7 (620 to 2155nm) with resolution of 250m for bands 1 and 2, and 500m for bands 3 to 7 were employed for determination of land use changes. Ground truthing were undertaken for the years 2006 to 2009. Groundwater data were obtained from DSİ (DSİ, 2010) along with three groundwater locations with water depth probes at Apak, Erosion Control Station and Vahapobası (Fig. 1) which measures water depth at two minute cycles.

Results

The groundwater depth at Apak (agricultural zone), Erosion Control Station (natural vegetation) and Vahapobası (grazing zone) (Fig. 1) measurements showed a gradual decrease at Apak however at Erosion Control and Vahapobası the water depth were relatively stable (Table 1). Groundwater in Karapınar region is continuously decreasing since 1980s with an average of 0.7m/year (Doğdu et al. 2007). In Apak, farmers notice acute decline of groundwater since 2005 which is in accordance with the booming of sugar beet, corn, alfalfa and potato cultivation in the region. According to local people, groundwater level at Apak was 18m 40 years ago. It declined to 45-50m 20 years ago. They said that decline of groundwater level started from 35 years ago (since 1975).

Table 1. The depth of groundwater fluctuation at selected zones from 2006 to 2009

Location	Altitude	Well depth	Water Level (annual average)			
			2006	2007	2008	2009
Apak	1012m	140 m	58 m	63m	66m	68
Erosion Control Station	995 m	40 m	22 m	21m	22m	23
Vahapobası	1007 m	30 m	16 m	14m	17m	15

The irrigated land calculated from satellite image in 2001 was 1.20% of the district area and increased to 10.13% in 2009 which is 748.4% (Table 1) (Fig. 2). The increase in Ereğli within the same period, neighboring to Karapınar on East was 2.4% ie irrigated land increased from 9.74% to 9.97% in the district area of Ereğli. The major crop pattern was rainfed cereals in 1990s with 80-85% however the increase of area for sugar beet, alfalfa, corn and sunflower from 2006 to 2009 is 109% ie from 10158ha to 19.405ha.

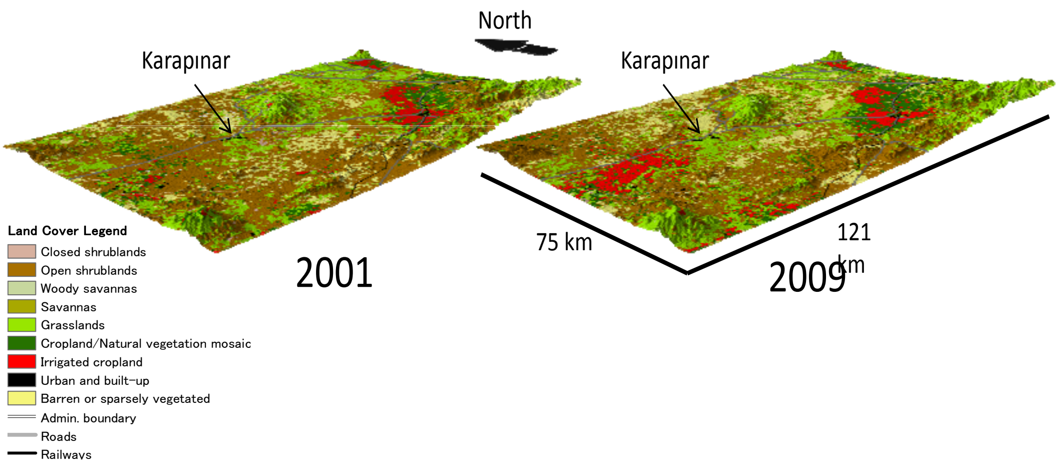

Figure 2. The change of irrigated lands from 2001 to 2009

The formation of sinkholes is also increased/accelerated from 2006 to 2009 with 13 events (Yılmaz, 2010) particularly on the Southeast part of Karapınar town center (Fig. 1). The sinkholes location overlaps to irrigated lands (Fig. 1, 2). Since 2010, sinkhole formation is not observed which may be attributed to high precipitation in 2010-2011 which was 232.1mm in 2008 and 394,9mm in 2011 (DMİ, 2012) as demand of irrigation in Karapınar region decreased following relatively high rainfall. However, this assumption needs detailed survey with employing state-of-the-art analyses such as isotope measurement (Kume et al. 2010).

Table 2. Changes in land use from 2001 to 2009 in Karapınar (%)

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Closed shrublands	0,31	0,34	0,49	0,42	0,66	0,44	0,38	0,46	1,03
Open shrublands	38	39,03	43,62	50,73	48,28	53,45	48,81	53,42	50,76
Woody savannas	0,03	0,02	0,03	0,01	0	0,3	0,27	0,66	0,18
Savannas	0,01	0	0	0	0	0,01	0,01	0,01	0
Grasslands	23,51	20,42	13,54	13,06	16,03	16,18	18,48	17,94	16,71
Urban and built-up	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Cropland/Natural vegetation including Irrigated field	10,62	8,65	8,78	7,39	9,57	8,71	8,17	3,48	5,09
Barren or sparsely vegetated	12,52	16,52	18,53	13,38	10,45	5,89	8,87	9,01	11,21
Irrigated field	1,1967								10,1322

Discussions

Anatolian traditional land use, in common, is sustainable with rainfed cereals in semi-arid Central Anatolia, terraced olive and vineyard orchards which are harvesting water and controlling erosion in Mediterranean. However, with the introduction of high input demanding agricultural practices since 1960s without proper land use plans, human shaped traditional lands ie anthroscapes started to degrade and severe environmental impacts have arisen alike desertification in Karapınar. The remarkable land use change in last decade caused unique environmental problem in the region which was spotted with formation of sinkholes.

The contemporary agricultural management plans focuses on economical benefits rather than balancing environmental/economical gains. Unfortunately, those plans failed to sustain not only in Turkey but many parts of the world. We suggest a physical model to overcome degradation/desertification of natural resources in Karapınar which is mainly based on traditional land use with adapting modern agricultural practices (Fig. 3).

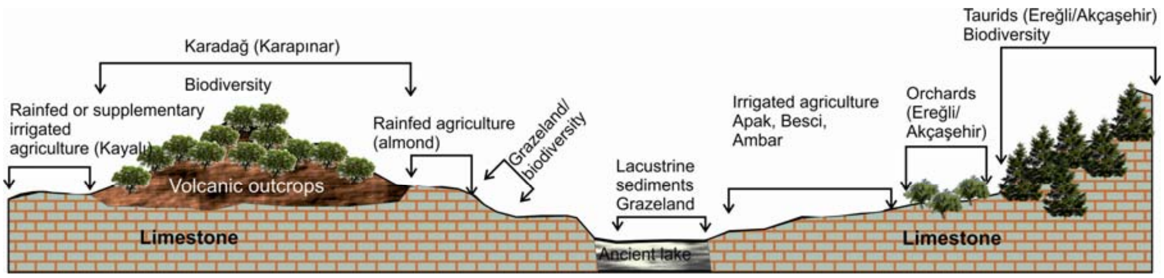

Figure 3. The Karapınar anthroscape model

The model employs physical properties of environment such as elevation, geology, soil, climate, local plant species, and aspect along with balancing requirements of locals on natural resources. Local's demands are of utmostly important because environmental programs will be inefficient without participatory actions. The figure below is a suggestion for Karapınar region which incorporates human's demands on natural resources with sustainable land management approach based on Anatolian traditional land use. The model aims to consolidate fragmented practices into one integrated management scheme for efficient use of funds for region's major environmental priorities alike CROP-MAL Project of TEMA Foundation.

Acknowledgement

This work was supported as part of the CROP-MAL Project (Creation of Rational Opportunities for Conservation of Marginal Arid Lands) under MITSUI & CO Ltd. Environmental Fund.

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Betterment of Soil Database, Integration with Natural and Artifical Environment and Agricultural Land Use Planning

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Abstract

The Environs Plans prepared in Turkey at 1/100,000 scale are essentially for protection of the natural and ecological assets in national development process, whilst those prepared at 1/25,000 scale are for regulating the functional and spatial relations between the settlements centers and their peripheries with close surroundings. Other lower scale plans prepared at 1/10,000 or 1/5,000 stand as Master Plans for urban development whilst 1/1,000 scale plans stand as Implementation Plans with detailed indications. These plans are produced for every settlement center, which possess the characteristic of physical development and spatial plans. Although, some studies have been carried out up-to-date at upper scales, neither national nor regional development plans have been prepared at 1/1,000.000; 1/500,000; 1/250.000 scales, yet. Beside those missing upper scale macro-plans, lower scale micro-plans are also missing, which are to be produced for rural areas pursuant to the Act Nr. 5403 on Soil Protection and Land Use Planning. It is apparent that, our planning system is lack of macro-scale spatial plans at national and regional levels as well as micro-scale land use plans at local levels.

In this context; priorities in following a "planning from below" approach towards upper scale macro plans are:

- re-organizing the spatial distribution system for enhancement of efficiency and effectivity of functions allocated to rural and agricultural settlements and centers,
- incorporation of agricultural aspects into physical and urban development plans widely and necessarily,
- spatial distribution of urban centers at national, regional, sub-regional, provincial and local levels to serve for agricultural and rural development,
- incorporation of spatial / physical dimensions in agricultural and rural development plans and policies.

Betterment of Soil Database

Betterment of the soil database is indispensable for sensitive analyses which are required for making planning decisions pertaining to protection of the natural environment and strengthening of agricultural production activities. It is the sustainability principle which has to be obeyed for using the natural resources composed primarily of soil, water and air in a rational matter without destructing these assets in meeting current and future human needs. For establishing the balance in use and protection of ecological values, natural assets, biological structures and organic resources, it is of utmost importance to undertake soil capability analyses. In this connection, soil data base which is in need of up-dating is necessary and relevant for making detailed analyses, factual identifications related to agricultural production activities and producing factual proposals and rational decisions within the preparation process of land use plans.

In harmonization of and ensuring the balance between the natural environment and the man-made environment, spatial plans and land use projects are the only instruments which can be effectively used. Those plans and projects comprise social and economic activities and reveal their spatial distributions by means of land use projects. Effective integration of the natural environment including soil, water and air components with the man-made environment including socio-economic and built components on basis of sustainability principle is a prerequisite for making successful plans. Within this framework, it is essential to analyze and match:

- soil, forest, water and underground resources in the natural environment,
- industry, trade, service and tourism activities in the economy based man-made environment,
- education, health, culture and housing activities in the social based man-made environment,

- technical infrastructure, transportation and logistics activities in the linkage based man-made environment with each other.
- The utmost relevant issue is attaching due regard to functionality, rationality, sustainability and integrity principles throughout location decisions and implementation actions. Effectiveness in implementation actions relies on strong justifications in decisions whereas for strong justifications up-dated and disaggregated data bases are required.

It is the prime goal of harmonization and integration of natural and man-made environment to minimize economy and ecology conflict to the possible lowest level and to ensure a balance between them. For this purpose, it is unavoidable to amply investigate the interrelations between the (man-made) settlement centers and the (natural) life support systems in their surroundings. Identification of the optimal demographic size of settlements for meeting the requirements of human activities and community needs from life support systems adequately is necessary for sake of sustainability. Over-population tendencies and congestions in numerous settlements have to be avoided for protection and rational use of natural resources. In this respect, the indicative characteristics of plans associated with imperative provisions and enforcement instruments are of utmost importance.

Preparation and Production of Land Use Plans

The prime provisions of the Act Nr. 5403 on Soil Protection and Land Use Plans envisage:

- development of prototype projects for agricultural enterprises and micro-level settlements as well as promotion of their extensive use with appropriate applications and adjustments to local conditions,
- integration of land consolidation, irrigation and crop pattern projects with agricultural and rural development and land use planning initiatives,
- focusing on agro-based industrial sites and zones in ensuring economy/ecology balance and fulfilling the requirements of sustainability principle in development planning,
- referring to functionality principle and relying on SWOT (strengths, weaknesses, opportunities, threats) analyses in spatial re-organization and land use planning tasks.

In the production of Land use plans, high priority is to be devoted to

- inputs for agricultural production and husbandry (labor force, pesticides, insecticides, fodder, mechanization, seeds, fertilizers, etc.),
- agricultural production activities and enterprises,
- gathering of agricultural products, storage, processing, packaging, warehousing, dispatching, distribution, etc.,
- consumption,
- waste disposal, sanitary landfill, treatment, recycling, composting, and renewable energy generation, etc.

Creation of hierarchical production, processing and service centers in compliance with the rationality principle in spatial re-organization and land use planning tasks is a basic requirement. Followings are the functions and roles which the small-sized urban centers in rural areas have to play as well as the services they have to provide:

- mechanization, maintenance and repair, input supply, etc. in context of agricultural production services:
- administration, education, health, cultural and social facilities, etc. in context of social infrastructure services:
- roads; water, electricity, and gas supply, treatment plants, waste disposal sites and sanitary landfills, etc. in context of technical infrastructure services.

Decisions and implementations in land use planning rely heavily on identification of local resources for mobilization and threshold analyses for location. Land use decisions can mainly be distinguished as between

- build up areas and
- absolute protection areas,

whereby those lying between these two can be identified as

- areas to be both built up and protected.

In build up areas; settlements urban expansions will take place along with industrial production as well as social and technical infrastructure services. Absolute protection areas; on the other hand, will comprise ecological production areas, particular vegetation areas, absolute agricultural production areas, irrigated agricultural production areas, natural conservation areas, etc. which have to be registered and legally restricted areas.
Preparation of criteria lıst for protection based build up land use types, evaluation of the criteria list, identification of specifications for land use, identification of protection conditions, build up land use with due regard to protection conditions, identification of mechanisms for control and enforcement (plan provisions) are the necessary studies which have to be under taken in order to be respectively applied for (i)pre-dominantly build up and subsidiary protected areas (ii) equivalently protected and build up areas as well as (iii) pre-dominantly protected and subsidiary build up areas .

Soil Resources of the Mediterranean and Their Impact on Food Security and Sustainable Development

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Introduction

The Mediterranean region covers about 854 million ha, but only 118 million of them (or 14 per cent) are suitable for agricultural production. In North Africa and the Middle East (MENA) agricultural land covers about 5 per cent; in Egypt and Algeria it occupies less than 4 per cent and in Libya less than 2 per cent of the total national land area respectively. Region wide land use/land cover divides between natural pastures/rangelands (15 per cent), forests and woodlands (8 per cent), with the remaining 63 per cent comprising desert sands, shallow, rocky, saline, sodic soils and areas sealed by urbanisation. Soil degradation is a severe problem in most countries. Estimates for the period 1961 to 2020 show for a rapid increase of population and extensive losses of agricultural land due to continued urbanisation and land degradation. If these estimates are correct, agricultural land per capita would more than halve from 0,48 ha (1961) to 0,21 ha in 2020 (Fig. 1). Food security is likely to become increasingly severe, especially in the MENA countries, which would require a major reassessment of the agricultural development policy for the whole region.

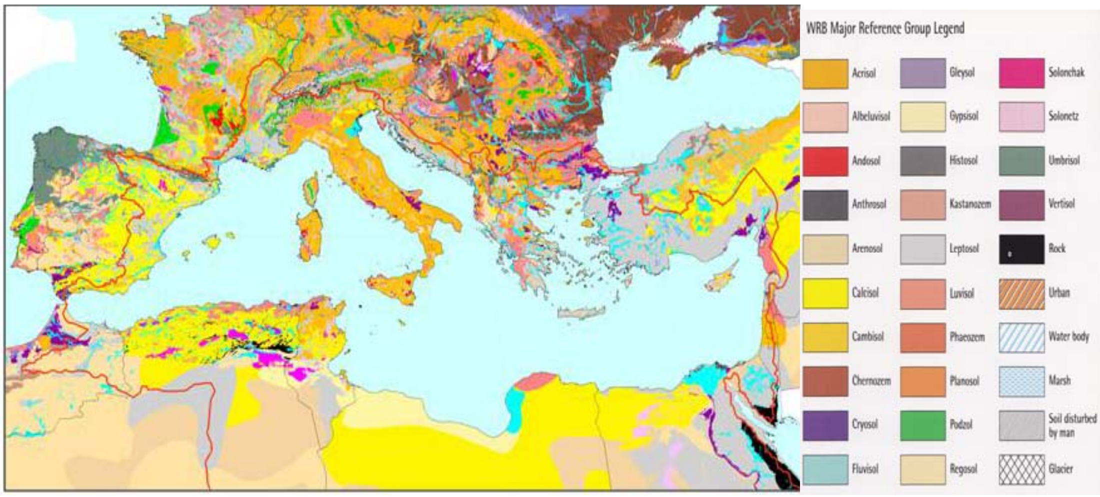
Keywords: soil degradation, sustainable soil management, population pressure, food security

Mediterranean Soil Resources

The World Reference Base for Soil Resources (FAO/ISRIC/ISSS, 2006) describes the soil as: "…any material within 2 m from the Earth's surface that is in contact with the atmosphere, with the exclusion of living organisms, areas with continuous ice not covered by other material, and water bodies deeper than 2 m". Soil is the interface between earth, air and water and hosts most of the biosphere. It is essentially a non-renewable resource in that the degradation rates can be rapid whereas the formation and regeneration processes are extremely slow. Mediterranean soils show great diversity that reflects the impact of climate, landscape, vegetation, time and especially, the long-term influence of the human activities. Erosion has been a dominant factor in carving landscapes and influencing soil distribution in a region that is also tectonically active. Some of the best-known examples of Mediterranean soils are the famous "terra rossa", defined as Rhodic and Chromic Luvisols (FAO/ISRIC/ISSS, 2006) or Rhodoxeralfs by the USDA Soil Taxonomy (Soil Survey Staff, 2010).

The following Reference Soil Groups of WRB (Map 1) are recognised in the Mediterranean region (Zdruli *et al.,* 2010):
Histosols (organic soils including peat);
Anthrosols and Technosols (soils strongly modified by human activities);
Leptosols (shallow soils reaching the lithic contact with the bedrock in less than 25 cm);
Vertisols (soils rich in swelling clays);
Fluvisols (formed on alluvium deposits, floodplains and tidal marshes);
Gleysols (characterised by poor drainage);
Solonchaks (high salinity);
Solonetz (alkaline soils due to high sodium content);
Andosols (formed on volcanic ashes characterised by allophanes or Al-humus complexes);
Kastanozems, Phaeozems and Umbrisols (fertile soils rich in organic matter content);
Gypsisols, Durisols and Calcisols (soils of dry climate characterised by the presence of indurated subsurface horizons);
Luvisols (clay enrichment by illuviation in subsurface horizons),
Arenosols (sandy soils including coastal sand dunes);
Cambisols (moderately developed soils);

Regosols (soils with no significant evidence of pedogenesis).



Map 1. WRB Soil Map of the Mediterranean 1:1000,000

Cambisols cover the largest area in the region, followed by Leptosols and Regosols. The most fertile soils are Kastanozems, Phaeozems, and Umbrisols that are rich in nutrients and posses good physical properties; however their extension is limited. Saline soils (natural and human-induced) cover about 10 million hectares throughout the region. Spain has 3.4 million ha, followed by Turkey (2 million), Libya (1.5 million), Egypt (1 million), Italy (1 million), Greece (600,000), Morocco (350,000), Tunisia (150,000), Syria (125,000) and Albania with 15,000 hectares. Soil salinisation and alkalisation (Solonetz soils) are regarded as major causes of desertification and are serious forms of soil degradation in the Mediterranean. Human-induced salinisation has expanded because of poor quality irrigation water, especially along the coasts by sea water intrusion into the fresh water aquifers.

Productive soils such as Cambisols, Luvisols, Vertisols, Fluvisols and Gleysols are extensive in the Northern Mediterranean (i.e. Po river valley and Tavogliere delle Puglie in Italy) as well as in the South, especially in the Nile Delta in Egypt. They are crucially important for crop production and should be protected by all kinds of soil sealing, including solar pannel establishments, as found in many parts of Mediterranean Europe. Histosols are very limited in extent and their impact on crop production is minimal, they should be protected however for the large amount of organic carbon they are able to sequester. Anthrosols are most widely spread in Sicily and in Apulia in southern Italy and used mostly for growing grapes, olives and orchards. Instead Technosols cover large areas, especially along the coast and are a direct indicator of urbanisation that often has expanded onto some of the most fertile soils of the region. Urbanisation is a big problem throughout the Mediterranean with hundreds of ha agricultural land lost also due high tourism pressure. The situation is very critical in Malta, followed by Slovenia, Portugal, Spain, Cyprus, Italy, and Greece and in the coast of Morocco, Tunisia, Egypt and Lebanon. In fact, 40 per cent of all the Mediterranean coast is already urbanised. Gypsisols and Durisols are widespread in the MENA region and Calcisols occupy large areas in Spain. In Turkey and Cyprus, Calcisols are the second most extensive soil type after Leptosols. Arenosols are typically found in the MENA countries, and along the coast associated with sand dunes in Italy, Spain and throughout North Africa.

Soil Resources And Population Pressure

Total agricultural land covers 34.4 per cent of the total land area in the Mediterranean EU countries but only 9.1 per cent for the countries located in the southern and eastern shores (Albania, Algeria, Croatia, Egypt, Jordan, Israel, Lebanon, Libya, Morocco, Palestinian Authority, Syria, Tunisia and Turkey). Excluding Albania, Croatia and Turkey, the percentage of agricultural land for the remaining countries compared with their total land area shrinks to 5 per cent (Zdruli, 2012).

The Mediterranean population of 428 million in 2005, of which more than 286 million lived in MENA (Plan Blue 2005), had increased by 50 per cent over the last 30 years and this trend remains high especially in the South Eastern part of the basin (2.35 per cent per year or 3.9 million additional people per year). Furthermore, the annual population increase in the urban areas of MENA is five times greater than rates of population increase in the Northern Mediterranean. By 2020, Egypt will have 95 million people and Turkey 87 million, collectively about 35 per cent of the total population in the region. By contrast in 1990, Egypt, France, Italy and Turkey had more or less the same number of inhabitants (55-57 million). In coastal Mediterranean regions, the population increased from 90 million in 1970 to 143 million in 2000 (NUTS3 level), primarily in the Southern and Eastern countries. The population in coastal areas is estimated to be 186 million by 2025, with the major increases again in the South and East. On average, between 50 to 70 per cent of total population of the Mediterranean riparian countries (excluding France and Turkey) live within 60 km of the coast. Population in the Southern and Eastern Mediterranean is estimated to be 300 million by 2020 (Plan Blue, 2005) and conservative estimates for total Mediterranean population range from 522 – 543 million people by 2020 (MEDITERRA, 2008).

Soil Degradation and Sustainable Land Management

The largest areas vulnerable to high erosion in Northern Mediterranean are located in southern and western Spain (covering 44 per cent nationally), and with local erosion hotspots on the southern coast. In Portugal, one-third of the country is at a high risk of erosion and in Italy and Greece, the areas with a high erosion risk cover almost 20 per cent of the total land area (Montanarella, 2007). Saline soils (natural and human-induced) cover about 10 million hectares throughout the region. Spain has 3.4 million ha, followed by Turkey (2 million), Libya (1.5 million), Egypt (1 million), Italy (1 million), Greece (600,000), Morocco (350,000), Tunisia (150,000), Syria (125,000) and Albania with 15,000 hectares. Soil salinisation and alkalisation (Solonetz soils) are regarded as major causes of desertification and are serious forms of soil degradation in the Mediterranean. Human-induced salinisation has expanded because of poor quality irrigation water, especially along the coasts by sea water intrusion into the fresh water aquifers

Figure 1 shows very disturbing scenarios for the region. The Mediterranean population is likely to more than double but the agricultural land area may shrink with the loss of 8.3 M ha (or 7 per cent) if the present rates of urbanisation and land degradation remain unchanged. The evidence is that even in the near future agricultural land and water resources that only partly fulfil food needs of the MENA population will come under increased and severe pressure as populations increase, land degradation remains unabated, and climate change impacts become more pronounced.

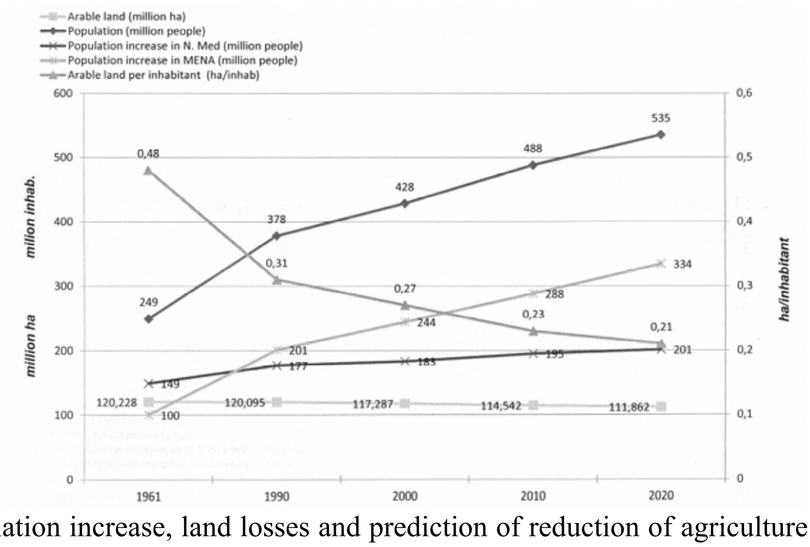


Figure 1. Population increase, land losses and prediction of reduction of agriculture land per capita in the Mediterranean

Conclusions

These data show that there are no "easy" options for expanding the cultivated land area, especially in the Southern and Eastern Mediterranean region compared to the Tropics where 83 per cent of the new cropland for the period 1980 – 2000 came at the expense of natural forests. However, there are options for much improved land management and for reclamation of some degraded lands. Most common interventions include terracing (i.e. Syria, Morocco) and expansion of cultivation onto desert areas (Egypt, Israel). These interventions would require increasing water use efficiency since agriculture use more than 80 per cent of the available water.

Implementation of *sustainable land management* (SLM) technologies is the best approach for mitigation and remediation (Zdruli 2010). Studies show that SLM has the potential to increase yields by 30-170 per cent, increase soil organic carbon sequestration up to 3 per cent (thus mitigating climate change) and increase water use efficiency by up to 100 per cent (WOCAT 2007). Technologies such as conservation agriculture, organic farming, no till or reduced tillage, reforestation, afforestation and agro forestry, halophyte cultivation in saline areas and development of new varieties of drought-resistant crops, water harvesting, increased water use efficiency, mulching, cover crops, controlled grazing, integrating crop and livestock production, and well designed terracing need to be implemented.

Resolution of these problems would illustrate how regional cooperation can provide sustainable benefits to the least favoured people of the Mediterranean who strive daily to make their living and at the same time protect the environment. If no action is taken, continued inefficient and inequitable use of land and water resources in the absence of implementation of sustainable development strategies will only worsen current conditions in the region, increase hardships and foment political instability.

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LAND DEGRADATION, REMEDIATION AND RECLAMATION

POSTER PRESENTATIONS

Bio Indication of Soil Fertility Related To Different Farming Systems

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Abstract
Fertility is the most practically important soil characteristic, which depends on soil biochemical components and their ratio. Application of bio-indices and biological methods is recently promoted to ascertain soil fertility. The objective of this study was to determine the soil bioactivity responses (saccharase and urease activity) on different land management systems and soil genesis type, content of soil organic carbon (SOC), total nitrogen (N), and C/N ratio. The trial was comprised of eight experimental plots (three land management systems and two crops groups: legumes and grasses). Site soil (*Hapli–Epihypogleyic Luvisol (LVg-p-w-ha), Albi–Epihypogleyic Luvisol (LVg-p-w-ab), and Hapli–Albic Luvisol (LVA-Ha)*, artificial drainage) samples collected from rotation fields of different fertilizing and farming systems, namely extensive (ExF), conventional (CF) and organic (OF)) at the Lithuanian University of Agriculture.
CF and OF promoted the highest enzyme activity. Enzyme activity correlated stronger with SOC (r=0.7) or ratio C/N (r=0.6) than that with total nitrogen content (r=0.5-0.6) Significantly higher 3 year mean value of saccharase (27.00 and 12.6 mg CG g^{-1}) and urease (5.78 and 4.16 mg NH_4^{+}–N g^{-1} 24 h^{-1}) were observed in CF and OF rotation fields respectively. Statistically significant differences between farming management types and soil biochemical indices revealed the relevance of enzyme activity as a proxy indicator for evaluating soil fertility.
Keywords: bio indication, soil fertility, enzymes

Introduction

Fertility is the most practically important soil characteristic, which depends on soil biochemical components and their ratio. About 3/4 of the organic carbon contained in terrestrial ecosystems and the majority of organic nitrogen are found in plant residues and soil organic matter (Abbott and Murphy, 2004). In addition, soil biota influences material and energy metabolism substantially, thus determines soil fertility. However the recent concern regarding to the long-term productivity and sustainability of agro-ecosystems resulted in application of various bio-indices and biological methods. Moreover, soil biodiversity are referred to confer stability to stress and disturbance, but the mechanism is not yet fully understood, thus biological equilibrium reached might be different from the original populations (Baležentienė, 2001). Extracellular enzymes are produced by plants, animals and microorganisms. These may be present in dead cells or cell debris and also adsorbed by clay or incorporated into humic substances (Dilly et al., 2007). Dissolved organic matter is produced by soil enzyme-catalysed depolymerisation of organic matter and is comprised of low molecular weight compounds that are often water soluble and thus more accessible to biota assimilation as energy, carbon, and nutrient sources. Thus, soil microorganisms and enzymes are the primary mediators of soil biological processes, including organic matter degradation, mineralization and nutrient recycling (Li et al., 2008; Nannipieri et al., 2002). Hydrolytic enzymes make nutrients available for plants and soil microorganisms from a wide range of complex substrates and are influenced by a wide range of soil properties such as pH, organic matter and texture, and also by farming management and anthropogenic impacts. Saccharase and urease are related to the C and N cycles, which are the fundamental factors in forming soil fertility (Dilly et al., 2007). Among other indices, enzyme activity is proposed as index of soil fertility (Li et al., 2008) or contamination (Ge and Zhang, 2011). These enzymes are non cellular and long time persisting in soil matrix though they are sensible for abiotic factors (Tian et al., 2010), especially for fertilizers. Some references pointed out an increase in abundance of microorganisms as well as in some enzyme activity in case of applying of organic and mineral fertilizers (Li et al., 2008). Past studies have shown that big doses (>120 kg ha^{-1}) of mineral fertilizers as well as the species of cultivated crop will change microorganism and ferment composition and abundance (Monokrousos et al., 2006). Therefore evaluation of enzyme activity is actual bio-indicator specific to soil organic matter biochemical alteration (Lagomarsino et al., 2009).

The intensive management of agriculture negatively affected both abiotic (soil, water, air, habitats) and biotic (species, communities and biodiversity) resources of environment (Tylianakis et al., 2010). Therefore recent developments in the EU policies to foster environmental friendly farming practices and agricultural surplus reduction have led to widespread interest in organic farming (UNEP-RIVM, 2003). Hence, over the last decades, organic management has been introduced in order to preserve soil sustainability by allowing the maintenance and even the increase of soil fertility through the use of farmyard manure, the omission of synthetic fertilizers and pesticides, and the lower use of high energy-consuming foodstuffs. Following the implementation of the EC regulation 2092/91, organic farming has been developing in Lithuania during the last two decades, and now occupies over 0.13 M ha. The demand for suitable soil quality indicators, evaluation and monitoring of the impact, and measurements of the success of any specific agricultural practices, has increased due to the implementation of environmentally-friendly agricultural policies.

The main aim of this study was to evaluate impact of farming management system (conventional, organic, and extensive) and different crops (legumes and gramineous) on activity of urease and saccharase related to the C and N cycles in 15 years period on different soils. Moreover, discrimination of soil hydrolases properties in organic and conventional management systems was measured. In addition, this study addressed the question, which of the main biochemical indicators resulted to be suitable for soil fertility rating.

Materials and methods

Soil samples were collected in accordance with ISO 10384–1:2002 from different farming fields at 8 sites: extensive (ExF: abandoned barley-couch-grass (b-cg; *Hapli–Epihypogleyic Luvisol, LVg-p-w-ha*; $N_{120}P_{50}K_{60-0}$), abandoned meadow (g; *Hapli–Albic Luvisol, LVA-Ha*) (FAO/UNESCO, 1997) and fodder galega (*Galega orientalis* Lam.) stand (lga; *Hapli–Albic Luvisol, LVA-Ha*); conventional (CF: 1) oat-vetch-winter wheat-barley-clover, ov-w-bcl; *Hapli–Epihypogleyic Luvisol, LVg-p-w-ha*; $N_{60}P_{50}K_{60}$-$N_{120}P_{50}K_{60}$-$N_{60}P_{50}K_{60}$; 2) oat-vetch-barley, ov-b; *Albi–Epihypogleyic Luvisol, LVg-p-w-ab*; $N_{120}P_{50}K_{60}$, and 3) w. wheat-oilseed rape-bare fallow, w-r-bf; *Albi–Epihypogleyic Luvisol, LVg-p-w-ab*; $N_{120}P_{50}K_{60-0-0}$), and organic (OF: oat-pea-barley-barley-clover, op-b-bc and w. wheat-oat-pea-barley, w-op-b; *Hapli–Epihypogleyic Luvisol, LVg-p-w-ha;* manure, 80 t ha^{-1} yr^{-1}) rotation crops in June of 2007-2009. OF is certificated by the EKOAGROS (Lithuanian Committee for Organic Agriculture). Weed control by tillage and herbicide was applied only in agro-phytocoenoses of conventional farming. Soil samples were taken in triplicates. Soil pH was recorded potentiometrically using 1 n KCl extraction, mobile P_2O_5 and K_2O (mg kg^{-1} of soil) – by A–L method. This study relies on analysis data obtained within a joint project presented by Sabiene et al. (2010).

Soil bioactivity was characterized by applying a bioassay of hydrolytic enzyme activity. The enzymatic activity was determined in air–dried soil samples. All treatments and measurements were replicated three times. Saccharase (EC 3.2.1.26) activity was measured according to the modified Hofmann and Seegerer method (Dilly et al., 2007). Urease (EC 3.5.1.5) activity was assayed by employing Hofmann and Schmidt spectrometric method. Urease and saccharase activities were expressed as production rates of NH^{4+}–N g^{-1} or glucose g^{-1}air dried soil (mg g^{-1}).

The least significant differences between treatment means were determined using Fisher's least significant differences (LSD_{05}). LSD, standard error (SE), correlation coefficient (*r*) has been calculated at level of statistical significance $p < 0.05$.

Results and discussion

As extracellular enzymatic activity followed their substrate availability within soil profile, hydrolytic enzymes (saccharase and urease) were undertaken as indicators indirectly identifying response to different crops (gramineous and legumes) and farming types (extensive/abandoned, organic and conventional) in this study. These essential for humus turnover and nutrient release or immobilization enzymes involved into C and N cycles of essential life and nutritious elements are mostly depended on SOC (Li et al., 2008). We investigated the 15-years effects of organic management on soil quality resembled by chemical and biological parameters of the soil. Responding to references (Diepeningen et al., 2006; Nannipieri et al., 2002),farming management type and crop rotation indicated significant impact on soil fertility indices, namely on SOC (*r* =

0.7), N (r = 0.4) and N/C (r = 0.7). Eventually it was actually to identify hydrolytic enzymes (saccharase and urease) fluctuation in the same background.
The most prevalent and investigated enzyme in nature saccharase is produced by plant and microbes catalysing saccharose (raffinose, stachiose, etc.) hydrolysis to glucose and fructose characterizing changes of SOC in soil. As referred Singh and Kumar (2008), saccharase is used as a reliable index of soil bioactivity and fertility due to association with humus, K_2O and P_2O_5 content, the indices which are related with farming system. Therefore saccharase activity with exception for CF crop stands was observed significantly different and dependent on farming type as well as crop during 3 study years (r = 0.3; Fig. 1). During three year conventional farming induced significantly the highest saccharase activity in winter wheat stand (27.00 mg CG g^{-1}) supposedly due to appropriate aeration conditions (Sang et al., 2009) and sufficient C containing substrate supply (Li et al., 2008).

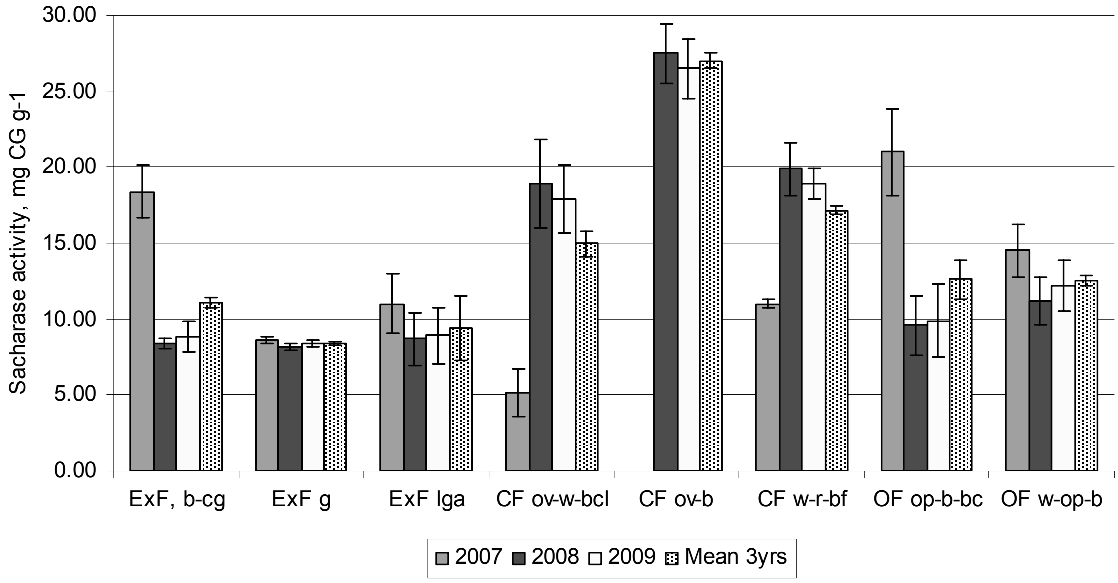

Figure 1. Saccharase activity responses to farming type and different crop stands (mean ± SE, $p < 0.05$)

The lower saccharase activity was observed in CF fallow (17.18 mg CG g^{-1}) and CF mixtures with legumes (15.87 and 14.95 mg CG g^{-1} respectively), as compared with that of CF w. wheat treatment. Relatively high saccharase activity in stands with legumes could be explained by formation of nodules on leguminous plant roots. As Cooper (2004), and referred, nodulated plant root produced glycosides containing flavonoids, such as C substrate which is decomposed by saccharase.
Extensive farming had not stimulated indices of soil fertility (SOC, N accumulation and C/N rise) and saccharase activity, which was observed significantly the lowest during the three experiment year in cereal (8.40 mg CG g^{-1}) and legume (9.38 mg CG g^{-1}) crops as compared with CF, OF and ExF (Mäder et al., 2002; Monokrousos et al., 2006). Response of saccharase activity to different farming types could be explained by its strong correlation with SOC content (r=0.7), which varied across different farming systems and ranged between 4.86 in ExF meadow and 12.4 % in IF w. wheat stands. The highest mean values of soil fertility indices were observed in field of conventional (17 g kg^{-1} SOC, 1.4g kg^{-1} N and 12 C/N ratio) and organic (17.5 g kg^{-1} SOC, 1.36 g kg^{-1} N and 13 C/N ratio) management system. In accordance with chemical parameters of soil fertility, the highest mean activity of saccharase was observed in CF (19.71 mg CG g^{-1}) and OF (12.57 mg CG g^{-1}) respectively. Therefore our study demonstrated that conventionally and organically managed soils exhibited greater saccharase activity due to beneficial conditions for accumulation of SOC (r = 0.7) and forming favourable C/N ratio (r = 0.7, Fig. 1), which, in turn, guarantee sufficient amount of C containing substrate (García-Ruiz et al., 2008).

As reported in numerous studies (Smith and Powlson, 2003; Renella et al., 2007), SOC content guaranteed decomposed polysaccharides mass – a proper substrate (saccharase) promoting saccharase activity. Therefore it could be concluded that most active SOC decomposition was observed in CF and OF, where the highest SOC content was determined. Uncultivated and unfertilized soils of ExF did not accumulate organic matter and other elements important when forming soil fertility, therefore lowest SOC content (5.67–4.86 g kg^{-1}) and saccharase activity (8.6–11 mg CG g^{-1}) were observed.

Urease activity represented potential ammonification rate and has attracted a considerable attention due to increasing application of urea as fertilizer to improve the soil fertility (Zeglin et al., 2007; Zibilske and Bradford, 2007). Similarly as in case with saccharase, the different soil urease activity was observed for different farming and crop types (Fig. 2). Urease activity was related with nitrogen–containing substrates dynamics in response to land management intensity and crop (r=0.6). The highest urease mean activity has been observed in CF and OF wheat stands (5.79 and 4.16 mg) possibly due to applied of heavy nitrogen rates ($N_{100–120}$). This trend corresponded with references (García-Ruiz et al., 2008), significantly higher potential ammonification in the conventional farms is consistent with the long-term application of ammonium or urea as the main fertilizer source, and suggests the presence of an important community of autotrophic nitrifying bacteria.

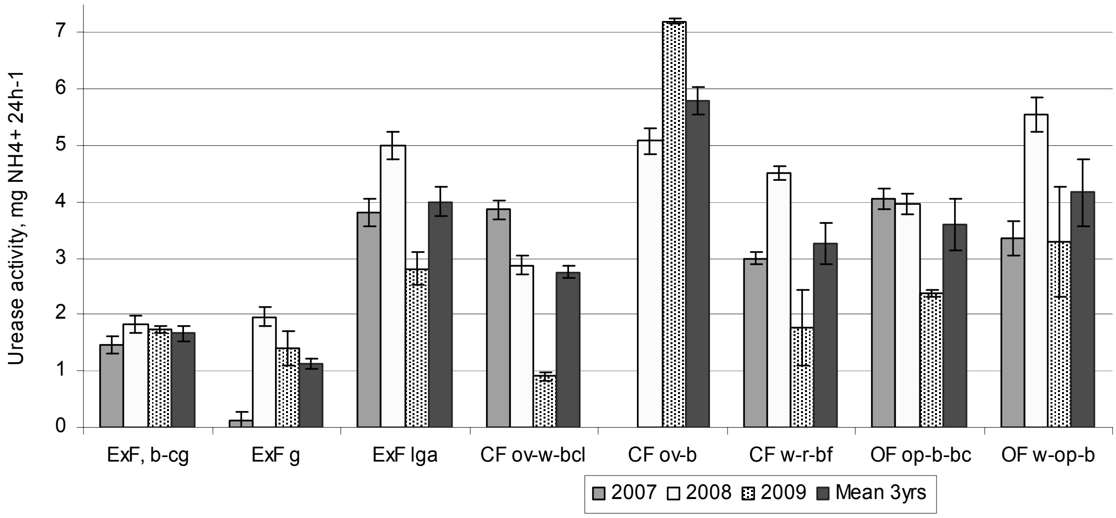

Figure 2. Potential ammonification rate responses (r = 0.6) to farming type and different crop stands (mean ± SE, $p < 0.05$)

Higher urease activity indicates that the plant continue to assimilate the nitrogen inputs (Singh and Kumar, 2008). These high annual inputs are targeted to provide heavy harvest in commodity-based crops. Nonetheless, rise of urease activity correlated stronger with SOC (r = 0.7) or ratio C/N (r = 0.7) than that with total nitrogen content (r = 0.6). Thus urease is related with total soil fertility (Renella et al., 2007). Decrease of urease activity was observed in soil of EF abandoned grassland (1.13 mg NH_4^+–N g^{-1} 24 h^{-1}) and barley-coach grass (1.67 mg NH_4^+–N g^{-1} 24 h^{-1}) due to the lowest total N (1.2 g kg^{-1}) and SOC (11 g kg^{-1}) content. Due to lower rates of soil quality indices (12.7 g kg^{-1} SOC, 1.19 g kg^{-1} N and 10.5 C/N ratio), the lowest urease mean activity (2.27 NH_4^+–N g^{-1} 24 h^{-1}) was observed in fields of extensive farming. Increase of soil fertility indices in conventional (17 g kg^{-1} SOC, 1.40 g kg^{-1} N and 12.7 C/N ratio) and organic (17.5 g kg^{-1} SOC, 1.36 g kg^{-1} N and 13 C/N ratio) farming indicated better agronomic management there. Land management stimulated the increase of mean urease activity in conventional (3.93 mg NH_4^+–N g^{-1} 24 h^{-1}) and organic (3.88 mg NH_4^+–N g^{-1} 24 h^{-1}) farming.

Summarising, soil chemical indices (N and SOC) and assessed hydrolase activity indicated positive impact and successful agricultural practices of conventional farming in studied sites and correspond with Zibilske, Bradford (2006). Nonetheless, C/N ratio (13.0) was significantly higher and more crop-favourable in organic farming, than that in conventional (12.2). Agro chemical properties alone were not sensitive enough to track relatively subtle soil quality improvements in farms over the past 15 years since the shift from conventional to organic farming in the investigated sites. As distinct from some references (Stockdale and Cookson, 2003), our results using hydrolytic enzymes suggest that soil functionality (i.e., its capacity to cleave organic compounds) was also enhanced under conventional management. Indeed, 15 years practices undertaken routinely were not sufficient for improving soil quality indices in the organic farms covered in this study. This emphasizes that the differences between organic and conventional farming are more gradual and that other sources of variation to account for are present. Observed variation of the assayed soil hydrolases activity might have occurred due to different site properties (i.e. soil type, landscape characteristics, or environmental conditions). In accordance with van Diepeningen et al. (2006), we found that site is a much stronger determinant of the soil agro chemical composition than management type. This finding suggested that a high number of plots showing a wide range of soil properties and different management history should be investigated in order to employ soil enzyme activities as an assessment tool to estimate beneficial environmental effects of friendly agricultural management practices.

Conclusion

The assessment of soil enzymes can be used as indicator of the biological activities and natural biochemical processes in soil. Soil enzyme activities have all the potentials to provide a unique integrated biological and biochemical assessment of soils because of their relationship to soil biota, easiness of measurement, and rapid response to all sorts of changes, i.e. anthropogenic, agronomic, chemical and environment conditions. In our experiment, conventional and organical faming promoted the highest enzyme activity. Enzyme activity correlated stronger with SOC (r = 0.7) or ratio C/N (r = 0.6) than that with total nitrogen content (r = 0.5-0.6) Significantly higher mean value of saccharase (27.00 and 12.6 mg CG g^{-1}) and urease (5.78 and 4.16 mg NH_4^{+}–N g^{-1} 24 h^{-1}) were observed in CF ov-b and OF w-op-b rotation fields respectively. In most of the studies, it was observed that enzymes behave differently with different SOC content. Fluctuation in enzyme activities in experimental soil might have occurred due to different agronomic practices and soil fertility conditions during the crop seasons. More intensive studies are required to evaluate the effects of different farming practices on important soil enzymes concerning the soil health and soil fertility. Statistically significant differences between observed farming management types and soil biochemical indices revealed the relevance of enzyme activity as a proxy indicator for evaluating soil fertility.

Acknowledgement

We are grateful to all the organic and conventional farmers who provided the information about their management of the soil and sampling permission. This work was supported by Lithuanian Ministry of Agriculture through a research fellowship during 2007-2009.

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Evaluation and mapping desertification condition, using GIS and RS and its application in natural resources

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Abstract

There are different models for mapping and evaluating the desertification condition, such as global FAO_UNEP model. Several models are also used for evaluation of desertification in Iran. In this study, two following methods were used: 1- ICD method (Iranian Classification of Desertification). 2- MICD method (Modified Iranian Classification of Desertification). In this research, at first, these models were considered and indices and factors were improved. Then, working unit map of this region was prepared by geomorphologic method and land use of each working unit was determined. This map has 8 working unit. At last, evaluation of desertification condition was determined in this region by ICD and MICD methods. In ICD method, from an intensity of desertification point of view, Niatak-Sistan region is in medium, high and very high classes. In this region the medium class is about 2857.42 hectare (59.3%), high class is about 1503.3 hectare (31.2%) and very high class is about 459.1 hectare (9.5%) of total area. In MICD method, this region has four classes of low, medium, high and very high. The low class is about 1149.9 hectare (23.86%), medium class is about 824.95 hectare (17.12%), high class is about 2385.7 hectare (49.5%) and very high class is about 459.04 hectare (9.52%). According to the results of this investigation and comparing them with the condition which have been observed in the Niatak-Sistan region, the MICD is determined as better method for evaluation of desertification condition in this region.

Key words: Desertification intensity, Desert region and Desertification index, unit work, ICD method.

Introduction

Desertification, land degradation in arid, semi-arid, and dry sub-humid regions, is a global environmental problem. About 2 billion people are potential victims of the effects of desertification (UNEP[1], 2002). About 80% of Iran is located in arid and semi-arid region and a third of its area is exposed to the threat of desertification (Iranian Forest, Rangeland and Watershed Management Organization, 2005).

In Iran there are several models that assessment desertification severity. Ekhtesasi and Mohajeri (1995) developed the ICD (Iranian Classification Deserts) model for the classification of Iranian deserts. One of the advantages of the ICD model is its capability to identify the type of desert environment such as environmental and anthropogenic deserts. ICD model was developed in four steps: separation of deserts types using plant types and land use maps, determination of desertification causes including the major and minor causes, classification of desertification and desertification mapping. This method classifies of desertification intensity to five classes: slight, low, moderate, severe and very severe. Also, Ekhtesasi and Ahmadi (2006) developed the MICD (Modified Iranian Classification Deserts) model. The purpose of this research is to survey current status desertification of Niatak - Sistan region, by ICD and MICD models, Which is considerable and administrative for priority of combat desertification, including mechanical– biological fight, in the from combat desertification plans with emphasis on technical interpretation and economic-social indices in Sistan region.

Materials and Methods

The study areas are located east of Zabol city near the Iranian- afghan border. It covers 4819.6 ha and its average evaluation is 470 meters above sea level. Geographical position is between 61" 36 33 to 61" 41 56 east's and 30" 59 05 to 31 07 23 Northern latitude (Figure1).

[1] - United Nations Environmental Program

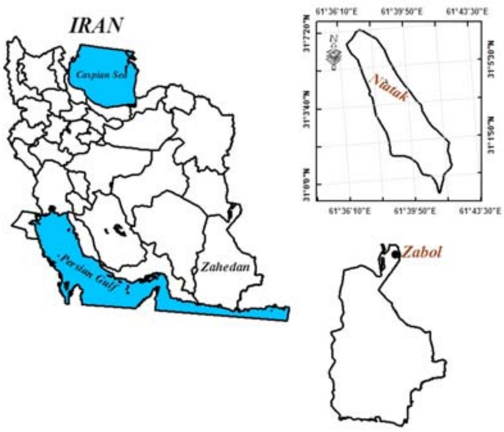

Fig 1: The position of study area

At this stage, to help basic studies such as plant types, land use maps and other perspective of desert, type of desert environment were separated and the assessment of desertification was made in all of them.

Desertification Intensity = environmental factors+ anthropogenic factors+ desertification indices

Table 1- Desertification intensity quantitative scores range and qualitative classes in ICD method

Desertification intensity	Range	Class
Slow	0 – 15	I
Low	15 – 30	II
Moderate	30 – 45	III
Severe	45 – 60	IV
Very sever	60 - 80	V

(Source: Ekhtesasi and Mohajeri, 1995, Classification method and type of desertification intensity for lands in Iran)

After evaluation each of desert units, in order to status of desertification map preparation, first, all work units that have the same desertification intensity class was sit in a range. Then according to type of deserts environment and major and minor factors effecting on desertification was separated to smaller areas. Finally, desertification intensity, type of deserts environment and effecting factors on desertification are calculated and plotted by using following formula below on final map.

Type of desert / Desertification intensity
――――――――――――――――
Major factors (A or E) / Minor factors

To evaluation desertification to MICD method with emphasis on wind erosion similar to ICD method, first, various land uses in region determination and then geomorphology facies map for scoring to indices related to factors were prepared. In this method, type of land uses in the different parts of region to help land use and plant cover maps determination and in the three groups, agricultural lands, forest and range lands and non-land use lands were classified. MICD method for each land use mentioned, special indicators suggest that after scoring the indicators, in end with sum of the scores given for each land use, determination feasibility desertification intensity and status region map is provided (tables 4, 5& 6). disassociate land uses and indicators related to them from each other, this possibility provides the can be assessed and scoring for indicators that are more important in desertification because all indicators of desertification, which are important for agriculture lands in non-land use lands and forest and range lands are unimportant and contrariwise.
Due to is not identical indicators in different land uses, use from classification table desertification intensity on the basis sum of the scores examined factors, would be impossible, and therefore before status of desertification assess in the study area, proceeding to equivalent the indicators

number in all land sues. Thus in the table related to present status of desertification assess in non-land use lands, soil texture index was added and also in the table related to forest and range lands, plant cover density index and gravel density index (greater than 2 mm), Were in a group (Hosseini, 2008). According to this model, desertification process has been classified in 5 classes involved Slow (Calm), low, moderate, severe and very severe (table 2).

Table 2- Desertification intensity quantitative scores range and qualitative classes in MICD method

Desertification intensity	Range	Classes
Slow(Calm)	0 – 5.6	I
Low	5.6 – 11.2	II
Moderate	11.2 – 16.8	III
Severe	16.8 – 22.4	IV
Very severe	22.4 - 28	V

(Source: Ekhtesasi and Ahmadi, 2004, Classification method and type of desertification intensity for lands in Iran)

Results

Study area belongs to cold hyper-arid climate and in terms of rainfall is very poor. Climates, droughts and inadequate rainfall from soil genesis and the establishment of appropriate vegetation in the region prevented. Destruction process is so increasingly, due to recent aerological and hydrological drought, changing land use, and range destruction, sand taking from the lake bottom and making sand dunes in farms. All these factors contribute to increased desertification. To investigate the status of desertification in study region to help geomorphologic, land use and plant cover maps, 8 working units of separation and desired factors in each unit were evaluated on the basis of tables designed. Result obtained of status of desertification assess by ICD method in tables 5, 6 and 7 are provided. Finally, attention to results obtained current status of desertification map by ICD model in the region of Niatak- Sistan were obtained (fig 5). Based on this method study region is in three classes low, medium and severe. In this region the low class is about 419.65 hectare (8.7%), the medium class is about 3336.73 hectare (69.2%) and severe class is about 1063.62 hectare (22.1%) of total area.

Discussion

The results indicated that the desertification dominant factor in the ICD method, environmental factors and region is except natural desert. About climate study area can be mentioned so low precipitation (57 mm) and also the continuing drought periods. Drought is climate, hydrological, agricultural, and ultimately economic – social in the study area that attention to the available evidence scoring to these factors was done with expertise vision. About geomorphology factor has, no topography phenomenon in the study area, so that changes of slope are inappreciable and very small in the plains (changes of slope$<0.06\%$). Situation soil and water resources due to the lithology special structure region such as fine sediment can be no exploitation of underground water resources and region water resources is restricted to the surface and underground water. A part of major is the surface water related to Hirmand River and attention to disregard Iran water rights by Afghanistan country (water allocation 26 m3/s to Iran) and also recent droughts has been faced with serious restrictions and water crisis in the region has intensified. Human factors and plant resources degradation, especially over cutting trees and shrubs to aim fuel preparation and also over grazing due to lack of sufficient forage from one side and imbalance livestock and pasture range land, the other hand natural resources destruction has intensified. As mentioned, due to recent drought and drying Hamoun Lake, region microclimate were severely affected and the 120-day winds (Louvar) carries sediment and wind erosion has gone so far as the majority of agricultural land convert to sedimentation region or Erg has been. And land use change what has been mentioned in the model (Converting agricultural land to forest, range land, abandoned, and no land use lands) is true in the region. As desertification indices, particularly resilience potential and reclamation of ecosystem with emphasis on technical and economic justification, the parts of area Haloxylon artificiality forest created and in contrast to restoration projects have failed in the other parts of areas. That in the scoring desertification indices was considered.

Table3- Result of Intensity and Factors desertification in Niatak-Sistan region by ICD Method

Unit Work Code	Quantitative Value of Environmental Factors	Quantitative Value of Anthropogenic Factors	Quantitative Value of Desertification Indices	Quantitative Value of Desertification Intensity	Desertification Intensity Class	Illustration of Current Desertification Position on Map
1-1-1	19	16.5	14	49.5	IV	(IV-P/r)/E-C(dr)
1-1-2	13.9	12	8	33.9	III	(III-P/f)/E-C(dr)
1-1-3	17.5	14.5	10	42	III	(III-Ap/f)/E-C(dr)
1-1-4	21.25	0	15.5	36.75	III	(IV-B/s.d)/E-C(dr)
1-1-5	14	11	7.5	32.5	III	(III-P/r)/E-C(dr)
1-1-6	22.25	0	18	40.25	III	(V-B/b)/E-C(dr)
1-1-7	17	0	6.5	23. 5	II	(III-B/c)/E-C(dr)
1-1-8	13.4	22.5	6	41.9	III	(III-A/i)/A-w.d(pu)

According to was evaluate in the study region the results shows that land degradation intensity in all work units was calcified into three classes low, moderate and severe. So that the working unit 1 with a quantitative value of 49.5 in the result of sums various factors with maximum quantitative values are placed in first priority of degradation. The work units 7 with quantitative minimum values lower priority. Results also showed that environmental factors were as the main factor in desertification of 81.7 % area of the studied region while 18.3 % of that was affected by anthropogenic factors.

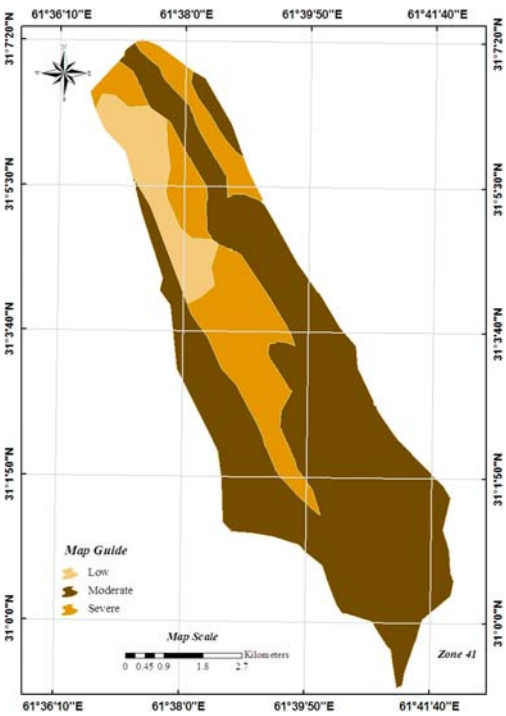

Fig2- Final map of status of desertification in Niatak-Sistan region, Iran by ICD method

Rating calculated in this method is thus type of land uses in the various parts of the region to help land use and plant cover maps determinate and separated and afterward in the three groups, agricultural lands, forest and range lands and non-land use areas were classified. Specific indicators score related to each of land uses in tables 9, 10 and 11 are presented. According to total scores given to these indicators, and table 4 was determined for each of land uses the current status of desertification map (fig6). The results showed that in MICD method, this region has four classes of low, medium, severe and very severe. The low class is about 1150 hectare (23.9%), moderate class is about 825.16 hectare (17.1%), severe class is about 2385.80 hectare (49.5%) and very sever class is about 459.03 hectare (9.5%).

Table 4- Current status of desertification evaluation caused by wind erosion on non-land use area

Index Type	Barkhan	Sand dunes	Clay Plain
Effective plant cover Or Gravel density (larger than 2 mm in the soil surface)	4	3.5	1.25
Plant survival in time soil surface	2.5	1.5	1
Confusion signs due to tool and animal traffics	4	3	2
Continual of wind blow more than threshold speed (6 m/s in 10 m height)	2	1.5	2.75
Wind erosive effects on soil and making Yarandang and Kalut on the soil surface	4	3.5	1
Pressure persistence of soil in dry conditions	4	3.5	1.25
Sing of (wind) sand mass at the bottom of the plants of the stones	3	3	1.25
Total value	23.5	19.5	10.5
Desertification Intensity	V	IV	II

Table 5- Current status of desertification evaluation caused by wind erosion on forest and range Land use

Index Type	Riparian of Niatak River	Mulch Covered Lands	Nebka-Clay Plain Sand dune	Niatak River Bed
Index type	1	1	1	1
Planting models in lands under cultivating	1	2	1.25	2
Windbreak condition around the farms	3	3	3	3
Soil and earth management	1. 5	1.5	2.9	2.5
Soil texture	1.15	3	3	2
Plant remains management	2.5	3	3.75	1.75
Soil humidity and irrigation duration	1	1.75	2	1.25
Total value	11.15	15.25	16.9	13.5
Desertification Intensity	II	III	IV	III

Table 6- Current status of desertification evaluation caused by wind erosion on agricultural Land use

Index Type	Irrigation Agricultural Lands
Index type	2.5
Surface condition of soil	3
Confusion signs due to tool and animal traffics	1.5
Continual of wind blow more than threshold speed (6 m/s in 10 m height)	3
Wind erosive effects on soil and making Yarandang and Kalut on the soil surface	3
Pressure persistence of soil in dry conditions	2.5
Signs of sand mass at the bottom of plants or stones	3
Total value	18.5
Desertification Intensity	IV

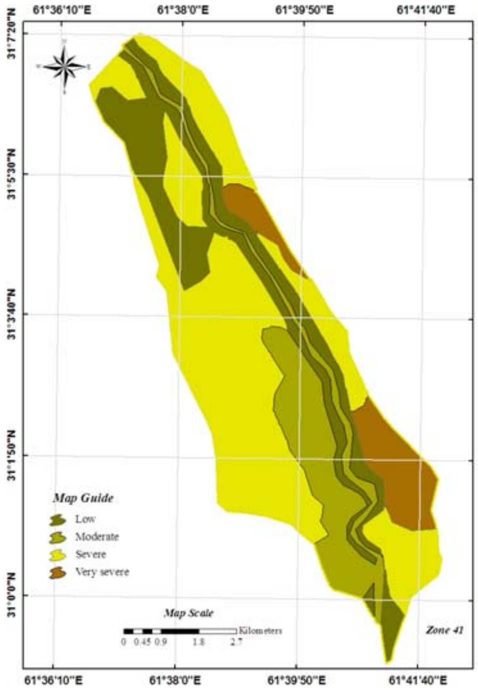

Fig3- Final map of status desertification in Niatak-Sistan region, Iran by MICD method.

Results of these two methods are different from each other, so that in ICD method is study area in three classes low, moderate and severe and in MICD method; this region has four classes calm, low, medium and very severe. By comparing the results of two ICD and MICD methods and comparing them with the condition which have been observed in the Niatak-Sistan region, the MICD is determined as better method for evaluation of status desertification in this region. So that, MICD method can be used as appropriate method for evaluation the potential of desertification intensity in regions with the similar characteristics. Because to this methods status desertification, with emphasis on wind erosion is determined, the only factors that affecting in wind erosion are, evaluate and scoring was and for scoring from many factors that will cause impact on each other and possibly intensifying or mitigate the impact each other were refused.

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Methods of Water Collection and Utilization in Arid Areas

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Abstract

The existence of water in arid and semi-arid areas is of high importance and getting water for the residents of these areas is a vital matter. Thus, the use and exploitation of water is a permanent indicator of art and technology. Harvesting rain water has a long history. Irregular rains and flooding in arid regions in many years without adequate rainfall has made people to consider the use the surface runoff from rainfall to meet their needs in different sectors. Water harvesting, includes all actions and operations employed to collect and store surface runoff within bankets, furrows, pools, water reservoirs, and generally any action that causes water to be stored behind barriers created by humans for drinking, agriculture, or watershed management.
Keywords: arid areas, water harvesting, banket, furrow, pool, water reservoirs.

Introduction

The outcome of people's experiences has resulted in various practices for water utilization or water management facilities evolved over centuries whose efficiency has been already proven. Rainwater collection has a history of approximately about 4000 years. Nomadic people, for instance, used to make water flow much faster by leveling the surface of hills and then they dug creeks in hill slopes and transferred the collected rain water for farming and other consumptions (Mousavi & Shayan, 1985). Though rainfall happens rarely in these areas, the collected water through this method is much considerable as a rainfall of ten millimeters is equivalent to one hundred thousand liters of water per acre. The collection of such water can provide the water needed for areas in which other water resources are far away or water transfer costs are high. The history of water collection indicate that this method was employed for various purposes such as providing drinking water, rolling mills, resort destinations, and for defensive purposes. The first cisterns were built in the Roman Empire. In Iran's tropical areas including Lar, a city in Fars Province (Iran), approximately 5600 traditional cisterns have been built to store water in dry seasons (Rashky, 2007). In very dry areas where the amount of rainfall is very low and sporadic, fresh water is not accessible, and to put it in a nutshell, the storable moisture in the soil not enough to produce crops, people usually do not use the rain water for dry farming or enhancing vegetation. In addition, they do not consider increasing the rate of water infiltration into the ground in order to reduce runoff and, as a result, to increase soil moisture because these measures are not much effective in increasing the water supply in the region. On the contrary, some measures should be taken to improve water permeability into the ground and to increase runoff or rainfall water and to use it in other places (Babrudian, 2001). While rainwater is collected usually to be used at a small scale such as villages, today in many countries such as Australia and Sudan too much water is collected to meet the needs of residents of dry areas by using indigenous knowledge. For instance, in dry areas located in West Australia approximately an area of 240 hectares has been constructed with asphalt or concrete in the form of artificial watersheds to provide the needed water for 23 small towns (Kordavany, 1994). Before the implementation of the project of rainwater collection through employing the required systems, it is needed to recognize the features of the area under study including climatic conditions such as wind, sunlight, temperature, the amount of rainfall, soil properties (including permeability), ground irregularities, and plant coverage.

Materials and Methods

This study uses data collection and reviews of other papers and books have done.

Results

Rainwater collected from natural and artificial watersheds in arid areas can serves as a new water source of low cost and good quality for dry areas.
The common uses of rainwater in arid areas are as follows:

- Farming through rainwater is the only possible method for crop production in deserts.
- It is possible to grow ranch and use range land in dry areas by the use of floods and also optimize more and accurate utilization of range lands.

The choice of a method for collecting rainwater depends on conditions of the region under study. In other words, the method employed in a given region should be appropriate for that region. Common methods for storing water in arid areas may include the followings:

- The use of synthetic materials to cover the soil surface: In order to prevent water permeation into the ground and to collect more water, it is possible to cover the ground surface with synthetic materials such as thin metal and plastic foils. These materials are employed in different ways (Hagh Nia, 1991).
- The addition or spraying (non-permeable) chemicals into the soil: One of the best methods for collecting rainwater is to spray or add chemicals to the soil. These chemicals may include sodium salts, bitumen, wax, and solid paraffin.
- The storage of runoff behind short dams: In order to prevent wasting water coming from temporary and seasonal rainfall, it is possible to construct small dams. These dams whose height reaches usually up to twenty five meters are able to provide a significant amount of water to be used for drinking, agriculture, and so on.
- Water storage in cisterns:
- Direct use of rainwater or runoff: Water flowing in the watersheds through rainfall can be collected and used. Followings are among some of the methods used for such a purpose:

– Curved dikes: In Nigeria, soil stacks are constructed in the form a semicircle on level lines inside which a small hole is dug. They are used in various sizes to renew pastures or to produce hay.

– Trapezoidal dikes: The trapezoidal dikes are traditionally used in East Sudan, Somalia, and Kenya in areas of more than one acre to collect a large amount of runoff. Simple design and lower cost of maintenance of these dikes are among the main advantages of this method.

– Water spreading: In arid areas, rain usually falls intensely and for short periods of time and, as a result, the rain water runs quickly into drainage holes toward the desert and becomes out of reach. Water spreading can significantly be influential in reinforce vegetation and enhance its efficiency (Hagh Nia, 1991).

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Methods to combat wind erosion in Jiroft, Iran

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Abstract

Wind erosion is of the most important processes of desertification in Jiroft, Iran which is to be controlled by means of mechanical and biological methods, including creating windbreaks. The present study aimed to select suitable type of windbreak for Jiroft. In this study, changes in wind speed around two types of windbreaks (mud walls and palm), has been studied. Statistical community and number of samples in the study area include two types of windbreaks: Biotic and Abiotic. Method of study is based on field and laboratory studies and literature review. The results showed that the mud wall has more protective role than palm against wind erosion.

Keywords: Wind erosion, Biotic and Abiotic, windbreak, Jiroft, Iran.

Introduction

Wind erosion and it processes in many the worlds arid and semiarid country is considered as desertification important instances (1). Blowing wind caused abrasion part of fertile soil particles, this fertile layer of soil, food sources is for plants and with erosion this part that is initial and most important part of soil is lands productive power has reduced and food shortages will showed which these factors, ultimately, caused reduce the yield per unit area and decreased soil fertility and caused converting lands to barren and wasteland lands. And in the results decreases the efficiency of lands and it subsequent production of low and for income region people is reduced this is followed by the development of poverty and migration. Since agricultural lands than to garden lands without the perennial species and every year, under the influence of tillage and tillage operations are more susceptible to wind erosion and the fallow period of time to prepare for planting can be affected by wind(6). Reducing wind reduces damage to plant, improves overall plant quality and production, decreases plant water use, improves the outdoor living environment, decreases human and animal health problems due to blowing dust, reduces home energy use, attracts wildlife, provides visual screens, and provides protection for domestic animals among many other things(7). one of the strategies and practices to prevent harmful effects of blowing intense winds, prevent from wind erosion and land degradation, create windbreak is in the around farm. Windbreak is defined as any types of barrier, either mechanical or vegetative, used for protecting the areas like building apartments, orchards or farmstead from blowing winds. Windbreak is installed usually perpendicular to the direction of prevailing wind to limit erosion by reducing wind velocity. A windbreaker when played his role well, which is properly designed and constantly be, kept in optimum condition (6). Windbreaks have long been recognized for protecting soils, crops, and livestock. They influence evaporation, transpiration, wind erosion, snow drifting, and crop yields (8). Wind erosion in some dry and hyper raid lands at 30 ton/ha has been reported .Farmland and fallow lands are not distinctive of this phenomenon in the Jiroft. The blowing cold winds of winter, a frostbite agricultural product has followed. In order to, blowing wind, increased evapotranspiration and crop water needs to be followed and cause reduces the yield per unit area and reduces the fertility of agricultural lands. Appropriate mechanisms to prevent wind damage, is create windbreak. Each windbreak with determinate height and density is capable reduce wind velocity for distance and thenceforward wind velocity is reached to initial situation, so are used of successive and numerous windbreaks for protect from a farm (field), which wind velocity is not capable to soil erosion. Since the spacing rows are an important role in the operations enforcement and costs, design and calculate the spacing rows so that can be prevented from wind erosion (cause reduction maximum wind velocities to threshold velocity) and other face important is the economic and low cost (3). Numerous studies have been conducted about windbreak, such as Nakhjavani (1949), in their experiment, the observed that wind protected regions with more velocity has caused the most damage, and this case for windbreaks that with wind direction acute angle have, is more(4). Wodroff & Zing (1953), Suggests windbreaks with 3, 5, 7 row will have more impact on reducing wind erosion, The tallest trees were planted in rows, second, fourth and fifth, respectively(9). Negli (1970), showed that wind velocity reducing rate in windbreaks with different properties (density, semi- density, low-density), but with the same height, at distance of 4 times the height of windbreak, minimum and about 21 percent is. And also with surveys and experiments have done the design table where in it regarding to windbreak height and density, percentage of maximum wind velocity reducing in the determination intervals was delineated(5). Benzhaf & et al (1992), at survey the effects 4 types of windbreak on wind erosion, evaporation potential and water impoundment to this result was reached which established windbreak the evaporation potential rate of 15 percent and particles abrasion about 50 percent reduces in the low points (2).

The research hypothesizes are as following

1- Windbreaks have more influence in wind velocity reducing in the Jiroft region.
2- Wind velocity reducer effect varies in different windbreaks around.
3- The quantitative relations changes of wind velocity will vary with each other in the different windbreaks around.
4- With measuring the changes of wind velocity, the requirement coefficients obtained for windbreaks design in the region.

The objectives of this research are as following

1- Access to the most appropriate living and non living windbreaks spacing design in Jiroft region.
2- Access to the most appropriate windbreaks spacing rows regarding to its type in Jiroft region.
3- Determine the most appropriate type of windbreak, regarding to influence different windbreaks in reduction of wind velocity, required costs, climatic and ecological conditions in Jiroft.

Study Area

Jiroft city is located in South-East Iran, Kerman province. The geographic location of the study area is 57 48 east longitude and 28 39 north latitude .Average height above sea level is about 601 m. Average temperature of Jiroft region is about 25 ° C, in summers the temperature exceeds 50 ºc and relative humidity has 60%.The climate has been except arid and semi arid region and annual average precipitation is about 150 mm. Soil texture in most parts of the region, is silt clay.

Materials and Methods

Materials and equipment needed in this research are:
13 Digital Anemometers, Global Position System (GPS), Digital Camera, Meter, Wind Tunnel, Shaker

Statistical Society and the number of samples

There are two types windbreaks live and non-living in the study area.
Windbreaks existent in this region are including living windbreak (tamarix aphyll) and non- living windbreak (Mud wall). In any windbreak case, 3 samples with different densities and heights and distances 1 and 20 times the effective height of the windbreak, windbreak front and 1, 2, 3, 4, 6, 8, 10, 11, 12, 16, 18 times the effective height of the windbreak in the windbreak back and at any distance in the four height 0.5,1,2 and 3 meters of the ground surface was measured wind velocity.

Determination soil granolometry

For estimate the wind erosion threshold velocity, identification soil texture of the study region has special importance. Since the surveys areas is under cultivation and farming , the first, amount of 500 gr of the soil surface (0-20 cm depth), depth of plowing the fields, city Jiroft was taken and the soil was transferred to the laboratory. After preparing the samples on the sieve 6 series sorted and was thrown based on ASTM classification and after 15 minutes was weighed soil remaining on each sieve and the data obtained in the granolometry table were record. In order to survey the granolometry index (Granolometry) was used GRgraph software.

Determination wind erosion threshold velocity

In agricultural lands the study area, surface soil is generally plowing. To determine the wind erosion threshold velocity, first value of 7 kg of surface soil (0-20 cm depth), deep plowing from study area was taken and was transferred to the laboratory and in the laboratory on special trays thrown and then trays poured into the wind tunnel and with turn on tunnel and view soil erosion by glass through body of the wind tunnel, samples threshold velocity measured, and then examined soil samples threshold velocity in the height of 10 meters was determined.

Measurement factors related to non-living windbreak (mud wall)

First, location of the study area was determined by Global Position System (GPS) and height windbreak was measured by index and windbreak density was determined using the theoretical estimates method, windbreak specifications is as follows.

Table1: Specifications non- living windbreak (Mud wall)

Region Temperature	Record Time	Record Season	Wind Direction	Effective heigh of the Mud wall	Percent and Rate Density	Type of windbreak
30 °c	15:30 Afternoon	Spring	South to North	1.8 m	Density , 100%	Mud wall

By 14 digital anemometer and in 14 points in the specific intervals from windbreak simultaneously at distance 20 times the height of windbreak (free space), and 1 times the height, windbreak front and 1,2,3,4,5,6,8,10,12,14,16,18 times the height, windbreak back and in the heights of 0.5,1,2 and 3 meters from ground surface was measured and data obtained were analyzed using EXCEL software.

Field Surveys and measurements factors related to tamarix aphylla

First, location of the study area was determined by Global Position System (GPS) and height windbreak was measured by index and windbreak density was determined using the theoretical estimates method by 3 experts, windbreak Specifications is as follows.

Table2: Specifications living windbreak (tamarix aphylla)

Region Temperature	Record Time	Record Season	Wind Direction	Effective height of the tamarix aphyll	Percent and Rate Density	Type of Windbreak
43 °c	15:30 Afternoon	Summer	West to east	5.7m	Non Density, 45%	tamarix aphyll

According to tests conducted on soil texture, generally, the region soil consists of sand 80.48%, Limon5.53%, pebbles2.92%, and clay10.97%, is. That with referral to graphs related to, erosion threshold velocity about 4 – 4.5 m/s is. After threshold velocity was calculated, windbreak design can be done with have prevailing wind velocity. Maximum percentages of particles are between 125 - 250 micron and these particles are most sensitive to wind erosion.

Determination Maximum Prevailing Wind Velocity in the region

According data 10 years Jiroft synoptic meteorological stations (1999 to 2008), maximum prevailing wind velocity of 54 km/h was and prevailing wind direction is from the South West to North East.

Results and Discussion

Result changes wind velocity around the non- living windbreak (Mud Wall)

In height, 0.5 m from the ground surface at distance of 1 and 5 times the height of the windbreak, windbreak back, had the most reduction in wind velocity. Maximum reduction wind velocity is in height 1 m from the ground surface at distance of 2 times the height of the windbreak, in the windbreak back, and wind velocity at distance 17 times the height of the windbreak is reached to initial velocity. Maximum reduction wind velocity is in height, 2 m from the ground surface at distance of 1 and 3 times the height of the windbreak, in the windbreak back, and wind velocity at distance of 18 times the height of the windbreak is reached to initial velocity. Maximum reduction wind velocity is in height, 3 m from the ground surface at distance of 2 times the height of the windbreak, in the windbreak back, had the most reduction in wind velocity and wind velocity at a distance 15 times the height of the windbreak, windbreak back is reached to initial velocity.

Generally, In the impermeable windbreak (Mud wall), all the wind flow deflected upward windbreak and there are regional with low velocity wind in the front windbreak, and since no flow does not pass through windbreak, so there is less pressure on the back windbreak. This phenomenon and uneven surface causing is the turbulent flow in the back windbreak which has led to reduction region length with low velocity wind. Non living windbreak such as (Mud Wall) allows not pass to wind.

Table3: Data wind velocity obtained from measurement wind velocity around Mud wall

height (m)	20h windbreak front	1h windbreak front	1h windbreak back	2h	3h	4h	5h	6h	8h	10h	12h	14h	16h	18h
0.5	9.8	3.77	0.96	2.75	2.25	2.18	0.83	1.18	2	3	4	6	7.8	10
1	9.2	4.5	1.26	0.8	1.7	3.58	5.7	1.41	7.1	4.6	5.4	6.9	8	11
2	11	8	2	7	2	6	5.9	3.2	4.3	5.2	5.4	5.8	8.2	11
3	9	5.3	5.33	3	4.45	4.77	6.3	4.9	5.7	6.9	8	8.2	9.5	12

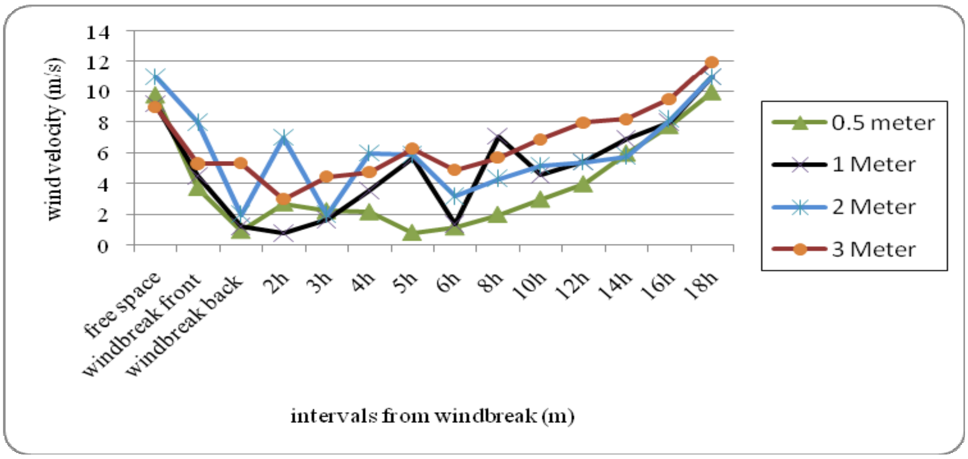

Fig1: Chart changes wind velocity around the non-living windbreak (Mud wall)

Table 4. Wind velocity around the non-living windbreak (Mud wall) of height 1 meter to height 10 meters from ground percent surface

18h	16h	14h	12h	10h	8h	6h	5h	4h	3h	2h	1h windbreak back	1h windbreak front	20h windbreak front
112.86	86.98	75	58.99	49.96	77.2	15.27	61.9	38.9	18.43	8.65	13.7	48.9	100

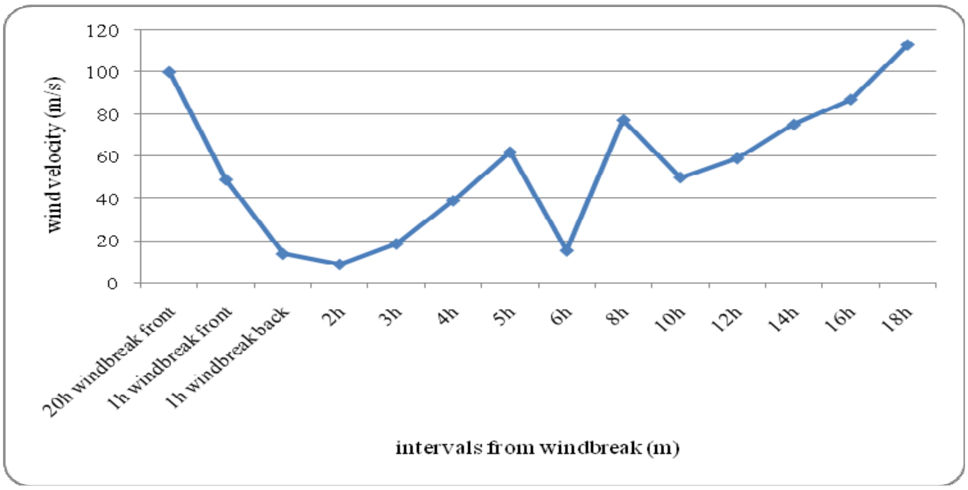

Fig 2: Chart percent changes wind velocity around the non windbreak (Mud wall) in height 10 meter

Result changes wind velocity in the around living windbreak (tamarix aphylla)

In height, 0.5 m from the ground surface at distance of 1 and 2 times the height of the windbreak, windbreak back (tamarix aphylla), had the most reduction in wind velocity and wind velocity at height of 3 meters from the ground surface at distance 12 times the height of the windbreak, windbreak back is reached to initial velocity that this has contradiction with the statements Negli.

In height, 1 m from the ground surface at distance of 1 times the height of the windbreak, windbreak back (tamarix aphylla), had the most reduction in wind velocity and wind velocity at height of 1 meters from the ground surface at distance 13 times the height of the windbreak, windbreak back is reached to initial velocity that this has contradiction with the statements Negli.

In height, 2 m from the ground surface at distance of 1 times the height of the windbreak, windbreak back (tamarix aphylla), had the most reduction in wind velocity and wind velocity at height of 1 meters from the ground surface at distance 15 times the height of the windbreak, windbreak back is reached to initial velocity that this has contradiction with the statements Negli.

In height, 3 m from the ground surface at distance of 1 times the height of the windbreak, windbreak back (tamarix aphylla), had the most reduction in wind velocity and wind velocity at height of 1 meters from the ground surface at distance 15 times the height of the windbreak, windbreak back is reached to initial velocity that this has contradiction with the statements Negli.

Table5: Data wind velocity obtained from measurement wind velocity around tamarix aphylla

Height of ground surface	20H	1h windbreak front	1h windbreak back	2h	4h	6h	8h	10h	12h	14h	16h
0.5	11	9.4	5.3	5.4	7.5	7.8	10	10.4	11	12	13
1	11.6	9	4.76	5	8.37	9.2	10	10.3	11	11.7	12
2	12.1	10.6	4.47	6.9	8.31	10.5	10.7	11	11.2	12	12.3
3	14.6	11.8	7.2	8.3	9	9.8	12	14	14.1	14.4	14.7

شکل

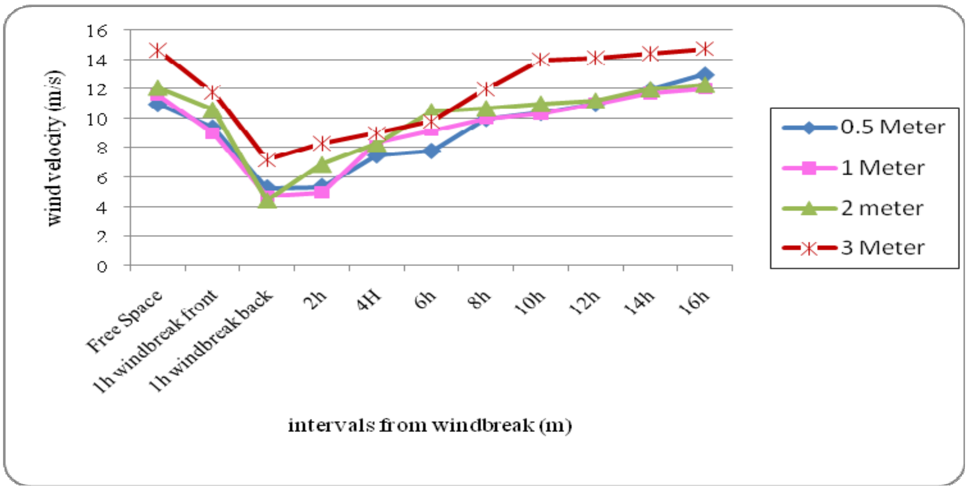

Fig3: Chart changes Wind velocity around the living windbreak (tamarix aphylla)

Table6: Percent Wind velocity around the living windbreak (tamarix aphyll) of height 1 m to height 10 m from ground surface

16h	14h	12h	10h	8h	6h	4h	2h	1h windbreak	1h windbreak	20h windbreak
108.24	100	94.39	90.93	84.32	76.4	73.63	43.42	37.75	77.28	100

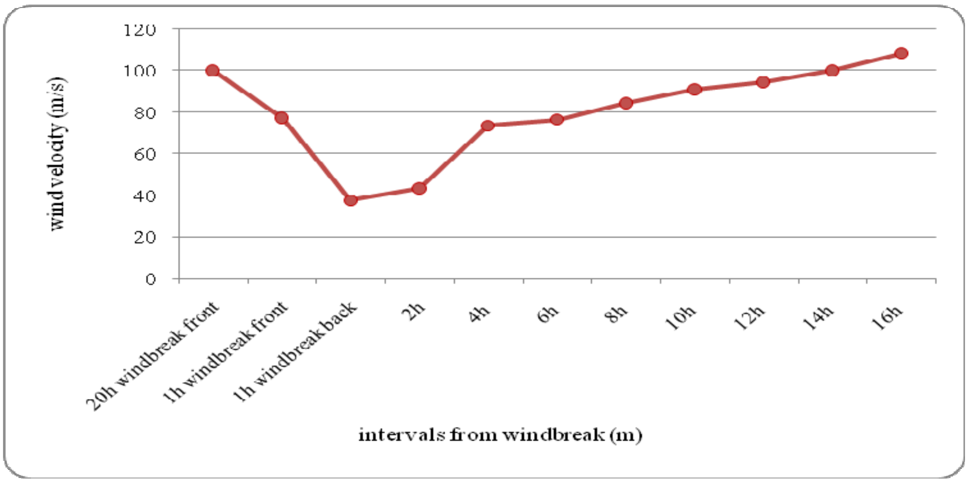

Fig 4: Chart percent changes wind velocity around the living windbreak (tamarix aphyll) in height 10 meter

Conclusion

Generally, most reduction in wind velocity had in the back Mud wall. In the impermeable windbreak (Mud wall), all the wind flow deflected upward windbreak and there are regional with low velocity wind in the front windbreak, and since no flow does not pass through windbreak, so there is less pressure in the back windbreak. This phenomenon and uneven surface causing is the turbulent flow in the back windbreak which has led to reduction region length with low velocity wind. So windbreak density is not always a positive factor and when the wind is deflected from top to down windbreak, reduction pressure on the lower part windbreak, caused be wind reflux and this wind acts as effective and creates be range with low- velocity wind. This wind can also affect the conservation area. Wind velocity at the end windbreak caused soil damage or severe injury to plants, which in this case is suggested the in two ends of windbreak, vertical windbreak be installed for reached to be minimize damage. Changes trend of wind velocity in front and back Mud wall and in around tamarix aphylla is irregular and regular, respectively. Wind velocity have very turbulence in the front and back Mud wall and fluctuations wind velocity are around the non living windbreak furthest living windbreak. The most appropriate distance windbreak bands for tamarix aphylla tree species with density 45%, about 3 to 4 times useful height windbreak and for mud wall with a density of 100%, about 8-7 times the useful height windbreak was obtained. So better is from mud wall to be used as a windbreak, although the primary cost of constructing mud walls is further than other windbreaks. But the ecological requirements have less and negative effects tree species such as centralization birds and insects also pesticide are not following out. Better are being used tamarix aphylla in areas that adequate water resources are available.

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Climatic Controls of Dust Emissions in Western Iran: An Examination based on Dust Storm Frequency from 1975 to 2005

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Abstract
Dust storms are natural events that occur mainly in arid and semi-arid regions of the world. Understanding of dust storms variability and associated dominant climatic controls is limited. In this study, we investigate the spatiotemporal distribution of dust storm frequency (DSF) and its relation to climatic indices (precipitation, wind speed, visibility and land cover) using data from 27 meteorological stations in Kermanshah, Ilam, Khoozestan and Khorramabad province throughout western Iran during the past 30 years. Geostatistics and geographic information system (GIS) were applied to estimate the spatial variability of DSF and the climatic indices. The results indicated that the precipitation and vegetation cover was significantly negatively correlated to the DSF. Additionally, we found closer correlation between wind speed changes and DSF especially in the south and southwest of Khoozestan region during last three decades. The highest and lowest mean annual DSF (102 days year $^{-1}$, 8 days year $^{-1}$) were occurred in Ahvaz district (in Khoozestan province) and Lorestan district (in Khorramabad province), respectively. The results suggest that these regions have a little effect on dust storms events because they are not key source of dust and most of the dust storms originated in Iraq.
Keywords: Climatic controls, Dust storm frequency, Kriging, Spatiotemporal variability, Western Iran.

Introduction

Dust storms are a meteorological phenomenon common in arid and semi-arid regions. The vast distribution of dry lands, long summer drought periods, scarcity of vegetation cover and strong winds prepare conditions favorable to dust storms in many parts of the world. Climate is generally regarded as an important factor affecting the occurrence of dust storms. Littmann (1991) examined the relationship of the Asian DSF with precipitation, temperature, wind speed, and other climatic parameters and found generally negative correlations to rainfall and positive correlations to wind.
The frequency and intensity of dust storms in western Iran have greatly increased during the last decades. The objective of this study was to investigate the spatiotemporal and variability and seasonal and annual patterns of dust storms in western Iran over 30 years. In this paper, we combine data on dust storm frequency (DSF), wind energy variations, geomorphic differences and land use over the past decades in western Iran, carry out a detailed analysis of dust storm occurrence, and attempt to determine the dust storm sources in western Iran.

Materials and Methods

Meteorological data (as monthly and annual values) obtained from 27 meteorological stations located throughout western Iran (Fig. 1), including precipitation, wind speed, dust storm frequency and visibility (DSF) from 1975 to 2005. We estimated energy of wind by Fryberger and Dean's (1979) method (drift potential) (DF) which is expressed as follows:

$$DF \propto V^2 (V - V_t) t$$

Where DF is drift potential, V is the wind speed exceeding a threshold at the measuring height, Vt is the threshold wind speed at the measuring height (12-12m, 6.0 m s^{-1}), and t is the time for which the wind below (expressed as a percentage of the measurement duration). The spatial variability analysis of the meteorological parameters performed using Kriging interpolation method by ArcGIS 9.3 software.

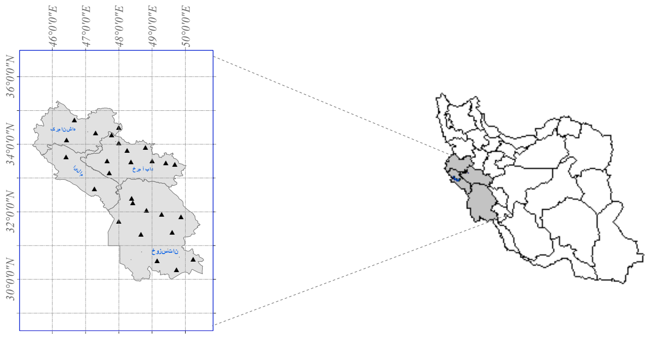

Figure 1. The location of meteorological stations (black triangles) used as sources of data in the present study. Kermanshah, Khoramabad, Ilam and Khoozestan Provinces, western Iran.

Results and Discussion

Temporal trends for DSF

Figure 2 shows the annual pattern of dust storm frequency within four key locations in western Iran form 1975 to 2005. Figure 3 compares the monthly pattern of dust storm frequency within four key locations in western Iran. There are few dust storms occurrence during months January to March and September to December in the areas. The highest dust storm frequency observed during April to August months.

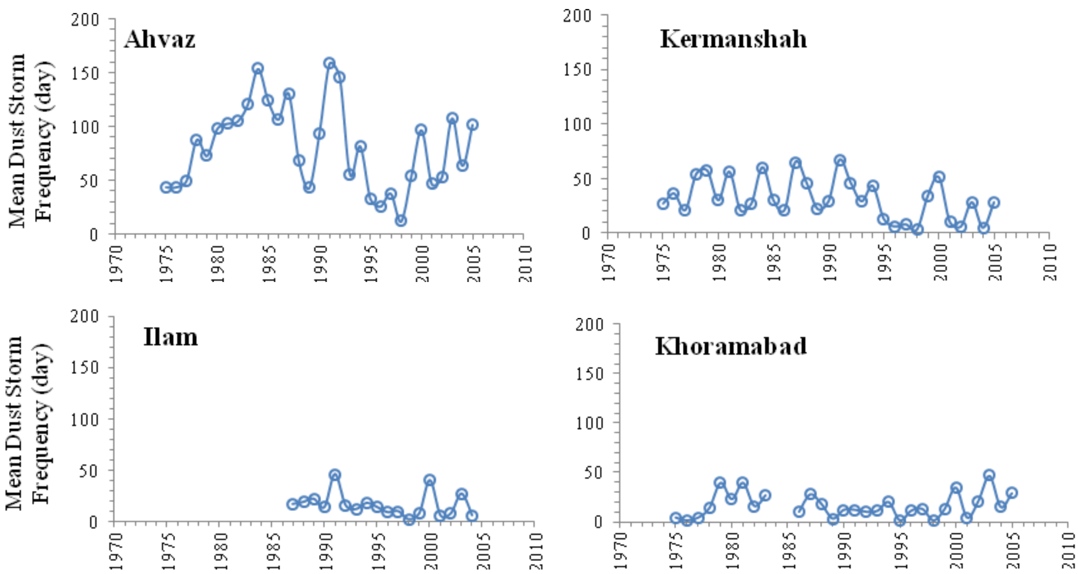

Figure 2. Temporal trends (as annual) in dust storm frequency at four key meteorological stations in western Iran from 1975 to 2005.

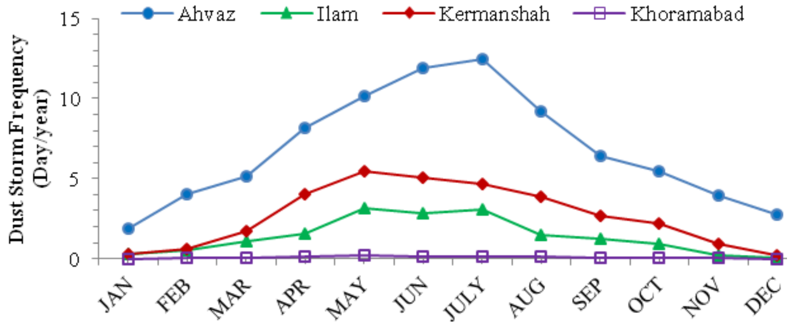

Figure 3. Temporal trends (as monthly) in dust storm frequency at four key meteorological stations in western Iran from 1975 to 2005.

The highest DSF did not always appear in areas with high DF values in western Iran, which shows that wind regimes is not the major factor that controls dust emissions in this region. The overlap between DSF and DF show that although DSF was not very closely correlated with DF in most regions, the temporal trends for both parameters were consistent throughout western Iran (Fig. 4). From 1975 to 2003, there have been no significant changes in precipitation and land form typein the study ares, thus to some extent, DSF have been controlled by variations in the regional wind energy environment.

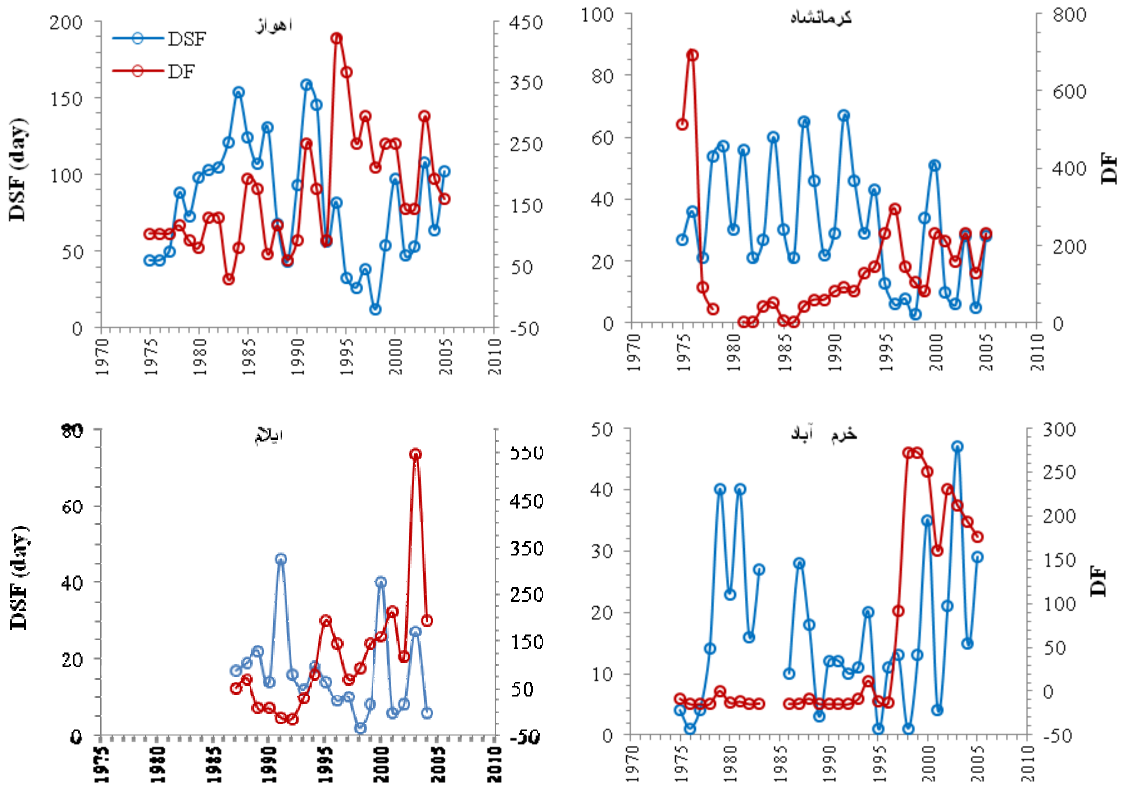

Figure 4 . Temporal trends in dust storm frequency (DSF) and drift potential (DF) (Vector Unit) at some key meteorological stations in western Iran from 1975 to 2005. The locations of stations are identified in Fig. 1.

Spatial trends for DSF

The regions with the highest DSF values were located at the southern and southwest of the study area (Fig.5). The highest DSF in these regions obtained 102, 82 and 63 day of year in Dezful, Ahvaz and Safiabad districts, respectively.

The mean DSF in western Iran was 30.7 day over year, which suggests that these areas were the major affected areas to dust storm emission from western Iran.

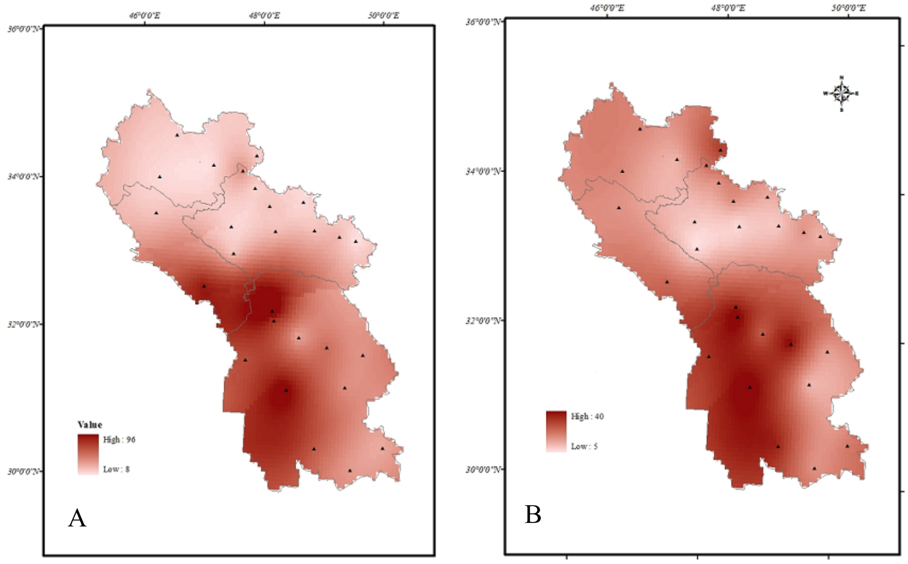

Figure 5 . DSF distributions (days/year) (A) and visibility (< 2 Km) (days/year) (B) from 1975 to 2005 in western Iran. The interpolations were obtained from data recorded at the meteorological stations in Fig. 1 using a Kriging method.

Figure 6 shows land use map in western Iran in 2002. As it shown, much of area is covered with vegetation. So, given the negative correlation between vegetation cover and dust storm occurrence, it may be say that the main sources for dust storm occurrence in these areas is located abroad of Iran.

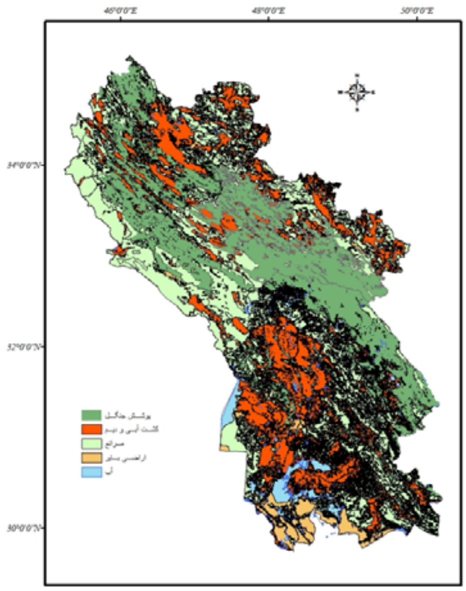

Figure 6. Land cover pattern in 2002 in the arid and semi-arid areas of western Iran.

Figure 7 shows spatial distribution of precipitation and wind speed in western Iran during 1975 to 2005. The relationship between wind speed and dust storm occurrence is documented since wind is the driving force for dust and transport (Liu *et al*., 2004). Results of our analysis shown that there are no specified correlation between these parameters (Figs. 5A and 7B). This opposite result can be due to that the main source of dust storms in these areas is located in countries in west and southwest Iran. There are visually strong negative correlation between DSF and precipitation (Figs. 5A and 7A). Dust storm occurs when the wind speed is sufficient to overcome the cohesive forces that exist between soil particles. It is facilitated by low soil moisture levels related to deficient precipitation that reduces the cohesion of soil and affects vegetation cover, which, in turn, allows greater wind speeds at the ground level. It should be pointed out that antecedent precipitation is only one of several major factors influencing the spring DSF. To comprehensively understand the spatial and temporal variations of dust storm occurrence, many other influential factors, such as surface winds related to cold surges, vegetation and topography, physical characteristics of soil, and human activities, will have to be taken into account.

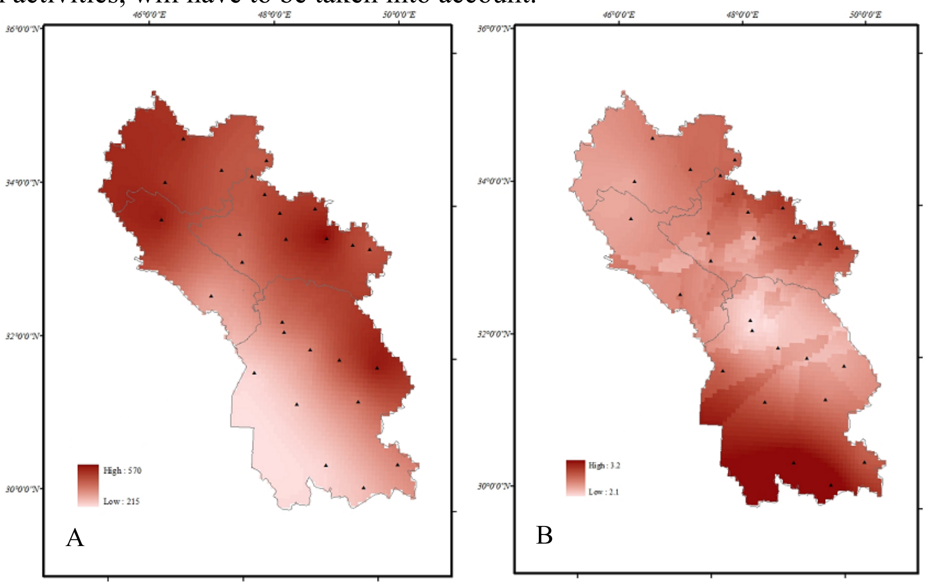

Figure 7 . Average annual precipitation (mm) (A) and average annual wind speed (m s^{-1}) (B) from 1975 to 2005 in western Iran. The interpolations were obtained from data recorded at the meteorological stations in Fig. 1 using a Kriging method.

Conclusion

The highest amount of dust emission occurred in regions with low annual precipitation. The mean annual DSF from 1975 to 2005 did not exceed 30.7 days/year in western Iran. The highest and lowest mean annual DSF were occurred in Ahvaz district (in Khoozestan province) and Lorestan district (in Khorramabad province), respectively. The results suggest that these regions have a little effect on dust storms events because they are not key source of dust and most of the dust storms originated in Iraq.

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Effect of Adding Different Sizes and Levels of Gypsum Stone in Some Physical Soil Properties and In the Crop of Sunflower

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Abstract
Two field experiments were conducted to study the effect of adding different sizes and levels of gypsum fractions as an amendment on the heavy soil properties, and yield of sunflower. The two experiments included three sizes of gypsum stone, namely < 2, 8 – 10 and 20 – 25 mm, and three levels of addition, namely 5, 10 and 15 %. Factorial experiment with three repetitions was used in completely randomized block design(RCBD). The results showed that the studied properties of the gypsum addition of level 15% and less than 2 mm size were more superior in comparison with other levels and sizes. That is to say the construction of the surface soil crust thickness reduced from 6.00 mm to 2.50 mm and the bulk density decreased from 1.58 Mg.m-3 to 1.42 Mg.m-3, and finally improved the hydraulic properties of the soil and improved sunflower crop.
Key wards: gypsum fractions, amendment, surface soil crust, sunflower.

Introduction

Most agricultural soils, especially in arid and semi-arid reign suffered to some physical and chemical problems, and to overcome these problems or to minimize its negative effects on soil and agricultural production. Many amendments used to improve soil properties including plant, animal waste and natural stones. Materials that can be added to the soil is gypsum $CaSO_4.2H_2O$ which uses of wide range to improve physical and chemical soil properties, especially in the heavy soil (Abbas 2008), Gypsum can plays an important role in improving soil structure, prevent clay dispersion , surface sealing and facilitate the seedling emergence (shainberg et.al, 1989). Richard (2005) noted that gypsum reduces soil bulk density, increase its ability to retain water, and prevent crust formation. Norton and Rhoton (2007) noted that the gypsum construction waste contains the same amount of calcium and sulfur as it contains agricultural gypsum. gypsum also reduces the negative impact of the sodium ions in the soil and irrigation water, and reduce soil erosion (Morin and Winkel 1996, Brent 2008). Zublena et,al. (1995) found that the addition of gypsum at 560-2242 kg/ha on the surface after planting to prevent soil dispersion and clogging pores thus increase the water infiltration and increase the seedling emergence because most gypsum additive dissolves and penetrates the soil after several rainstorms also found that the largest gypsum fraction from 2.9 cm and mixed with the soil is less effective than the fraction larger than 2.9 cm prevent the crust formation. Celetti et.al, (2007) and Uusitulo et.al, (2010) referred to the gypsum added an average of 4 tons/ha every 3-4 years enhances the soil aggregate stability, reduce runoff and soil erosion.
The study aims to estimate the importance of adding gypsum to improve heavy soil characteristics and productivity of sunflower crop as one of economic crops.

Materials and methods

The physical and chemical properties of the soil (0-15 cm) Used in this experiment are as shown in table (1).

Table 1. Some physical and chemical properties of soil studied

Soil Particle $g.kg^{-1}$			Texture	Bulk Density $Mg.m^{-3}$	pH	EC $ds.m^{-1}$	O.M	$CaCO_3$
							$g.kg^{-1}$	
clay	silt	sand						
503.2	430.3	66.5	Silty clay	1.32	7.95	1.25	17.60	340

Took different separate diameters of gypsum fraction namely; <2 , 80-10 and 20-25 mm as stated in the Soil survey Handbook (1974), used three levels 5, 10 and 15%, Mixed soil with separate gypsum by three levels for each size and placed in plastic pots (5 kg). Designed experiment as complete randomized block design (RCBD). The experiment Became: (3 sizes × 3 levels × 3 replicates) + 3 without addition = 30 pots. (Fig 1).

Figure 1. Layout of the experiment design

The two experiment left under natural conditions and supplemental irrigation to keep the soil at field capacity. At the end of the experiment estimated the thickness of surface soil crust and bulk density of soil and crust, also estimated the proportion of saturated moisture, the moisture content at field capacity, electrical conductivity of soil and the degree of interaction for all levels of gypsum.

In the second experiment Prepare the same soil and previous treatments, after wetting the soil in pots planted ten seeds of sunflower on 1 March 2011 and left under natural conditions and supplemental irrigation when signs of wilt on the plants, while taking notes daily to see the signs of wilt in each treatment and estimated percentage of germination then reduced the number of plants to three in each pot, On June 5, 2011 measured the high of plants , Qatar flower and leaf area of the law mentioned by Elsuhoonie and Eldabas (1982) Leaf Area = $0.65\ \Sigma L^2$.

Result and Discussion

1 - Effect of gypsum in the soil physical characteristics

A - Soil bulk density : table (2)shows increase in bulk density of the soil with increased rates of the gypsum fraction levels (less than 2 mm) as the highest density of soil has1.38 *Mg*. m^{-3} at the level of addition 15% (less than 2 mm), while decreased with increased rates addition of largest size. The reason of increase the soil bulk density when added very fine fraction of gypsum that clogged pores of the soil and thus increase the bulk density of the soil This is consistent with what Abbas (2008) found.

Table 2. Soil physical characteristics

Gypsum Fractions mm	Addition levels %	Soil bulk density	Crust bulk density	Crust thickness mm
		Mg.m^{-3}		
<2	5	1.36 c	1.52 c	5.67 b
	10	1.36 c	1.46 d	4.17 bcd
	15	1.38 ab	1.43 e	2.50 d
8 - 10	5	1.36 c	1.54 b	5.17 b
	10	1.36 c	1.47 d	4.00 bcd
	15	1.35 d	1.46 d	3.17 cd
20 – 25	5	1.36 d	1.52 c	5.67 b
	10	1.36 d	1.51 c	5.00 b
	15	1.39 a	1.51 c	4.67 c
control	0	1.39 a	1.58 a	6.00 a

B - Crust bulk density : table (2) shows decrease in crust bulk density with increased levels of gypsum addition, the less density of the crust was 1.42 *Mg*. m^{-3} at the level of adding 15% of the size less than <2 mm, Also notes significant differences in bulk density of the crust between the levels of addition while the largest value of 1.54 *Mg*. m^{-3} at the level of addition of 5% (80-10 mm), This indicates that the addition of gypsum improved soil structure , aggregate stability and thus reduced the crust formation and this is consistent with what the Zublena et, al. (1995)found.
C - Crust thickness : table (2) shows decrease in crust thickness with increased levels of gypsum addition, the less thickness of the crust was 2.50 mm at a level of adding 15% for size less than 2 mm, Also notes significant differences in the crust thickness between the levels of addition while the largest value of 5.67, 5.67, 5.67, 6.00 mm, respectively, at levels of 5% (less than 2 mm), 5 and 15% (20-25 mm) and the level without addition respectively, and this is consistent with what the Zublena et,al. (1995)and Brent (2008) found.
D- Electric Conductivity : table (3) shows high values of electric conductivity EC with increasing levels of gypsum adding, due to the influence of decomposition of gypsum in the soil solution, which increased the soil salinity this is consistent with what Uusitalo et.al, (2010) found

Table 3. Some soil properties in the end of the experiment

Gypsum Fractions mm	Addition Levels %	EC $ds.m^{-1}$	(F.C.) %	WHC %
<2	5	2.58	38.50 b	42.29 b c
	10	2.73	39.50 a b	42.52 b c
	15	2.85	40.52 a	44.20 a
8 - 10	5	1.55	38.50 b	40.26 c
	10	2.00	39.00 b	41.60 c
	15	2.58	41.00 a	43.50 a b
20 – 25	5	1.58	38.45 b	42.50 b c
	10	2.07	39.00 b	42.80 b c
	15	2.10	39.50 a b	43.00 b
control	0	1.48	37.00 c	41.00 c

E – Hydraulics Constant : table (3) shows increase the percentage of water saturation and the moisture percentage at field capacity with increasing levels of addition of two sizes 2 mm and 80-10 mm, the highest percentage has 36.52 and 44.20% at the level of addition 15% (less than 2 mm) and 36.00 and 43.50% at the level of addition of 15% (80-10 mm), respectively, the reason for this is to increase the viability of gypsum to reduce the dispersion of soil and improve the soil structure and this is consistent with what Morin and Winkel (1996) found.

2-The gypsum effect on some sunflower properties
A– Rate of Germination response and the symptom of Welting signs: table (4) shows percentage germination ranged between 85-95% for all added gypsum. The average wilting point ranged between 11-18 days and the longest period showing the wilting point was 17.2 - 17.5 days showed at 15% of size <2 mm and 80-10 mm respectively.

B - height of Plant : table (4) shows that the adding of gypsum on the average of plants height significant differences, the <2 mm of 15% give the highest plant which is 48.66cm were as the average high without of gypsum is 38.66 cm, this indicate that the adding gypsum improve the conditions of germination which increased the height of plant, and that what Jayawardne et,al. (1985) found.

Table 4. Effect of gypsum additions on sunflower properties

Gypsum Fractions mm	Addition Levels %	Germination %	signs of wilt day	Plant height cm	Leaf area cm^2	Qatar flower cm
<2	5	85	9 b	41.50 b c	6.15 a	3.50 a b
	10	85	9 b	44.50 a b	6.78 a	3.83 a b
	15	90	11 a	48.66 a	8.02 a	4.33 a
8 - 10	5	90	9 b	42.50 b c	5.07 a	3.50 a b
	10	95	10 a b	43.30 b c	6.32 a	3.26 b c
	15	90	10 a b	44.33 a b	7.38 a	3.66 a b
20 – 25	5	90	8 b c	41.16 b c	5.75 a	2.50 c d
	10	95	8 b c	39.66 c	6.10 a	2.00 d
	15	90	9 b	40.50 b c	5.58 a	2.50 c d
control	0	90	8 b c	38.66 d	5.27 a	2.00 c d

C - Leaf area : table (4) showed addition 15% of gypsum (less than 2 mm) gives largest area of laves which is 8.02 cm^2, although all the results show no significant differences in leaf area for all levels of adding gypsum.

D – Flower qatar: table (4) shows that of adding15% of gypsum(less than 2 mm) gives larger diameter 4.33 cm larger than of adding 15%of size 8-10 mm, that may be due to improving the conditions of germination by adding largest size of gypsum.

Conclusion

1 - Gypsum is natural conditioners from cheap and could be added to heavy soils to improve the negative characteristics.

2 - Add gypsum fraction to the soil level of 15% for small diameters less than 2 mm reduce the crust formation experienced by most of the soils that affect seedling emergence and plant growth.

3- Gypsum works to improve the properties of the soil to increase water conservation of soil moisture, especially in the areas of agriculture rainfed.

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Estimation of gully erosion volume and effective factors on gully development (Case study: Qarahtykan gully region in Sanganeh of Razavi Khorasan– south east of Iran)

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Abstract
There are many pollutant factors in environment that have produced many chalenges. Among these factors, soil erosion could be referred that with detachment and movement of soil particles and sedimentation in reservoirs and air causes water pollution and endanger environment and health.
Gully erosion is one of the most destructive types of water erosion especially, that causes huge destruction. Thus understanding factors affecting on Sediment production by gully plays an important role in prevention of environmental pollution. This research was carried out in the Qarahtykan region in the Sanganeh of Khorasan –e- Razavi in Iran. The volume of gully erosion measured by differential method. soil parameters (saturation percentage, salinity, acidity,organic matter, potassium, sodium, magnesium, calcium, sand, silt and clay) and characteristics of the watershed located at upstream of 30 gully headcuts were measured to determine effective factors on gullies development. The results revealed that in this region with the average gully volume equal to 385 /66 cubic meters($m^{3)}$, factors such as EC, potassium,peresent of sand and silt of soil and watershed area above the gully heads had the most influence on sediment production and subsequent contamination of lakes and rivers water.
Keywords: volume of gully erosion; effective factors; air and water pollution; Garahtykan; Razavi Khorasan; Iran.

Introduction
The factor which creates and moves water is water erosion. It is a common kind of soil erosion. It is 55.6% in the world and it is introduction as a common kind of soil destruction (Ahmadi, 1378). Each year about 26 billion tons of soil erosion in the world disappears. soil erosion rate was estimated about 2 billion tons of annual that 7/6% of the world, including soil erosion is In Iran (Soleymanpour from the Mirsanjary, 1386). Among water erosion types, gulling erosion is very important. First , it is performed few researches in this field. Second, erosion production share is 100 times more than splash and surface runoff erosion (soufi , 1382). Gully is an erosion channel whit more than 30 cm depth (soil science association in America, 1984) or Cross-sectional area more than 929 cm^2 (Poesen and et al, 2003) that not be destroyed by tillage (Bradford and Piest, 1978). A lot of factors play important roles in gullies creating and initiation. Heidary (1383) remarks that effective factors in Kerman gullies initiation is the catchment area and the slopes above the gullies escarpment and effects on he surface runoff. Soleyman pour (1386) in a research on 6 regions in Fars concluded that 4 factors of the slope, 24 hours rainfall, sand percentage and coefficient related to catchment formation are the most important factors in sediment production from gullies initiation. Suri and markuich in 2009 surveyed about road, riprap and topography in making temporary gullies in Israeli. The research showed that slope and catchment area above the gullies are the most important factors in making and initiation the gullies.

Material and Methods
Performing this research, Gharahtykan with cold arid climate is chosen as a gulling erosion region in Sanganeh of Razavi Khorasan province, in Iran.
Sanganeh has been 120 km north east of Mashhad and the border of Iran and Turkmenistan. Area of this region is 2000 hectares. The regional climate is cold arid desertification based on domarten method. The average height of above sea level is 690 meters and average annual rainfall and average rainfall of 24 hours is respectively 170 and 23 mm. The land use is pasture (Rangavar,1386). The average gullies volume is 385/66 m3, the average area is 270/79 m2 and the

gullies average length is 58/23 meters. Figure 1 shows the location of the Sanganeh gully region in Iran.

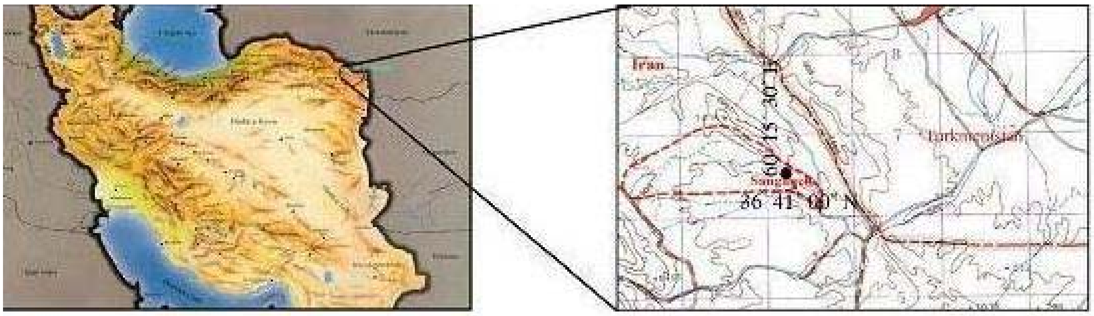

Fig1. General view and location of the Sanganeh study watershed, Iran

In this research tried surveying soil parameters (saturation, salinity, acidity,organism matter, potassium, sodium, magnesium, calcium, percent sand, silt and clay) and watershed characteristics of high Frontal area 30 gullies in Gharahtykan including vegetation, slope, area (Fig 2). We determined 10 meters as an appropriate distance for the determination of the width computation and the measurement in gullies. Each gully dimension computation consists of the depth, width and height. The collection of the few volumes in gully make the gullied erosion volume. We measured the vegetation cover closed grain and the barren soil percentage in catchment which is situated above the escarpment of each gully by accidental arrangement of at least 10 plots which are one square meter at the end of the transects. After study and field measurements of gully volume, drainage area above gullies headcut and outlet, flow length from water divide to gully heads, slope and percentage of coverage on the upstream of headcuts, soil samples of surface horizon at headcut and multiple regression analysis was used to investigate the relationship between volume of gully erosion as the dependent variable and these factors as independent variables.

Fig 2. Study of soil and measurements of vegetation

Results

Conclusion of surveyed gullies show that each gully produced 385.66 m3erosion. Gully development area is 166.51 to 1854.82 m^2, The slope of the gully development is 1 to 5%. The gullies vegetation average is 44.7% which show a medium situated in vegetation. The soil cover of the mentioned region is silt-loam. The average percent of the sand, silt and clay equals to 27.73, 57.04 and 15.21 in sequence. Also the organic matter average is 1.38%. The mentioned gulling region consists of necessary organic matter in order to the resistance is not against water erosion (Table 1).

Table 1. The results were statistically significant variables in Gharahtykan

Ave	Max	Min	Variables
385.66	1009.56	27.67	Sediment (m3)
694.8	1854.82	166.51	Development Area(m2)
2	5	1	Development Slope (%)
26.99	69.47	8.16	flow length from water divide to gully head (m)
44.7	72	10	vegetation (%)
0.45	9	0	gravel (%)
30.1	65	9	bare soil (%)
40.25	47.09	27.56	saturation (%)
4.15	6.72	1.6	salinity (dsm^{-1})
7.09	7.25	6.8	acidity
1.38	3.98	0.07	organism matter (%)
1.01	3.35	0.5	potassium (meq/Lit)
10.02	21.5	1.4	sodium (meq/Lit)
26.68	43.4	10	magnesium (meq/Lit)
6.22	14	2.4	calcium (meq/Lit)
27.73	50.32	11.51	sand (%)
57.04	69.79	37.33	silt (%)
15.21	21	8.7	clay (%)

The survey of the relationship between Gharahtykan. gullies volume and modulated variations shows that there is a relationship between gullies initiation rate whit 5 Variables of salty, potassium rate, sand, silt and development area in 5% level whit coefficient of the determination of 80.4% (table2).

Table 2. The final equation using stepwise regression and the coefficients

Equation	Standardized coefficients					Coefficient	The Significant level
	B_1	B_2	B_3	B_4	B_5		
Y= -2,270.45 + 64.80 EC – 224.33 K + 24.84 sand + 29.034 silt + 0.38 development area	0.4	-0.58	1.1	1.16	0.64	80.4 %	5%

In accordance whit standard coefficient and achieved linear equation it is increased 0.4 to the producing sediment rate in each unit EC, each unit sand (percent sand) 1.1% , each unit silt (percent silt)1.16% and each unit development area 0.64%. It is also decreased 0.58% from producing sediment rate in a unit potassium.

Since the soil characters and catchment area in upstream of initiation of this region, there should be done actions to decrease the producing level of the runoff which is on the surface. Upstream catchment of this region, we can increase the roughness coefficient, soil organic matter and resistance increment through the increment of vegetation cover.

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The Study of Effect of the Slope on the Volume of Gully Erosion: A Case Study: Alamarvdasht Lamerd, Fars Province, South of Iran

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Abstract
The gully erosion is of high priority due to sedimentation and damages as a result of land, routs, and buildings degradation in the Fars Province. In this study, to examine the factors affecting gully sedimentation, Alamarvdasht Lamerd, was selected. In this area, 30 active and representative gullies were selected and the gully morphometric characteristics were measured. Dependent and independent variables were evaluated and statistical analysis were performed using a stepwise procedure in SPSS software. The results showed that the sedimentation rate is related to six variables viz. the upstream and downstream slope of the gully, bared soil, vegetation, magnesium and upstream watershed area. The 1% level with coefficient 52/6 percent assumed as significant. Slope reduction and vegetation around the gully can have a major impact in reducing the gully erosion and sediment production.
Keywords: Gully erosion; Soil; Slope; Alamarvdasht.

Introduction
Gullies make some problems in producing sediments in downstream recent studies performed by (Wasson and et al, 2002 ; Dunnet and et al, 2005;) showed that gulling erosion is often the most important resource for producing sediment and gullies. The sediment function in warragamba zone, the south of newsavat wels, show that the yield sediment in areas which have gullied erosion, is at least twice the non gullied areas by Armstrong and Mackenzie (2002).
(Poesen,2003) remarked that the effects of different factors like the watershed area, slope and vegetation cover in gullies initiation area the priorities related to the gullied erosion. The research result deals whit the strategies to reduce the developments in addition to the identification of the effective factors in initiation gullies and the determination of the sediment amount from the gullied erosion.

Material and Methods
Allamarvdasht is situated in south of the Fars province it's area is 258/82 square kilometers (Fig,1). The studied region has the geology formation related to alluvium in quaternary period. The temperature average is 24/7 centigrade and the rainfall average is 235/68 millimeter per year. It is estimated that the most rainfall amount is 47/3 millimeter per day. The regional climate is arid desertification based on domarten method (counselor engineering, Hasseb Karaji, 1386).

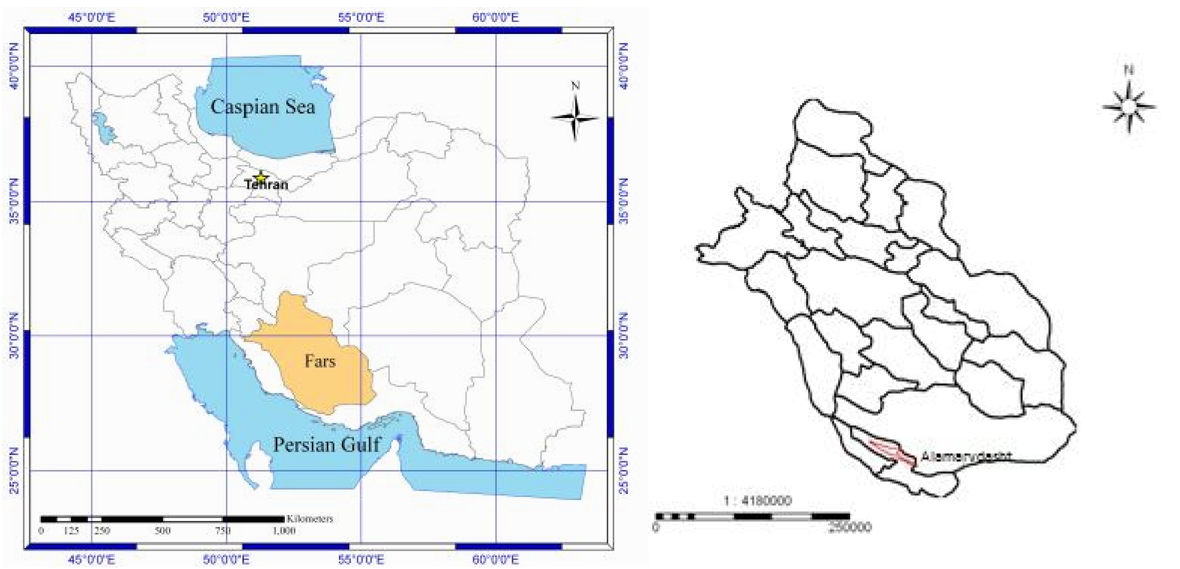

Fig1. Position range studied

Topographic map 1:25000 in 1373 and picture through satellite (IRS) showed the catchment line and the gullied erosion line. considering the gullies we determined 30 gullies in order to measure the gullied erosion volume. According to the researcher performed by Niknam and Soufi (2008), we determined 10 meters as an appropriate distance for the determination of the width computation and the measurement in gullies (Fig,2).

Fig2. Measured along the gully in Fadagh, 1389

Each gully dimension computation consists of the depth, width and height. The collection of the few volumes in gully make the gullied erosion volume. We measured some of the characters related to the catchment area (drainage area) in selected gullies like area and slope which is in gully out let and escarpment upstream in desert. We measured the vegetation cover closed grain and the barren soil percentage in catchment which is situated above the escarpment of each gully by accidental arrangement of at least 10 plots which are 1 square meter at the end of the transects. we measured the clay, silt, sand , electric herding percentage and also the soil organic matter, organic carbon, acidity soil and the catyone available in soil and soil cover in laboratory. Finally we analyzed the relationship between the erosion volume and the relevant factors through step by step method by SPSS soft ware version 13.

Results

The barren above soil percentage average is 94/97 percent above the headcut related to the selected gullies of Allamarvdasht, the vegetation cover percentage is 3/6 and the stone and closed grain percent is 1/43. according to the above mentioned in formation, we can conclude that in this region, the barren soil and some vegetation cover above the headcut in Allamarvdasht make the gullied erosion. It also increases the gulling region area and makes sediment. The produced sediment average in Allamarvdasht selected gullies was 86/87 m^3 in 1389. The soil cover was silt loam. The soil in Allamarvdasht gullies catchment show that the average clay, silt and equals to 15/85, 58/76 and 25/38 percent is various. Table 1 showed some of the volume related to Allamarvdasht (Table1).

Table 1. The results were statistically significant variables in Alamarvdasht Lamerd

Alamarvdasht			
Ave	Max	Min	Variables
86.78	836.61	5.4	Sediment(m3)
2	3	1	Slope%(Development)
2	4	1	Slope%(Initiation)
64.32	338.47	8.03	Initiation Area (m2)
303.28	2025.68	41.36	Development Area (m2)

Gullies show that the development has a positive relation whit b variations gully escarpment, escarpment slope percentage and gully outlet, barren soil, mg., vegetation cover percentage in gullies escarpment up streams in 1 percent level and 52/6% coefficients and the achieved linear equation (Table2).

Table 2. The final equation using stepwise regression and the coefficients

Equation	Standardized coefficients						Coefficient	The significant level
	B_1	B_2	B_3	B_4	B_5	B_6		
Y= -3000/613+3443/27 Slp1+6689/52Slp2+17020/42 Area1 -1/91 mg +30/95 cover +29/43 soil	0.260	0.290	0.614	0.301	0.827	0.842	52.6%	1%

We discover that in a unit $s1p_1$ (gully escarpment slope),0/290% and $area_1$ (gully escarpment area) 0/614%, vegetation cover 0/827% and soil (barren soil) 0/842% productive sediment is added and in 1 unit mg., 0/301 amount is reduced.

Discussion

Of the gullied erosion in Alamarvdasht is the slope percentage. So in order to decrease the gullied erosion we should use a slope decrement method and the increment of the roughness coefficient and the resistance of the level1. If there is no possibility in demonstration of such strategy, we should mislead the created run off above the gully escarpment. We also should make an entrance to a part of the gully. It is also necessary to demonstrate making new gullies on the entrance of run off to the gully. If you face to emergency situations, you can decrease the run off altitude and volume through the mechanic action. Treating and modifying the salty soils and soil sodium through modifiers are effective actions in gullies control and the decrement of the gullied erosion danger.

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Cover the Soil Surface in the Gully Erosion (Case Study: Alamarvdasht, Fars Province, South of Iran)

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Abstract
Soil erosion and watershed degradation is a major social and economic problem in developing countries. Not only is the soil erosion the cause of soil impoverishment and farms discarding, but also with sedimentation in waterways, reservoirs, ports and reducing the capacity of gullies cause great losses. Gullies in Fars Province spread across an area of over 50,000 hectares and cause problems for agricultural production and sustainable food production. The present study intends to examine the effect of topsoil coverage on the elongation of gully in Alamarvdasht Lamerd area, located in the southern Fars province. In this study 30 gullies representative for the morphometric characteristics of the region, the gully length, the percentage of gravel, bare soil, and vegetation were measured. Regression relationships between the dependent variable, the gully length, and the independent variables including percent gravel, bare soil, vegetation were assessed using the SPSS software. The results indicated that among the independent variables, the percentage of bare soil was the most effective factor on the initiation and development of gullies at 5% level with coefficient of 0/65 percent in Alamarvdasht. Per unit increase in this variable led to 0/842 units expansion of the gully. Restoration of vegetation, increasing the surface roughness, along with increasing soil organic matter, is effective on controlling the gully erosion and reduce the risk of the gully.
Keywords: Alamarvdasht; Gully length; Vegetation; Topsoil; Initiation and Development.

Introduction
Up to late 90s in 20 th century, a lot of searches performed on surface and rill erosion. But at the end of 20th century, the researchers payed much attention to such erosion because of the shortage of the searches in gullied erosion field. Gullied erosion is a kind of water erosion. It is known because of the sediment production and much damage to the area, roads and constructive excluders in Fars (Dehghani, 1387).
(Soufi,1382) dealt whit a survey of the effects of the different strategies in gullies development in Allamarvdasht and Lamerd catchment area called in this research the gullies initiation were surveyed between the years 1334 to 1373. The result showed that the gullies area has got 3 times during these years. Different factors cause the gullies initiation and sediment production in Fars catchment areas and we can mention the slope, rainfall amount, flood water, roads, making bridge, soil erosion, vegetation destruction, changing area, sand and clay erosion (soleyman pour,1389). The researchers studied the gullied erosion movement and it is relationship whit catchment area characters in India, after surveying slope parameters, catchment area, channel density, surface erosion and sub surface erosion cover remarked that the slope factor and catchment area are the most important factors in gullied erosion initiation of this area, which should be controlled through the protection of high slopes (kukal et al, 2002).

Material and Methods
Allamarvdasht is situated in south of the Fars province it's area is 258/82 square kilometers (Fig,1). The studied region has the geology formation related to alluvium in quaternary period. The temperature average is 24/7 centigrade and the rainfall average is 235/68 millimeter per year. It is estimated that the most rainfall amount is 47/3 millimeter per day. The regional climate is arid desertification based on domarten method (counselor engineering, Hasseb Karaji, 1386).

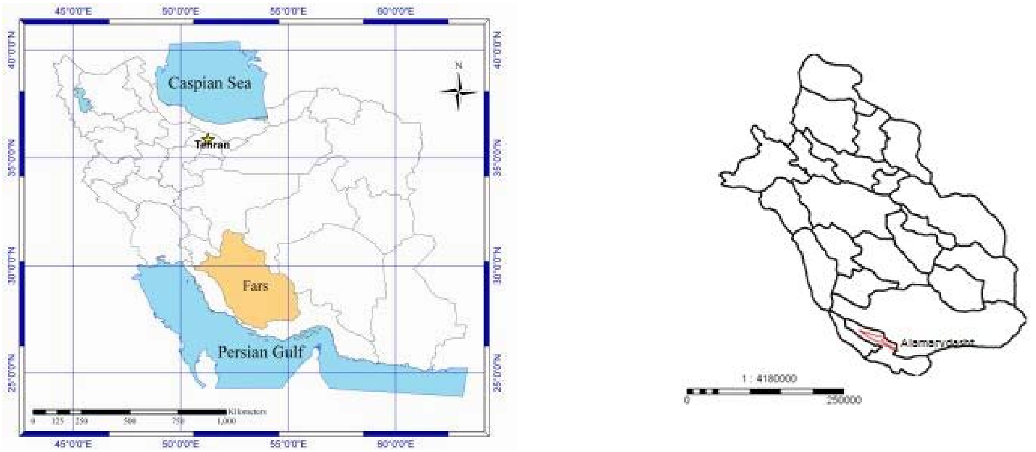

Fig1. Position range studied

Topographic map 1:25000 in 1373 and picture through satellite (IRS) showed the catchment line and the gullied erosion line. Considering the gullies we determined 30 gullies in order to measure the gullied erosion volume. According to the researcher performed by Niknam and Soufi (2008), we determined 10 meters as an appropriate distance for the determination of the width computation and the measurement in gullies (Fig,2).

Fig 2. Measured along the top and bottom of the gully,1389

Each gully dimension computation consists of the depth, width and height. The collection of the few volumes in gully make the gullied erosion volume. We measured some of the characters related to the catchment area (drainage area) in selected gullies like area and slope which is in gully out let and escarpment upstream in desert. We measured the vegetation cover closed grain and the barren soil percentage in catchment which is situated above the escarpment of each gully by accidental arrangement of at least 10 plots which are 1 square meter at the end of the transects(Fig,3).

Fig3. Measurements of vegetation, 1389

We measured the clay, silt, sand, electric herding percentage and also the soil organic matter, organic carbon, acidity soil and the cation available in soil and soil cover in laboratory. Finally we analyzed the relationship between the erosion volume and the relevant factors through step by step method by SPSS soft ware version 13.

Results

The soil cover is often lumi silty and the gullies are spread on the alluvium formation in the quaternary. The research results show that Allamrvdasht gullies lengths are between 13/67 to 131/4. Allmarvdasht gullies length average is 47/70. The characters related to surveyed area gullies show that the gullies depth in Allamrvdasht is 0/84. They are situated in depth gullies group (more than 0.8 meter). Gullied erosion and run off in this area is due to much barren soil and much shortage of vegetation above the headcut related to Allamrvdasht gullies which cause an increment in area of the gully area (Table1).

Table 1. The amount of bare soil with vegetation or gravel in the upper headcut gully

The average percentage of vegetation	The average percentage of gravel surface	The average percentage of bare soil	Alamarvdasht
3/6	1/43	94/97	

Between the dependent variation (gully length) and independent variation (surface of the soil, vegetation cover and the percentage of the closed grain) the percentage of the barren soil on 5% in 65% in making and producing of Allamrvdasht gullies. Increasing 1 unit to this variation, increases 0/742 unit to the gully length. So the vegetation cover plays an important role on creating and developing of the gullies related to the gulling area in Allamarvdasht.

Discussion

The research result shows that the effects of the barren soil is the symbol of the producing speed above the escarpment of the gullies. According to the research finding against the gullies we can say that the quick and sure evacuation of the flow through drainage or vegetation cover with deep roots, can control the gully. In order to decrease the gullies initiation, we can cover the vegetation and decrease the barren surfaces. It helps the surface run off decreased. Then we can deal whit the decrement of the catchment area level on gullies upstream through, we should decrease the longitude initiation of the gullies through the entrance of the less surface run off. Considering much production of the surface on gullies upstream we can collect the surface run off by creating soil in altitude 1 meter at the end of gullies. In this way the settlement of vegetation cover is much easily possible around gullies.

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Effects of organic matter chemical composition on terbuthylazine environmental pollution

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Abstract: The aim of this paper was to study in laboratory and field the terbuthylazine pollution in a soil amended with three different organic wastes after (municipal solid waste, MSW, poultry manure, PM, and cow manure, CM). In laboratory, herbicide sorption and herbicide leaching experiments were studied, whereas in the field, the terbuthylazine concentration in sediments and runoff water after the use of Guelph Rainfall Simulator (GRSII) at two simulated rainfall rates were studied. The results indicated that sorption of terbuthylazine on organic amended soils increased compared to non-organic amended soil. However, terbuthylazine sorption increased by a factor of 4.5 upon amendment with MSW, whereas for PM and CM, the factor increased 4 and 3.4, respectively. Also and compared with the CM-amended soil, in the soil amended with MSW the total sediments and runoff water were significantly lower 25.1% and 27%, respectively. Therefore, the sorption of herbicide increased with the humic acid-like content in the organic waste applied to the soil. The higher sorption probably caused a higher decrease of herbicide in the soil solution, and therefore, lowest herbicide concentration in leachates, sediments and runoff water. Since the adsorption capacity of terbuthylazine was higher in MSW than the PM and CM-amended soils, the addition of organic wastes with higher humic acid-like concentration is more beneficial for decreases the terbuthylazine environmental pollution.

Keywords: Organic wastes, terbuthylazine, sorption, sediments, runoff water

1. Introduction

Environmental problems associated with the presence and accumulation of herbicides in soil as well as in surface and ground waters has grown considerable in the last few years (Celis et al., 2006). Herbicides used in agriculture can be transported to surface or gound waters, causing adverse ecotoxicological effects on aquatic life and affecting drinking water quality (Ben-Hur et al., 2003).

In the last years, the use of organic wastes to enrich soils of low organic matter content and to aid as nutrient input can modify surfaces of soils and subsurface materials promoting sorption of herbicides and retarding their movement as a secondary effect (Cox et al., 1997). Since soil organic matter is the main soil component contributing to the sorption of herbicides (Li et al., 2003), the addition of exogenous organic matter to soil has been suggested as a possible method to reduce herbicide movement (Ben-Hur et al., 2003). However, the influence of organic matter on soil properties, herbicides sorption and herbicide loss possibly depends upon the type, amount and dominant components of the added organic materials.

The objective of this study was to investigate the sorption and mobility of the terbuthylazine herbicide in a soil amended with three organic wastes. This evaluation was carried out by studying the sorption process in batch experiments, to obtain the corresponding sorption isotherms, as well as the mobility in column experiments, to determine the leaching potential of terbuthylazine. Finally, losses of terbuthylazine in sediments and runoff water using a rainfall simulator were also studied.

2. Material and methods

The soil used for the laboratory and field experiments is a Plagic Antrosol (FAO, 1989). The main soil and organic wastes characteristics, as well as those of the humic acid fraction, are summarized in Tables 1 and 2. The methodology used in the determination of the physical and chemical parameters in soil and organic wastes is described in Tejada et al. (2011).

The herbicide used was the terbuthylazine (N2-tert-butyl-6-chloro-N4-ethyl-1,3,5-triazine-2,4-diamine).

Table 1. Characteristics of the experimental soil and organic wastes (± standard errors). Data are the means of four samples.

	Soil	PM	MSW	CM
pH (H_2O)	8.6 ± 0.2	7.1 ± 0.3	6.2 ± 0.3	8.3 ± 0.2
Sand (g kg^{-1})	529 ± 49			
Silt (g kg^{-1})	242 ± 19			
Clay (g kg^{-1})	229 ± 10			
Organic matter (g kg^{-1})	1.1 ± 0.2	614 ± 26	469 ± 15	764 ± 29
Humic acid-C (mg kg^{-1})	18.5 ± 2.4	672 ± 1.4	1030 ± 17	461 ± 13
Fulvic acid-C (mg kg^{-1})	9.8 ± 1.1	715 ± 10	711 ± 10	631 ± 24
Total N (g kg^{-1})	0.4 ± 0.1	38.8 ± 2.9	17.3 ± 1.3	29.2 ± 2.1
Fe (mg kg^{-1})	35.8 ± 3.7	180 ± 22	815 ± 38	407 ± 28
Cu (mg kg^{-1})	9.7 ± 1.3	1.6 ± 0.3	82.6 ± 9.8	24.2 ± 1.8
Mn (mg kg^{-1})	11.3 ± 2.1	4.2 ± 0.9	75.6 ± 8.1	14.1 ± 1.2
Zn (mg kg^{-1})	8.1 ± 1.5	3.3 ± 0.8	134 ± 13	10.3 ± 1.6

Table 2. Acidic functional group contents (± standard errors) of three laboratory replicates) of humic acids isolated from PM, MSW and CW.

	Total acidity	COOH	Phenolic OH
		(mol kg^{-1})	
PM	3.99 ± 0.13	2.99 ± 0.09	0.99 ± 0.05
MSW	4.29 ± 0.04	3.19 ± 0.03	1.10 ± 0.03
CW	2.81 ± 0.02	2.00 ± 0.03	0.80 ± 0.01

Laboratory and field studies were conducted. For sorption studies the treatments used were: (1) S, non-organic amended control soil (10 g soil); (2) S+CM, soil amended with CM at rate of 10% (10 g soil + 1 g CM); (3) S+PM, soil amended with PM at a rate of 12.4% (10 g soil + 1.24 g PM); and (4) S+MSW, soil amended with MSW at a rate of 16.3% (10 g soil + 1.63 g MSW)

Terbuthylazine sorption was determined according to Cabrera et al. (2009) criteria. Triplicate samples (5 g) of the unamended and organic amended soil (S, S+CM, S+PM, S+MSW) were treated with 10 ml of terbuthylazine solution (initial concentrations, Ci, ranging from 5 to 50 µM in 0.01 $CaCl_2$). Previously, it was determined that equilibrium was reached in less than 24 h, and that no measurable degradation occurred during this period. Equilibrium concentrations (Ce) in the supernatants were determined by HPLC. Sorption isotherms were fitted to Freundlich equation ($Cs=Kf \times Ce^{1/nf}$) and sorption coefficients Kf and 1/nf were calculated.

Terbuthylazine was extracted twice with methanol at 1:2 soil/solution ratio for 15 min. Extracts were mixed and rotary-vacuum evaporated almost to dryness at 40 ºC. The residue was dissolved in 2 ml of methanol and analyzed by HPLC (Cabrera et al., 2008).

Leaching experiments were conducted in 30 cm length×3.1 cm internal diameter glass columns filled with 20 cm of soil. Glass wool plus 10 g of sea sand was placed on the bottom of the columns to prevent losses of soil and contamination of leachates with soil particles. The columns were hand-packed with 180 g of soil without and with organic wastes (10 g of MSW, 13.7 g of PM and 10.9 g of CM) with the intention of applied the same amount of organic matter and 10 g of sea sand was placed on the soil surface. The columns were saturated with water, allowed to drain for 24 h, and then the amount of terbuthylazine corresponding to an application rate of 2 kg ha^{-1} was applied to the top of the columns. Daily, the columns were leached with 200 mm d^{-1} of distilled water and the leachates were collected and filtered. The terbuthylazine concentration was analyzed by HPLC at 1, 3, 7, 10, 15, 20 and 30 days after the application of herbicide to soil. The leaching experiment was conducted in triplicate.

The experimental field layout was in a randomized complete block design with four treatments and three replicates per treatment. The plot size was 8 m X 6 m, and the treatments were the following: (1) S, control soil, no organic amendment and with 2 kg ha^{-1} of terbuthylazine; (2) S+MSW, soil amended with 10000 kg ha^{-1} yr^{-1} of MSW (4690 kg OM ha^{-1} yr^{-1}, fresh matter) and with 2 kg ha^{-1} of terbuthylazine; (3) S+PM, soil amended with 7638 kg t ha^{-1} yr^{-1} of PM (4690 kg OM ha^{-1} yr^{-1}, fresh matter) and with 2 kg ha^{-1} of terbuthylazine; and (4) S+CM, soil amended with 6139 kg t ha^{-1} yr^{-1} of CM (4690 kg OM ha^{-1} yr^{-1}, fresh matter) and with 2 kg ha^{-1} of terbuthylazine.

Each organic waste was applied to the soil surface on 15 February 2008 whereas the terbuthylazine was applied on 20 April 2008.

The Guelph Rainfall Simulator (GRSII) was used for determined the terbuthylazine concentration in sediments and runoff water. Any soil loss was collected from bounded 1.0×1.0 plots within a wetted perimeter that extended approximately 0.5 m beyond the plot borders. Two simulated rainfall rates have been used: low-intensity at 60 mm h^{-1}, using a 3/8 in. 20 W nozzle, at a height of 1.2 m and pressure of 69 kPa, and high-intensity at 140 mm h^{-}1, using a 1/2 in. 30W nozzle, at a height of 1.7 m and pressure of 40 kPa. The volume of runoff at 60 min was measured.

Sediments and runoff water was collected 30 April 2008, 20 May 2008 and 15 June 2008, respectively, after eliminating plants from the soil surface. Immediately after each simulated event, samples of sediments and runoff water were collected in plastic bottles and the contents stirred to uniformly suspend the solids and mix them with the water phase. The samples were filtered through a filter of 0.45 µm pore size and then analyzed for terbuthylazine for HPLC. The samples were then dried at 105 °C to determine the sediment mass.

Analysis of variance (ANOVA) was performed using the Statgraphics Plus 2.1. The means were separated by the Tukey's test, considering a significance level of $P<0.05$ throughout the study. For the ANOVA, triplicate data were used for each treatment and every incubation day.

3. Results

The sorption of terbuthylazine on organic amended soils increased compared to non-organic amended soil (Fig. 1). For each organic amended soil, the herbicide sorption with MSW was higher than with PM and CM. Sorption isotherms were fit to the Freundlich equation and sorption coefficients Kf and 1/nf were calculated (Table 3). The results indicated that Kf values significantly increased in organic amended soils than for non-organic amended soils. However, terbuthylazine sorption increased by a factor of 4.5 upon amendment with MSW, whereas for PM and CM, the factor increased 4 and 3.4, respectively. Tthe results indicate significant differences between S+MSW and S+CM treatments. Also, the 1/nf coefficients significantly decreased in organic amended soils than for non-organic amended soil. For organic amended soils, the 1/nf coefficient was higher in the soil amended with MSW, followed by PM and CM, respectively.

Table 3. Freundlich sorption coefficients Kf and 1/nf and standard error for terbuthylazine in unamended and organic amended soils. Column (mean ± standard errors) followed by the same letter(s) are not significantly different (p<0.05)

	Kf	1/nf	R^2
S	6.93a ± 0.95	0.92a ± 0.05	0.963
S+MSW	31.22c ± 2.46	0.80c ± 0.06	0.943
S+PM	28.03bc ± 2.03	0.83bc ± 0.05	0.958
S+CM	23.48b ± 1.99	0.86b ± 0.04	0.977

Herbicide applied in organic-amended soils resulted in lower maximum concentrations in the leachates as compared with the application of the herbicide in the unamended soil (Fig. 2). The maximum concentration of terbuthylazine in leachates was significantly reduced from 6.9 µM for the unamended soil, to 2.7 µM, 3.4 µM or 3.8 µM for the MSW, PM or CM-amended soils.

At the highest intensity of rainfall simulation, terbuthylazine losses were higher than for the lower intensity simulation (Fig. 3 and 4). For both herbicide losses in sediments and runoff water, the terbuthylazine losses were significantly highest in unamended than for organic-amended soils. Total sediments and for 140 mm h^{-1}, the terbuthylazine losses significantly decreased 44.7%, 36.6% and 28.3% in MSW followed by PM and CM-amended soils compared to unamended soils.

For runoff water and at the highest intensity of rainfall simulation, the terbuthylazine were significantly highest in organic amended soils than for unamended soil. Again, the results indicate significant differences between S+MSW and S+CM treatments. In this respect and compared with S+CM treatment, runoff water decreased 27% in S+MSW treatment.

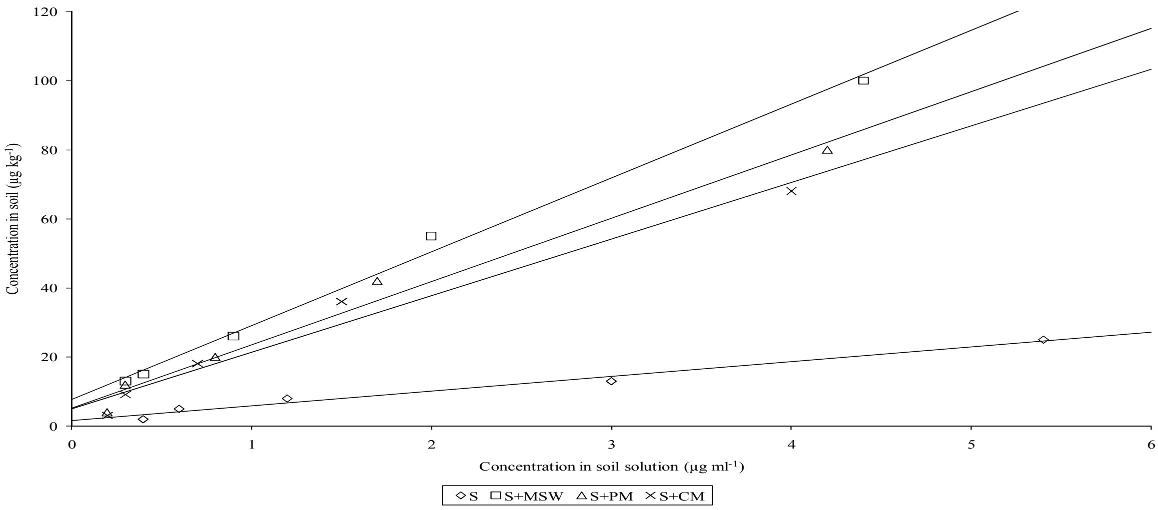

Fig. 1. Terbuthylazine sorption isotherms in unamended and organic amdended soils. Symbols are experimental data points, whereas lines are the Freundlich-fit sorption isotherms.

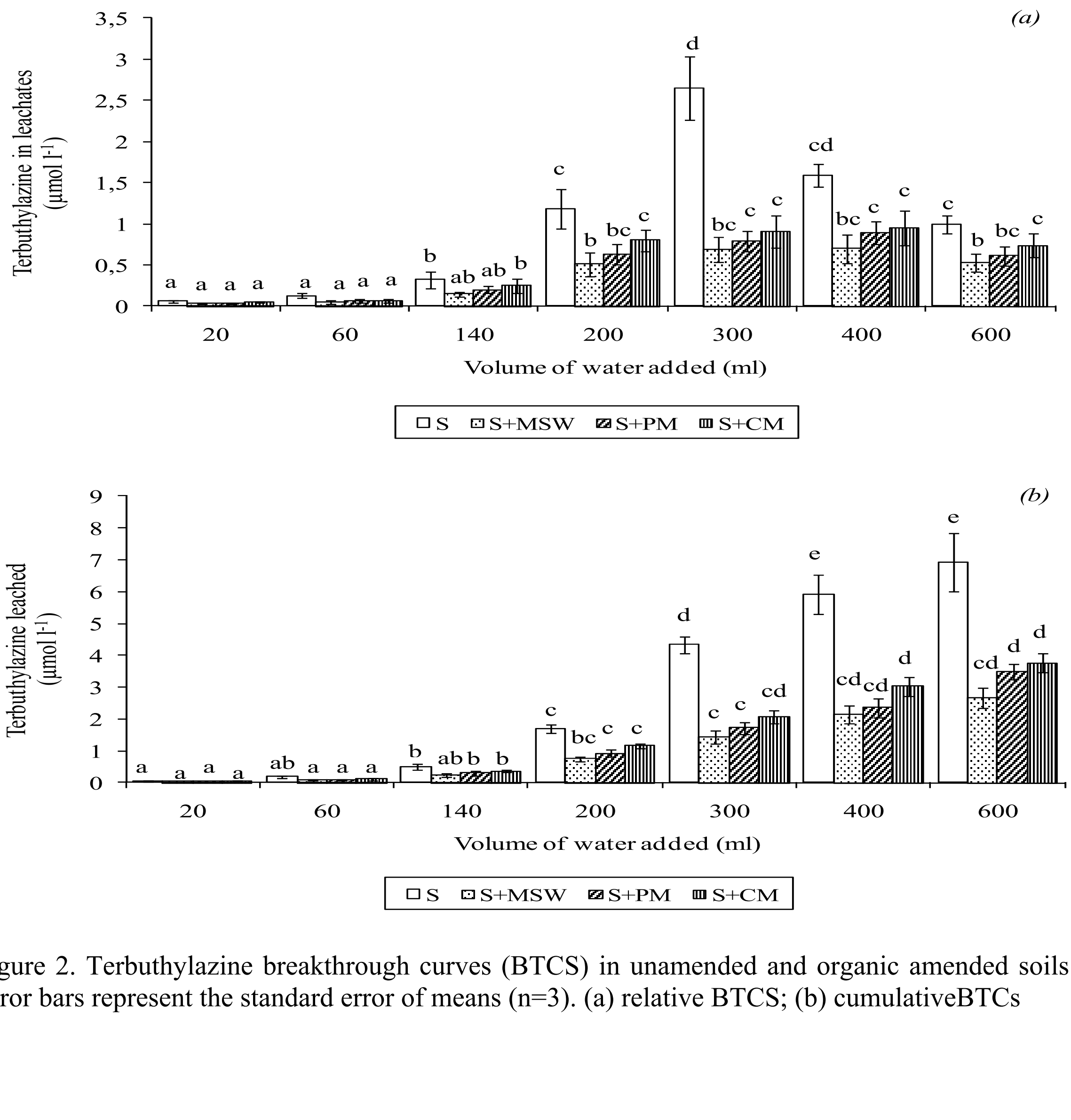

Figure 2. Terbuthylazine breakthrough curves (BTCS) in unamended and organic amended soils. Error bars represent the standard error of means (n=3). (a) relative BTCS; (b) cumulativeBTCs

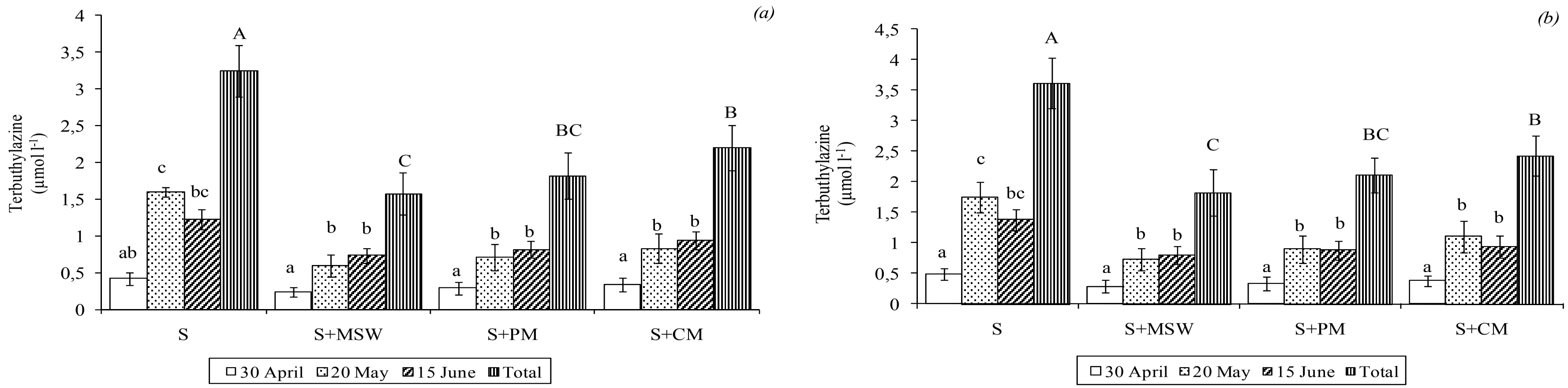

Figure 3. Terbuthylazine (µmol l^{-1}) in sediments at 60 mm h^{-1} *(a)* and 140 mm h^{-1} *(b)* in soils. Error bars represent the standard error of means (n=3). For lowercase and uppercase, column (mean ± S.E.) followed by the same letter(s) are not significantly different (p<0.05)

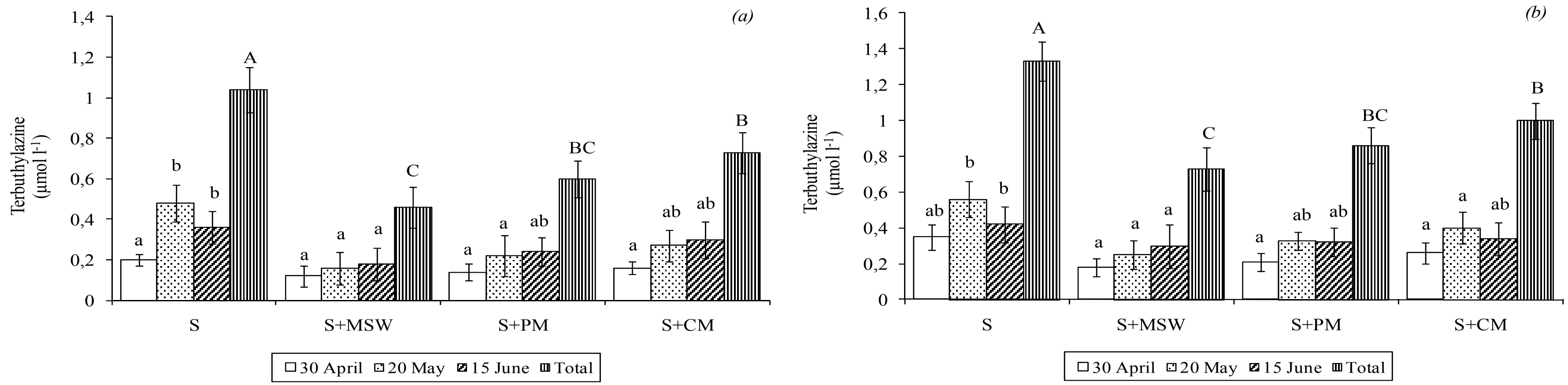

Figure 4. Terbuthylazine (µmol l^{-1}) in runoff water at 60 mm h^{-1} *(a)* and 140 mm h^{-1} *(b)* in soils. Error bars represent the standard error of means (n=3). For lowercase and uppercase, column (mean ± S.E.) followed by the same letter(s) are not significantly different (p<0.05)

4. Discussion

Our results suggested that terbuthylazine mobility is greatly influenced by the soil organic matter. The amount of herbicide leached and in sediments and runoff water suggested a lower potential risk of environmental contamination for the organic-amended soils.

The terbuthylazine sorption isotherms and Freundlich sorption coefficients obtained in this study, suggested that organic matter play a fundamental role in the sorption of the herbicide in agricultural soils, probably as a result of the humic substances containing several major functional groups, such as carboxyl, phenolic, alcohol and carbonyl (Datta et al., 2001). These results are in agreement with Guo et al. (1993) who found that sorption coefficients for alachlor and atrazine increased on amended versus unamended soils. Similar results were obtained by Si et al. (2006) for ethametsulfuron-methyl in organic-amended soils.

However, our results also suggested that the chemical composition of the organic matter influenced in the terbuthylazine sorption. Several studies of metal complexation with organic matter indicated that the sorption of heavy metals increased when the humic acid-like content increased in the organic matter, compared to the fulvic acid-like content, probably due to the humic acid-like possess a higher number of carboxylic groups than fulvic acid-like (Tejada et al., 2007).

The terbuthylazine sorption isotherms and Freundlich sorption coefficients indicated higher herbicide sorption in MSW-amended soils, followed by PM and CM. Therefore, and similar to the heavy metals complexation, the sorption of herbicide increased with the humic acid-like content in the organic waste applied to the soil. The higher sorption probably caused a higher decrease of herbicide in the soil solution, and therefore, lowest herbicide concentration in leachates, sediments and runoff water.

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Effects of brassica napus compost on soil enzymatic activities and wheat yield

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Abstract: The objective of this work was to study the effect of incorporating a *Brassica napus* compost (BN) at rates of 10, 20, and 30 t ha^{-1} with and without inorganic N fertilizers on soil biological properties, nutrition and wheat yield parameters crop for three years on a Typic Xerofluvent located near Sevilla (Spain). Soil enzymatic activities increased more significantly when BN was applied with inorganic fertilizers. At the end of the experimental period and for 30 t ha^{-1} of BN applied to soil, dehydrogenase, urease, β-glucosidase and phosphatase activities increased 19.5%, 10%, 7.5% and 10.5%, respectively in BN+inorganic N fertilizers respect to BN without inorganic N fertilizers. Also, grain N, P and K contents were observed, and better wheat yield parameters were obtained for soils treated with BN+inorganic N fertilizers. Wheat yield parameters of the third experimental season were better than those of the second and first experimental season, due to the residual effect of the organic matter after their application in the first season. At the end of the experiment and for 30 t ha^{-1} of BN applied to soil, the application of BN+inorganic N fertilizers in soils increased the number of grains spike^{-1} (3.8%), thousand seed weight (3.5%), number of spikes m^{-2} (0.7%) and yield (2.7%) with respect the application of BN without inorganic fertilizers in soils. The explanation of these results can be a consequence to the optimum soil C/N ratio in BN+inorganic N fertilizers amended soils, prevailing the mineralization process versus the immobilization process.
Keywords: *Brassica napus* compost, soil biological properties, wheat yield

1. Introduction

M most of the composts constituted by non leguminous plants have low levels of N. In addition, low mineralization rates from composts constituted by non leguminous plants require high application rates to satisfy the complete N requirement of crops. According to Sikora and Enkiri (1999), combining composts with low levels of N with sufficient N fertilizer to meet crop requirements is an appealing possibility because it could (i) utilize organic wastes at lower rates than when applied as the soil fertilizer, (ii) reduces the amount of N-inorganic fertilizer that need to be applied to soils, and (iii) reduces the accumulation of non-nutrient organic wastes constituents in soils. However, any added organic matter, needs a certain time to mineralize and supply the nutrients needed by the crops (Tejada and Gonzalez, 2006). For this reason some authors suggest the addition of mineral fertilizers at the same time to supply the nutritional nutrients that the plant requires in the early stages of development (Tejada and Gonzalez, 2006).

The objective of this study was to evaluate the effects of a *Brassica napus* compost (BN) residues at different rates with and without inorganic fertilizer (NH_4NO_3) on some biological soil properties and its repercussion in the wheat yield parameters.

2. Material and methods

The study was conducted from December 2002 to June 2005 near to Sevilla city (Spain) on a Typic Xerofluvent. [pH= 7.6±0.2; Clay (g kg^{-1})= 172±24; Silt (g kg^{-1})= 139±30; Sand (g kg^{-1})= 689±47; Total N (g kg^{-1})= 0.79±0.11; Total C (g kg^{-1})= 6.1±0.4; C/N ratio= 7.7±0.5].

Compost consisted on *Brassica napus*, L. plants (stems+leaves). The plant residues were composted in trapezoidal piles (2 m high by 2 m width by 3 m length) and under aerobic conditions. The composting process was considered to have finished after 210 days, when the C/N ratio and the temperature had become constant. [Dry weight (%)= 30.4±1.4; Total C (g kg^{-1}, dm)= 405.8±3.6: Total N (g kg^{-1}, dm)= 8.5±0.9; C/N ratio= 47.7±4].

The experimental layout was a randomized complete block design with six treatments and 3 replicates per treatment. The block size was 7 m x 7 m. The treatments were: (1) C, control soil, non fertilized control plot; (2) BN10, fertilized with 10 t ha^{-1} of BN compost (dw); (3) BN20, fertilized with 20 t ha^{-1} of BN compost (dw); (4) BN30, fertilized with 30 t ha^{-1} of BN compost (dw); (5) BNF10, fertilized with 10 t ha^{-1} of BN compost (dw) + 150 kg N ha^{-1}; (6) BNF20, fertilized with 20 t ha^{-1} of BN compost (dw) + 150 kg N ha^{-1}, and (7) BNF30, fertilized with 30 t ha^{-1} of BN compost (dw) + 150 kg N ha^{-1}.

The BN compost was surface broadcasted on 27 November 2002, 29 November 2003 and 28 November 2004, respectively, and incorporated to a 25-cm depth by chisel plowing and disking the day after application. The N fertilizer (NH_4NO_3) was incorporated on 28 November 2002, 30 November 2003 and 29 November 2004, respectively to a 25-cm depth. The chemical composition of the compost was the same for the three experimental seasons. In this respect, the compost was stored at 0 °C after application in the first experimental season to avoid mineralization.

Wheat (*Triticum aestivum* cv. Cajeme) was chosen as the test crop, and was planted at a rate of 150 kg ha^{-1}. The sowing dates were the 14 December 2002, 17 December 2003 and 15 December 204, respectively. The number of grains $spike^{-1}$, the number of spikes m^{-2}, thousand seed weight and crop yield (kg ha^{-1}) were determined on samples collected in each plot (18 June 2003, 20 June 2004, and 21 June 205, respectively).

Soil samples (0-25 cm) were collected at the end the wheat growth cycle (18 June 2003, 20 June 2004, and 21 June 2005, respectively). Dehydrogenase activity was measured by the Garcia et al. (1993) method. Urease activity was determined using the Kandeler and Gerber (1988) method. β-glucosidase activity was measured using the Masciandaro et al. (1994) method. Phosphatase activity was measured using the Tabatabai and Bremner (1969) method. Also, soil C/N ratio evolution was determined at the end of each experimental season.

Grain mineral composition was characterized by analysing N (by the Kjeldahl method, MAPA, 1986) in fresh matter. After the calcination of grain at 450 °C, P was determined (Guitian and Carballas, 1976), and K was measured by atomic emission spectrophotometry.

Analysis of variance (ANOVA) was performed using the Statgraphics Plus 2.1. The means were separated by the Tukey's test, considering a significance level of $P<0.05$ throughout the study. For the ANOVA, triplicate data were used for each treatment and every incubation day.

3. Results

Figure 1 shows soil C/N ratio evolution during the three experimental seasons and for all treatments. For BN amended soils with inorganic N, the soil C/N ratio values had optimum values (10-12), however for BN amended soils without inorganic N had soil C/N ratio values lightly highest to the optimum values. The statistical analyses showed significant differences for all treatments during the experimental period. The activity of the dehydrogenase enzyme was significantly stimulated during the experimental period in the green manure amended soils (Fig. 2). This stimulation was higher when highest doses of organic matter were applied to the soil and when inorganic N was added with the plant residues. Also, urease activity was strongly stimulated by green manure with inorganic N addition to the soil, principally at a higher rate of organic matter (Fig. 2). Also and at the end of the experimental period, the stimulation of this enzyme was higher in BNF30 amended soils (85%), followed by BN30 (83.3%), BNF20 (81.8%), BNF10 (78.9%), BN20 (76.9%), and BN10 (73.9%) treatments respect to the C. At the end of the experimental period, the evolution of β-glucosidase activity increased 98.7%, 98.6%, 98.6%, 98.4%, 98.3% and 97.1% respectively, in BNF30, BN30, BNF20, BNF10, BN20 and BN10 amended soils respect to the C. The evolution of phosphatase activity during the experimental period were similar to the other enzyme activities studied, emphasizing the highest values in the plots amended with inorganic N and highest doses of organic matter applied to the soil (Fig. 2).

Grain N, P and K contents were highest in the organic amendment soils than for C (Fig. 3). Figure 4 shows the yield parameters for the different treatments during the experimental period. Number of grains $spike^{-1}$, thousand seed weight, number of spikes m^{-2} and wheat yield increased respectively in BNF30, BN30, BNF20, BNF10, BN20 and BN10 amended soils respect to the C.

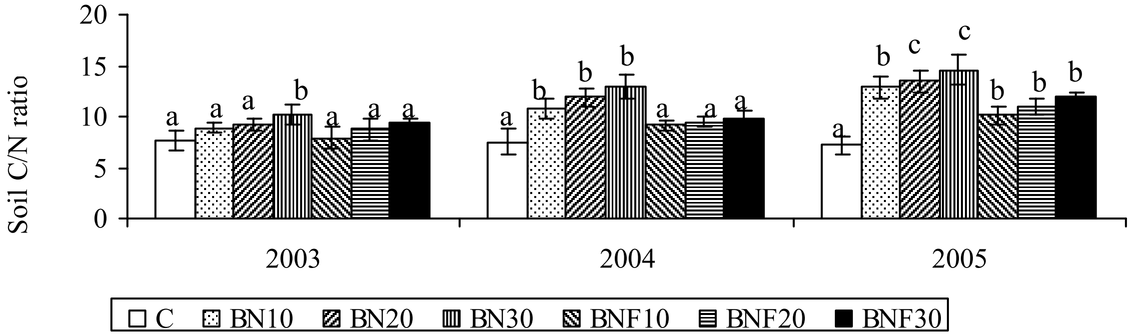

Figure 1. Soil C/N ratio (± standard errors) in soils during the experimental period. For each treatment, data followed by the same letter are not significantly different (*P*<0.05).

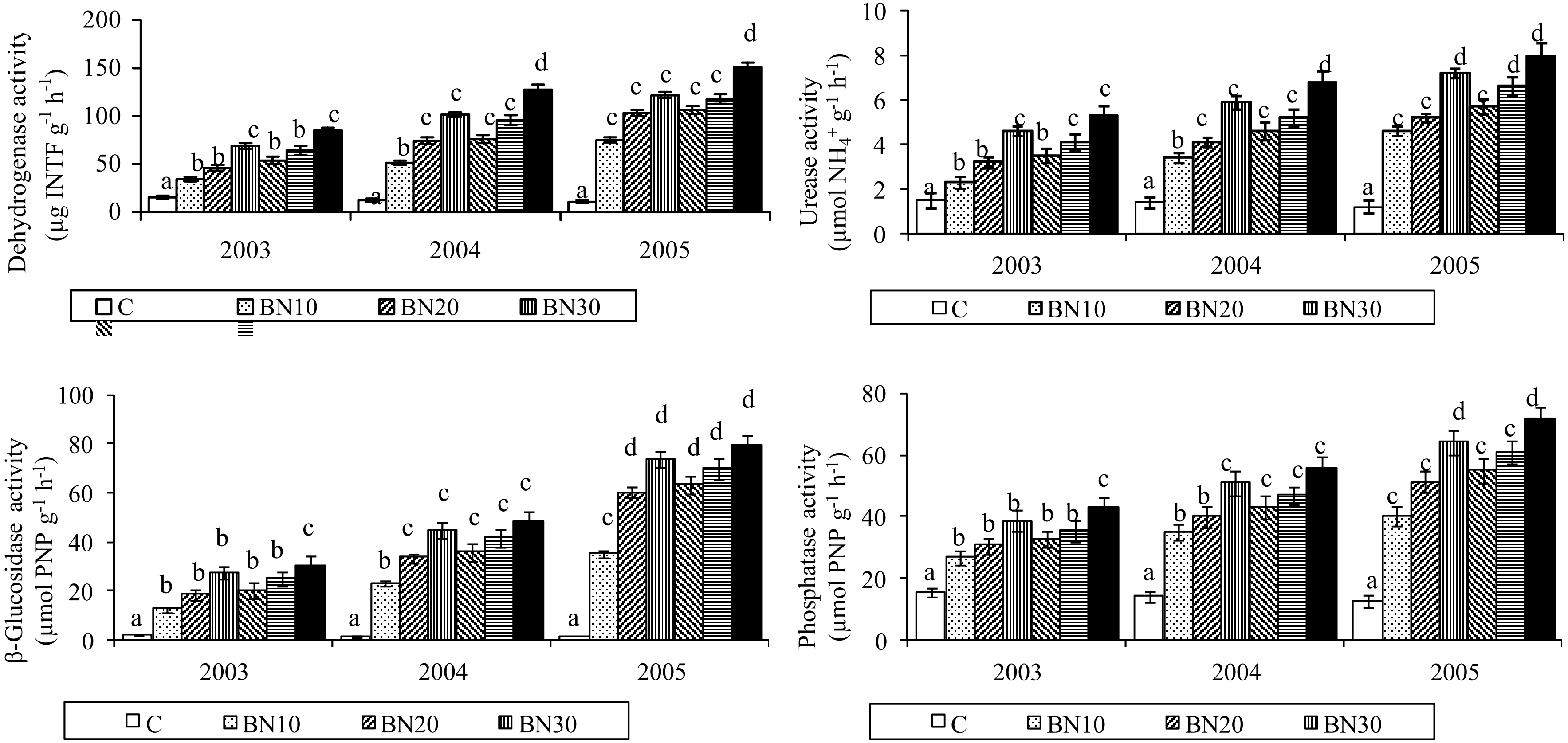

Figure 2. Dehydrogenase, urease, β-glucosidase and phosphatase activities during the experimental period. Error bars represent the standard error of means
INTF: 2-p-iodo-3-nitrophenyl formazan; PNP: *p*-nitrophenol
For each treatment, data followed by the same letter are not significantly different according to the Tukey's test ($P<0.05$).

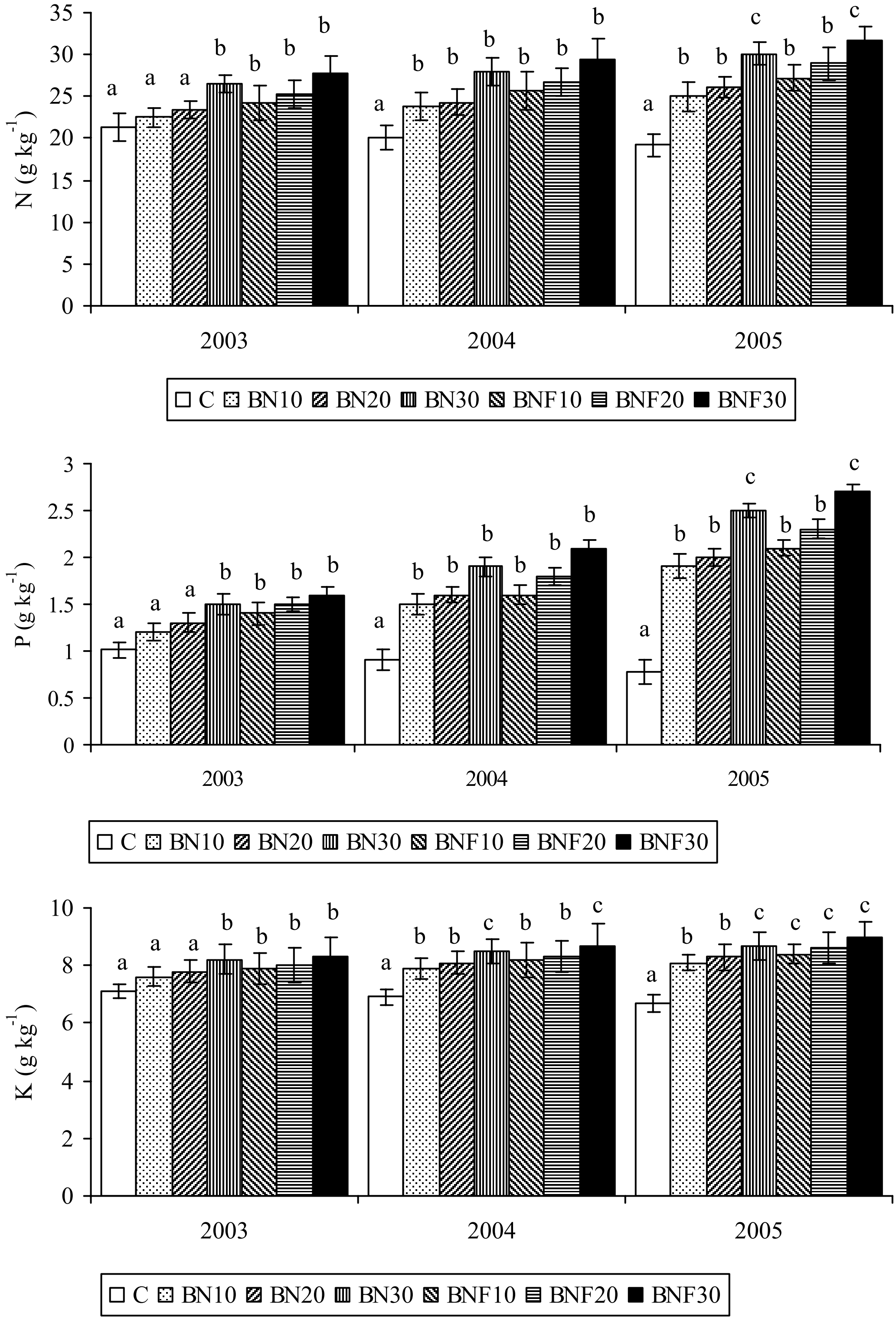

Figure 3. Grain N, P and K contents in wheat at harvest (on a dry matter basis) during the experimental period. Error bars represent the standard error of means

For each treatment, data followed by the same letter are not significantly different according to the Tukey's test ($P<0.05$).

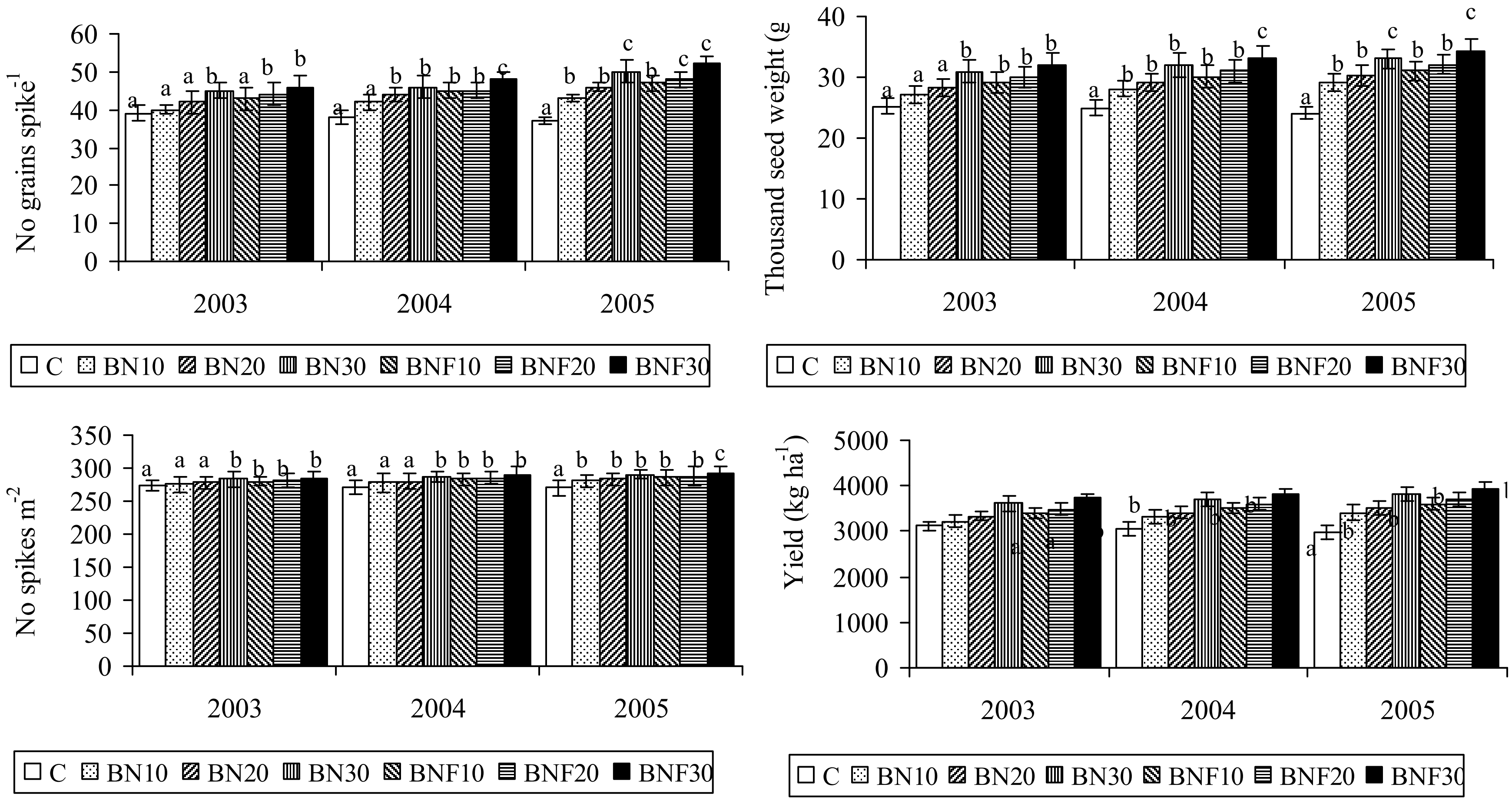

Figure 4. Whet yield parameters. Error bars represent the standard error of means
For each treatment, data followed by the same letter are not significantly different according to the Tukey's test (P<0.05).

4. Discussion

The application of BN compost to soil increased enzymatic activities. Tejada and González. (2006) indicated that the incorporation of organic amendments to soil influences soil enzymatic activities because the added material may contain intra- and extracellular enzymes and may also stimulate microbial activity in the soil. Thus, the effects of BN residues on dehydrogenase activity might be due to the more easily decomposable components of plant residues on the metabolism of soil microorganisms. The highest values of soil enzymatic activities for BN-amended soils, are in agree with others authors (Tejada and Gonzalez, 2006) who indicated that the organic amendment had a positive effect on the activity of these enzymes.

According to Tejada and Gonzalez (2006), the C/N ratio of the organic wastes will largely determine the balance between mineralization and immobilization. Our results indicate that optimum soil C/N ratio (10–12) was observed for BNF treatments. For this reason, we think that in the TP+BN treatments mineralization it prevails versus the immobilization and soil enzymatic activities are highest. In BN treatments (C/N ratio no optimum) immobilization it prevails versus the mineralization and soil microbial biomass and soil enzymatic activities are highest.

The values obtained for the plant yield parameters during the experimental period are consequence of the dynamic of the soil organic matter. Soil enzymatic activities measured are responsibles for important cycles such as C, N, and P. In our study, the values of the soil enzymatic activities are highest in the plots amended with BN compost with inorganic N than BN compost without inorganic N. These values indicate that the soil N and P contents are highest in the plots amended with BN compost + N. As it has been commented previously, this may be due to better mineralization of organic matter for BNF treatments than for BN treatments. Also, these parameters of the third experimental season were better than those of the second and first experimental season, due to the residual effect of the organic matter.

Since the increase in microbial diversity may increase soil microbial functionality and therefore increase the N and P available levels by plants, wheat yield parameters increased significantly when a higher dose of BNF were applied to the soil respect at the same dose of BN.

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Comparison the effects of burn land and various vegetation cover treatments on soil chemical and physical characteristics

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Abstract

Land burning can alter the chemical, physical and biological properties of a soil. This study was conducted at mountain rangelands of Nesho in Mazandaran province in order to show the effects of wildfire and various vegetation cover treatments on soil physiochemical characteristics. For this research, was selected an area about 6 hectares, which includes different vegetation percentages and an area which burned by fire with human factors with area about 4000 square meters. 110 soil samples were gathered from 0-30 cm depth as systematic grid 30×30 m in regions with different vegetation cover and were transported to laboratory and were measured. In sample sites, were placed the quadrats and the vegetation was measured. In burned sites, vegetation cover was zero and elsewhere vegetation cover percent were divided in different classes including 0-30, 31-50, 51-70 and more than 70 percent to examine the vegetation cover effects. To determine the effects of burning on soil characteristics, comparison of means was performed with Duncan method in the SPSS16. Results of One-way ANOVA at burned sites and different vegetation cover treatments on soil characteristics showed that effects of fire was significant only on Potassium, Organic matter, Silt content and Bulk density.

Keywords: Burning, Soil characteristics, Nesho rangeland.

Introduction

Fire as one of the oldest Ecological factors, for thousands of years affect biological cycle of plant species in rangeland ecosystems (Trabaud, 1987). Fire can have effects on soil and its internal processes which is critical on ecosystem structure and function. The most important change following fire on above ground is disappearing of ground vegetation mass and increase solar radiation, speed of wind erosion, aridity and soil temperature (Johansen et al., 1982). In this case the ground takes more precipitation that will increase soil erosion. The direct heat of the fire at below and above ground lead to loss of nutrients, damage to the soil microorganisms and changes in water absorption pores at the soil surface (Johansen et al., 1993). If the fire associated with the loss of organic matter, nitrogen and sulfur will be considered premier importance factors of rangeland degradation. So fire has advantages and disadvantages and to be used only for special processes such each improvement program with regard ecological principles. Accidental or deliberate fires can create a lot of damage to vegetation cover, so use it as an improvement method in rangelands in recent years has attracted researchers and experts according to positive results from research in other countries but still not perform investigations for Iran (Mesdaghi, 2007). Fire can change the chemical, physical and biological properties of soil that different researchers have studied (Mohseni saravi, 2008). For example, in soils with high acidity, fire leads to soil pH greater than 8 (Arocena and Opio, 2003). But the effect of fire on soil and soil organisms depends on the severity of fire (Moghadam, 2005). Each area has physical, chemical and biochemical soil properties according to special climate characteristics which is there. Fire has a significant impact on all of these features and can have barrier damage on natural ecosystems and human management but sometimes mentioned as a management tool.

Low-intensity fires have little impact on biological and chemical properties of soil. But the high temperatures of fire may be changes fundamental characteristics such as soil texture, mineralogy and Cation Exchange Capacity (Kettering and Bigham, 2000). Bry (2006) imported increasing of soil temperature, stimulates of biological activity, increasing organic matter and the availability of soil nutrients after burning of soil surface debris. It seems that the benefits of burning debris in improving the soil by moderate opening of mineral nutrients for use of product, has less effects rather than damaging effects on soil physical properties.

Materials and Methods

Study area and sampling

The study area is located at central Alborz zone, Mazandaran province northern Iran and 40 km south of Ruyan County (50° 08' 00" E to 50° 08' 17" and 36° 21' 49" N to 36° 22' 04"). It has 1700 m altitude above sea surface and 6 ha area (Figures 1 and 2). The land use of this area was forest that was transformed to rangeland about 30 year ago. The climate is cold-mountain based on Emberge method with mean annual precipitation of 253 mm, mostly falling in the winter, autumn and spring. Minimum and maximum monthly mean temperatures were -4.1 and 28.4 in January and August respectively. The annual mean temperature is 12.17◦C. Nesho village is surrounded by forest from each side. A sampling site was selected in Nesho rangelands. 110 Soil samples were sampled by a systematic sampling strategy at 0 to 30 cm depth below the surface on a regular grid spacing of 30 × 30 m from 0-30 cm depth. In sample sites, plot placed and vegetation cover were measured.

Laboratory analysis

The samples were air-dried and passed through a 2 mm sieve to prepare them for experiments. The methods that were applied were: hydrometer method for soil texture, Kjeldahl method for total nitrogen, and the modified Walkley- Black wet oxidation procedure for organic carbon content. Multiplying the soil organic carbon by 1.72 resulted in soil organic matter. Titration method with EDTA solution were used for measuring Calcium and Magnesium, Pycnometer method for Particle density, sampling cylinder method for Bulk density and also soil pH and electrical conductivity (EC) were measured in saturated mud and saturated extract, respectively. Saturated moisture was determined from saturated mud and weighing method. Caco3 was measured by Titration method with I N NAOH. The amount of Phosphorus that exists in extracts of soil was determined by Spectrophotometer. Absorbable K and Na after extraction were measured using 1 N ammonium acetate (pH= 7). Bulk density and soil actual density were measured applying sampling cylinders and Pycnometer respectively, also calcium and magnesium were measured using titration method with EDTA solution.

Statistical analysis

First, normality of data investigated by Kolmogorov-Smirnov test. Since Phosphorus and Nitrogen not followed normal distribution, we used logarithmic conversion before statistical analysis. We used One-way ANOVA to determine the effects of burning and different vegetation treatments on soil characteristics and comparison of means was performed with Duncan method in the SPSS software, version 16.

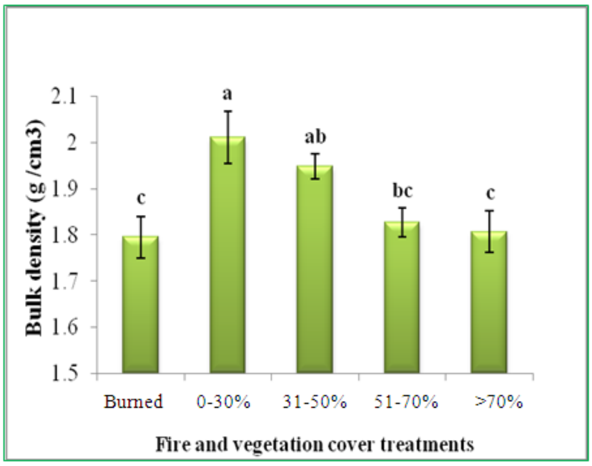
Results

Results of One-way ANOVA at burned sites and different vegetation cover treatments on soil characteristics showed that effects of fire was significant only on Potassium, Organic matter, Silt content and Bulk density. Table 1 and table 2 shows variance analysis and changes in soil properties (Mean ± Std. Error) respectively. Figures 1, 2, 3 and 4 show compare means of bulk density, potassium, silt content and organic matter respectively by Duncan method.

Table 1. Variance analysis of Fire and vegetation cover treatments impact on soil properties

Soil properties	Units	Fire and vegetation cover treatments
$Caco_3$	%	0.494 ns
OM	%	3.909 **
N	%	0.186 ns
P	ppm	1.40 ns
K	ppm	3.115 *
Bd	g/cm3	4.932 **
Pd	g/cm3	0.549 ns
pH	-log [H+]	1.150 ns
EC	ųs/cm	0.891 ns
Na	ppm	0.913 ns
Ca	m.e./litr	0.430 ns
Mg	m.e./litr	0.556 ns
Sand	%	1.284 ns
Silt	%	2.271 *
Clay	%	0.321 ns
SM	%	0.792 ns

Values of table is F and ns, *, ** show not significant, significant at α=0.05 and absolute significant at α=0.01 respectively



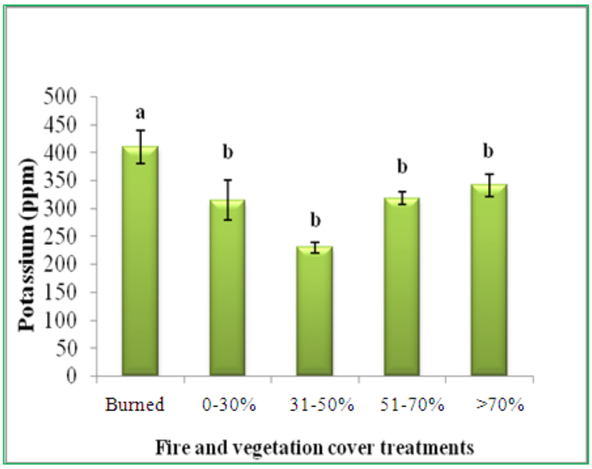
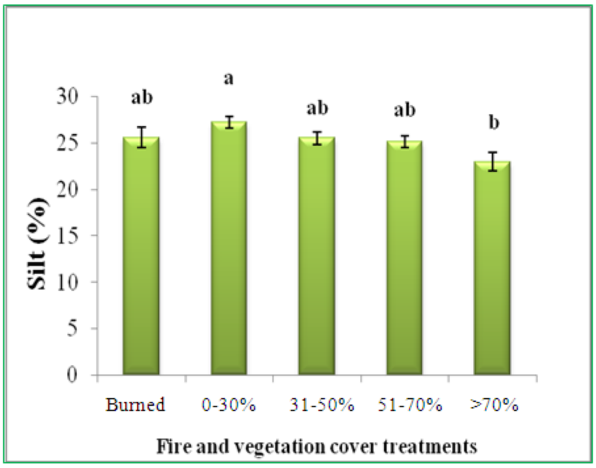


Figure 1. Compare means of Bulk density by Duncan method   Figure 2. Compare means of Potassium by Duncan method

Table 2. Changes in soil properties (Mean ± Std. Error) at burned and vegetation cover treatments sites

Variables	Fire	0-30%	31-50%	51-70%	>70%
Caco$_3$	3.257±1.23 ^{a}	3.261±0.73 ^{a}	4.05±0.44 ^{a}	4.09±0.54 ^{a}	4.69±0.7 ^{a}
OM	2.643±0.096 ^{a}	2.174±0.097 ^{b}	2.149±0.072 ^{b}	2.369±0.069 ^{ab}	2.504±0.096 ^{a}
N	0.043±0.01 ^{a}	0.054±0.01 ^{a}	0.055±0.006 ^{a}	0.047±0.004 ^{a}	0.059±0.013 ^{a}
P	7.777±0.82 ^{a}	10.745±1.31 ^{a}	7.97±0.59 ^{a}	8.201±0.56 ^{a}	9.106±1.32 ^{a}
K	409.46±29.97 ^{a}	314.58±35.81 ^{b}	299.74±10.11 ^{b}	317.77±11.17 ^{b}	341.31±19.76 ^{b}
Bd	1.7943±0.045 ^{c}	2.0108±0.057 ^{a}	1.9479±0.027 ^{ab}	1.826±0.031 ^{bc}	1.806±0.045 ^{c}
Pd	2.509±0.121 ^{a}	2.448±0.044 ^{a}	2.484±0.03 ^{a}	2.440±0.36 ^{a}	2.402±0.058 ^{a}
pH	6.561±0.158 ^{a}	7.007±0.14 ^{a}	6.585±0.099 ^{a}	6.711±0.98 ^{a}	6.89±0.138 ^{a}
EC	641.28±87.96 ^{a}	557±48.59 ^{a}	561.30±22.59 ^{a}	551.54±19.90 ^{a}	609.64±43.04 ^{a}
Na	238.41±32.59 ^{a}	229.26±21.78 ^{a}	211.40±12.07 ^{a}	194.12±11.59 ^{a}	209.54±21.62 ^{a}
Ca	1.841±0.079 ^{a}	2.1023±0.106 ^{a}	2.039±0.079 ^{a}	2.031±0.08 ^{a}	2.11±0.14 ^{a}
Mg	4.571±0.60 ^{a}	4.046±0.7 ^{a}	3.72±0.28 ^{a}	3.639±0.25 ^{a}	3.50±0.54 ^{a}
Sand	52.731±1.73 ^{a}	52.763±1.009 ^{a}	53.143±0.99 ^{a}	54.286±0.64 ^{a}	55.949±1.02 ^{a}
Silt	25.571±1.06 ^{ab}	27.178±0.65 ^{a}	25.521±0.68 ^{ab}	25.143±0.62 ^{ab}	22.951±0.98 ^{b}
Clay	21.069±1.28 ^{a}	20.06±0.99 ^{a}	21.335±0.91 ^{a}	20.57±0.63 ^{a}	21.10±1.11 ^{a}
SM	53.312±2.36 ^{a}	49.492±2.43 ^{a}	52.514±1.17 ^{a}	51.965±1.58 ^{a}	55.337±2.71 ^{a}

Not same signs in each columns show significant differences in compare means (Duncan method at α=0.01)



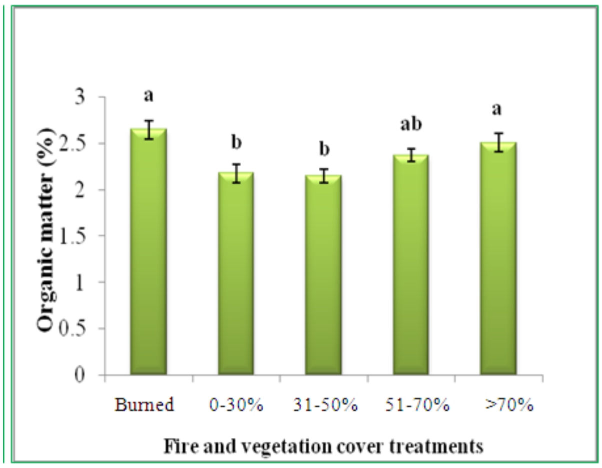


Figure 3. Compare means of Silt content by Duncan method   Figure 4. Compare means of Organic matter by Duncan method

Discussion

The results of compare means with the Duncan method showed potassium and organic matter had highest and bulk density had lowest values at burned sites and had significant differences with different vegetation cover treatments. According to the statistical results are presented in table 2 and figure 4, as well as can understand that fire had significant effect on soil organic matter percentage at different vegetation cover treatments. The reason for this may be high intensity of fire that the heat of the fire could affect soil organic matter. Increase in soil organic C after fire can be the decline of the mineralization rate because of decrease biological activities through decreasing fraction of humic and non-humic material by burning, incorporation organic carbon with minerals and protection against biochemical decomposition similar to aromatic carbon compounds, transform organic matter into a very stable material from reducing the oxygen and carbon alkyls and producing short carbon chains (Certini, 2005). Potassium also release during fire in a gaseous state at atmosphere but potassium release immediately from the litter on the soil surface which may this is the reason why with occurring frequent fires potassium levels not decrease in soils (Wells, 1971). Results of this research showed bulk density was decreased at burned sites. Increasing of organic matter lead to increase porosity and water maintaining capacity in soils and compaction and bulk density decreased (Sommerfeldt and Chang, 1985). Results of One-way ANOVA at burned sites and different vegetation cover treatments on soil characteristics showed that effects of fire was not significant on Acidity (pH), Electrical conductivity, Caco3, Particle density, total phosphorus, total Nitrogen, Saturation moisture, Sand and Clay content, Sodium, Calcium, magnesium. Wan and Lou (2001) after analyzing data from 78 studies reported concentrations of total nitrogen will not cause significant changes by the fire. Some researchers, including (McKee, 1982) reported increasing the soil available potassium after forest fires and expressed this increase is not considerable, while others such as (Ross and McKee, 1995) not reported an increase. (Raison et al. 1985) Expressed more than 50 percent of the phosphorus in the surface of material may be released during fire. Whereas the places that are frequently burned may lead to phosphorus deficiency (Handreck, 1997). These differences are probably due to differences in fire severity, soil phosphorus levels, sampling and fire time or difference in measurements of available phosphorus (Caster and Foster, 2004). Generally, can be stated that in current condition with low information about fire effects on environment and because of risks of its use, using of fire proposed on small-scale and research projects. We recommended performing biological methods such as seed spreading, seeding and mount culture after each fire since we saw an increase in the amount of soil organic carbon after fire.

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Salinisation and Sodisation in the Irrigated Perimeter of the Mina (Northwest Algeria). Diagnosis of Soil Degradation State and Improvement Prospects.

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Abstract
In Algeria, the secondary salinisation constitutes the major and rapid cause of soil degradation and affects about 10 to 15% total area of irrigated lands. The irrigated perimeter of Mina located 350 km west of Algiers has 10600 hectares and is one of the most affected by secondary salinisation phenomenon.
Current work concerns, the degradation state diagnosis of soils by salinisation and sodisation, on one of the most contaminated plots of this perimeter spanning 18 hectares. The approach is based on two analyzing scales of soil state degradation:
- electromagnetic conductivity scale in situ by the EM38 which allowed us to deduce with correlation via ArcGIS, maps of electrical conductivity of saturated paste extract and of exchangeable sodium percentage,
- structural stability scale that allowed us to map the index of structural stability test according to the fast wetting by immersion.
The results show an important accumulation of salts in the soil profile. According to the land use map (cereals, olive and pomegranate) and the irrigation water quality (5,39 $dS.m^{-1}$ in average), the currents hydro-agricultural practices explain largely the salts accumulation in soils profiles and the low yields.
A sustainable hydro agricultural management must take into account, an optimized irrigation conduct and a functional drainage. In this case, the intersection of cards of ESP and structural stability, gives a thematic map of soils sensitivity to physical degradation that constitutes a very relevant tool for optimizing improvement of agro-system.
Keywords: soil degradation, salinisation, sodisation, structural stability, perimeter of Mina.

Introduction

Secondary salinization, one of major cause of rapid soil degradation (Szabolcs, 1993 and Lahlou et al., 2002), affects about 10 to 15% of total irrigated areas in Algeria (Cheverry and Robert, 1998). The irrigated perimeter of Mina, located 300 km west of Algiers, covers an area of 10 600 hectares and is one of the most affected by secondary salinization (Boualla, 2004).
A contribution to diagnosis state of soil salinization and sodisation of this perimeter is done on a parcel of 18 ha based on two scales of analysis:
- An in-situ scale of electrical resistivity (Kearer et *al*., 2002),
- A scale of structural stability (test fast wetting by immersion).

These two scales of observation have established maps of electrical conductivity of saturated paste extract (CEspe), the exchangeable sodium percentage (ESP) and the structural stability of the studied plot.
The cards intersection of the ESP and the structural stability has developed a thematic map of sensitivity to the soils physical degradation. The latter is a relevant interest, particularly, to optimize the hydro-agricultural management of the agro ecosystem.

Materials and Methods

Materials

Study Site
The study plot is located in the heart of the irrigated area of Mina. It is part of the plots having high levels of salinisation.
Electromagnetic Conductimeter
The Electromagnetic Conductivity (EMC) is a technique used by geophysicists for recognition tests of soils. Recently it has been adapted to the study and characterization of agricultural soils. Besides

its advantage of being nondestructive, it permits evaluation of the apparent total salinity of the soil to a depth of 2 meters. The device we used is called the Geonics EM38 in (Fig 1).

Figure. 1. Electromagnetic Conductimeter EM_{38} in vertical position

Methods

Study Methodology

The methodology adopted for this study (Fig. 2), is initially the in-situ measurements in a systematic grid of 25 x 25 m, followed by sampling of soils.

The next step is devoted to a series of laboratory analyzes of samples taken. The data will be processed by statistical and geostatistical and will characterize the study area by the salinity, the SAR and the land use maps.

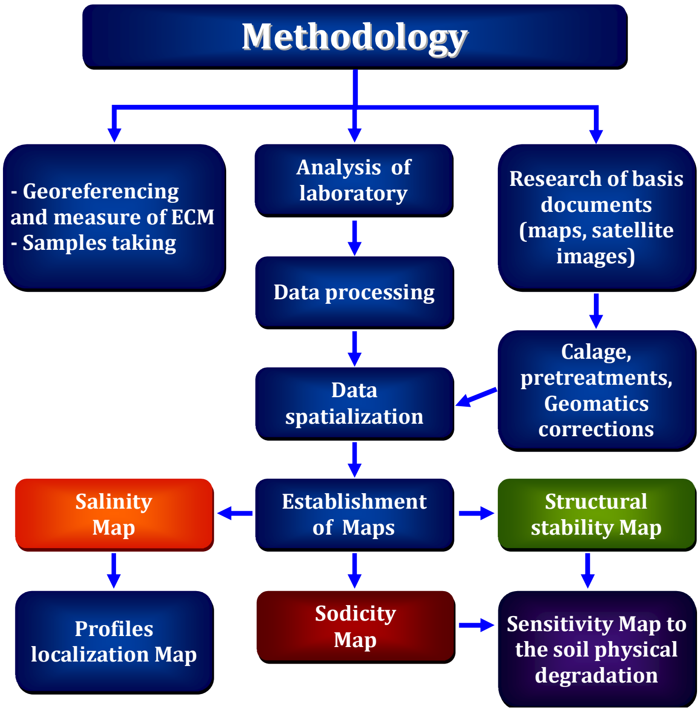

Figure 2.Methodological Organogram adopted

Results and Discussions

The Salinity measure by the method of electromagnetic conductivity (EMC) gives values proportional to those of the electrical conductivity of the soil saturated paste extract (CEspe). Indeed, the values of EMC and those of CEspe are connected by a correlation coefficient of about 0,96 (Fig. 3). This is consistent with what is reported in the literature (Benkhelifa, 2007).

The evolution of the average salinity to a depth of two meters after one year, from March 2010 to March 2011, shows that much of the area is affected by salinity class 8-16 $dS.m^{-1}$, then by the

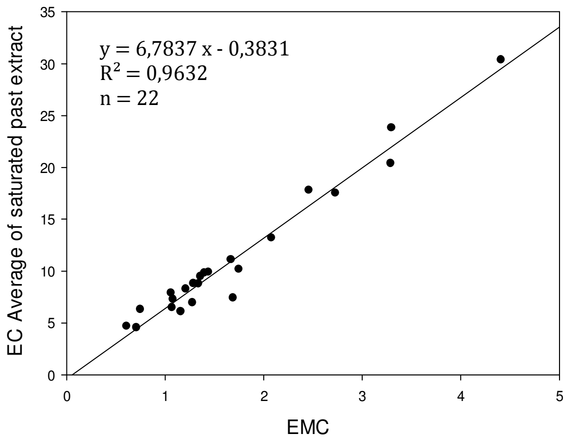

Figure 3. Correlation between EMC and ECspe

class 4-8 dS.m^{-1} (Fig. 4). This can be explained by the combined effects of irrigation water quality (5,39 dS.m^{-1}) and also by the capillary transfers.

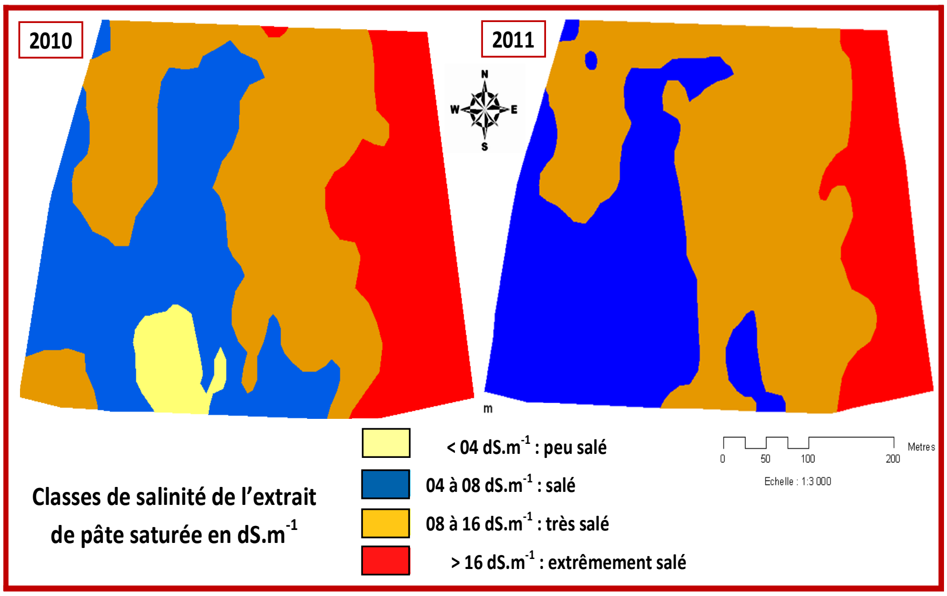

Figure 4. Evolution after a year of total salinity in the experimental plot

For these two classes of salinity (4-8 and 8-16 dS.m^{-1}), the cumulated areas affected record 64,03 and 84,65 % respectively for the years 2010 and 2011 (Table 1). This shows that the current hydro-agricultural management is in way to driving toward a salinity of increasing with time. This is even more problematic than the clay content of soils of the plot are high (23-58%).

Table 1. Distribution of the plot surface by total salinity class after one year

Salinity Class dS.m^{-1}	Surface (%)			
	Values march 2010		Values march 2011	
< 04	4,43		0	
04 à 08	22,14	<u>64,03</u>	34,85	<u>84,65</u>
08 à 16	41,89		49,80	
> 16	31,54		15,35	

For further analysis, it is important to assess the degree of soil sodisation of the studied plot. Indeed, the sodisation phenomenon is likely lead to a deterioration of the structural stability of soils. Therefore, we established the ESP cards and structural stability (Fig. 5), using the method of test fast wetting by immersion (Le Bissonnais and Gaillard, 2004).

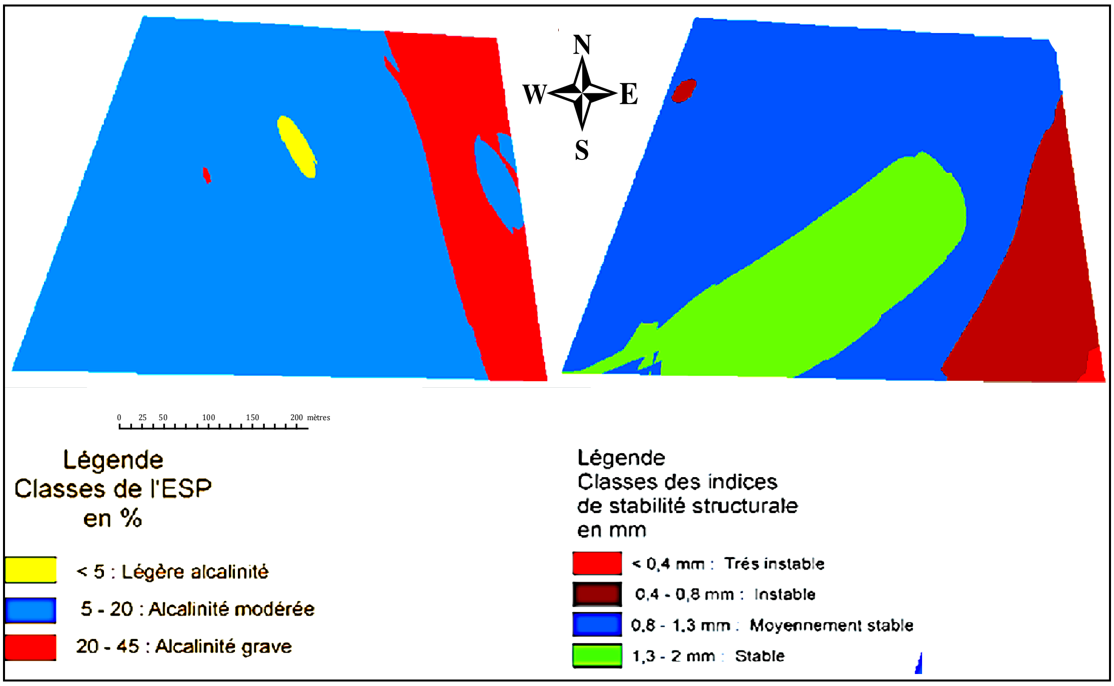

Figure 5. Maps of the ESP and structural stability

These two maps show that this is the east part of parcel that is contaminated by high sodicity (alkalinity) and therefore is subject to structural instability. This permits the adoption of remedial measures for this part. For the rest of the plot, for cons, it is better to be preven in managing agricultural water. By making a crossing of the two previous maps, we obtain a map of sensitivity to physical deformation of the soil of the plot. The latter (Fig. 6), is a valuable tool for effective

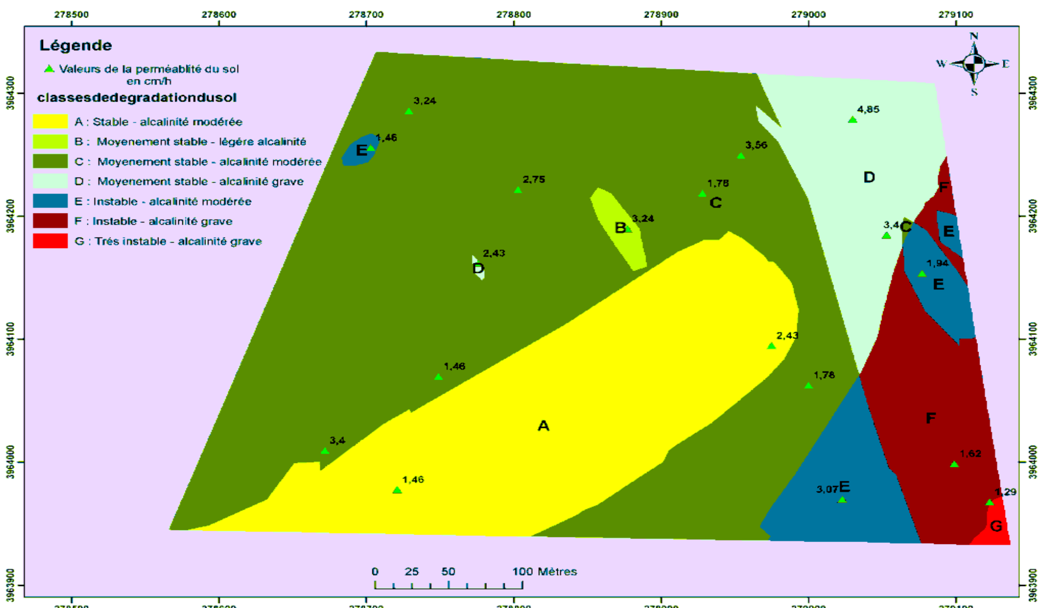

Figure 6.Sensitivity map to the physical degradation of soils of the study site

management of hydro-agricultural environment particularly with regard to preventive perspective. Indeed, it shows an overall state of degradation that has not yet reached the critical threshold since even for the parties most affected (F and G) values of saturated hydraulic conductivity are far from displaying a state of impermeability because they vary between 1,29 and 1,62 cm.h^{-1}.

Conclusions

In this study, the contribution to the diagnosis of the state of degradation of the irrigated area of Mina shows that the current hydro-agricultural practices are not optimized and the phenomenon of salinization and sodisation, continuous to risk of increasing the soil degradation . However, it also shows that the state of physical degradation has not yet reached a critical level which argues for a preventif approach in managing hydro agricultural. For this, the implementation of sensitivity maps to the physical degradation of soils appears to be a very subtle within the reach of farmers to guide their irrigation conduct. In this case, the hydro-agricultural management requires a comprehensive approach and the introduction of sustainable management adapted to the environment (drainage, leaching rates, liming).

In addition to technical measures, it is important to focus on socioeconomic measures (creation of positions of employment and small industries) likely to develop the region while maintaining its ecological balance.

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Reduction of soil salinity and sodicity by *Aellenia glauca* , *Salsola soda and Halocnemum strobilaceum*

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Abstract

Soil salinity and sodicity can cause some problems such as decreasing of water uptake by plant, degradation of soil structure, and also toxicity for plant, so reclamation of such soils is very important issue. One of the common ways for reclamation of such soils is usage of chemical materials with water, which has some problems. In order to study the effects of three halophyte species of plants *{Aellenia glauca* (M.bieb.) Aellen},{*Salsola soda* L.}and *{Halocnemum strobilaceum* (Pll.) M. B.}on reduction of soil salinity and sodicity, an experiment was conducted with complete randomized design with three replicates and each replicate was done in four vases. The seeds were cultivated in a saline-sodic soil .The results showed that all three species reduced significantly electrical conductivity (EC), acidity (pH), exchange sodium percent (ESP), sodium absorbtion rate (SAR) and sodium solution in soil (Na^+) in 5% probability level. Soil salinity (EC) was reduced 40.5% by *A. glauca* 31.7% by *S. soda and* 36.2% by *H. strobilaceum* also soil sodicity (ESP) was reduced 18.9% by *A. glauca* 11% by *S. soda and* 26.7% by *H. strobilaceum*.

Key words: Aellenia glauca, Electrical conductivity, Halocnemum strobilaceum, Salinity and sodicity , Salsola soda

Introduction

Limited freshwater resources, irrigation with poor quality water and soil salinity leading to reduced agricultural production in arid and semi-arid regions (Al busaidi and Cookson,2004). About 23.5 million hectares of land in Iran (14.2 percent) have salinity, sodicity and drainage problems (Dewan and Famouri,1964).Salinity causes the osmotic potential of soil solution reduction (Osmotic stress), Specific ions effects (salinity stress), Imbalance in plant nutrition (nutrient stress) or a combination of these three factors(Rabhi et al.,2010). In addition, degradation of soil physical properties (in the presence of sodium exchange) should also be considered. There are various, physical and biological methods for saline and sodic soils reclamation. The most used method in Iran is chemical method (leaching and application of gypsum and sulfuric acid). But this method is difficult , expensive and requires certain actions, including construction of underground drainage network. Biological methods that include the use of organic materials, Salinity-resistant plants(halophytes)cultivation and etc, are simple and cheap.

Ravindran et al.(2007) studied a saline and sodic soil reclamation with six halophyte species. Their results showed that *S. maritime*, *S. portulacastrum*, *E. agallocha*, *C. inerme*, *I. pes-caprae* and *H. curassavicum* species reduced soil electrical conductivity(EC)71.5%,50%,49%,44% and19% respectively and sodium adsorption ratio(SAR)82%,75%,71%,67%,58% and 50% respectively. Ren et al.(1992) with using the results of a field study in china reported that widely and consistently planting and harvesting *P. chinampoensis* species of plant in saline lands reduce soil salts and improve soil quality for Salt-sensitive plants cultivation. Hanay et al.(2004) were investigated saline and sodic soils reclamation in turkey with gypsum and gypsum with compost. They reported that gypsum and gypsum with compost application to soil, reduce EC from 12.62 to 1.8 and 2.09 dS/m respectively and SAR from 44.22% to 6.61% and 6.78%.

The objective of this research is study the effects of three halophyte species *A.glauca*, *S.soda* and *H. strobilaceum* on reduction of soil salinity and sodicity.

Materials and methods

The seeds of three native halophyte species *A. glauca*, S. *soda* and *H. strobilaceum* were collected from around the Oumia Lake (in West Azarbaijan). Seeds germination in four water salinity levels 0, 10, 20 and 30 dS/m was determined. Some saline and sodic soil was prepared from Bilverdi agriculture research station of Islamic Azad University of Tabriz (in West Azarbaijan) and its some physical and chemical properties such as particle density (ρ_s), bulk density (ρ_b), porosity (n), hydraulic conductivity (K_S), carbonate calcium percent (CEC), pH, exchangeable sodium percent (ESP) and sodium adsorption ratio (SAR) was determined (Table1).

Table 1.Some physical and chemical properties of experimental soil

K_S (cm/hr)	$CaCo_3$ (%)	n (%)	ρ_s (gr/cm^3)	ρ_b (gr/cm^3)	Na^+ (mg/kg)	SAR	ESP (%)	pH	EC (dS/m)	Texture
0.55	23.5	46.76	2.63	1.4	19964	46.8	44.8	8.44	27.6	Silty clay loam

Due to high EC (>4dS/m) and ESP (>15%) selected soil is saline and sodic. For salts balance determination and salts leaching control, halophyte species should not be planted in field, thus planted in pots. 25 seeds were planted in each pot after filling the pots with soil. Three repeats for each species and four pots for each repeat were considered. Drain water was collected from the bottom of the pots and again was poured into the pot thus be prevented from salt leaching. After the growth period, the soil in each pot was air dried and due to the difference in salinity with depth thoroughly mixed until be quite uniform. Then some soil chemical specifics (EC, pH, SAR, ESP) were determined. Agricultural experimental design has been conducted was completely randomized design. Mean comparison was performed using Duncan test at 5% level. Analysis of variance and mean comparison of data was performed using the SPSS-17software.

Results

Soil chemical properties data analysis of variance is given in Table 2. According to this table there is significant difference in the level of 1% between treatments. Mean comparison of EC, pH, ESP and SAR are given in figure 1 to 4 respectively.

Table 2. Soil chemical properties data analysis of variance

Source of variation	df	Mean of square			
		EC	pH	ESP	SAR
Species	3	77.74**	0.068**	78.78**	364.463**
Error	8	0.836	0.003	0.728	2.69
Coefficient of variation (%)		4.54	0.665	2.22	5.35

**: significant difference in the level of 1%

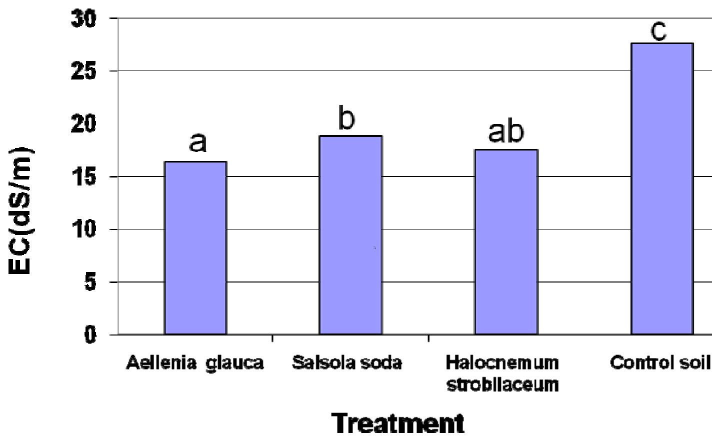

Fig.1. Mean comparison of soil planted with halophytes species and control soil EC

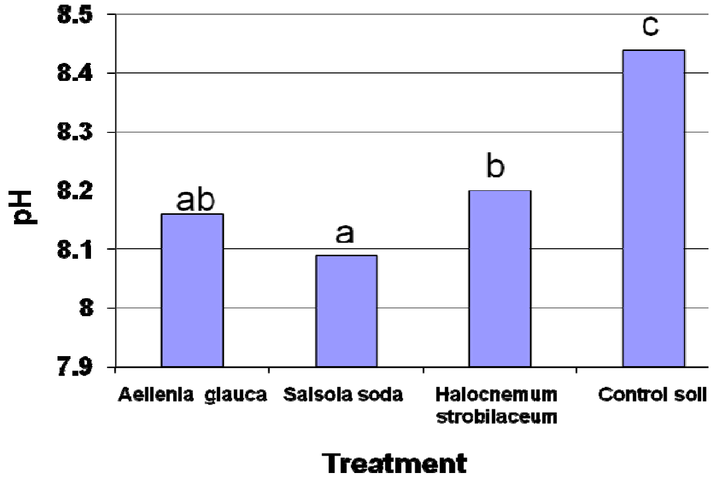

Fig.2. Mean comparison of soil planted with halophytes species and control soil pH

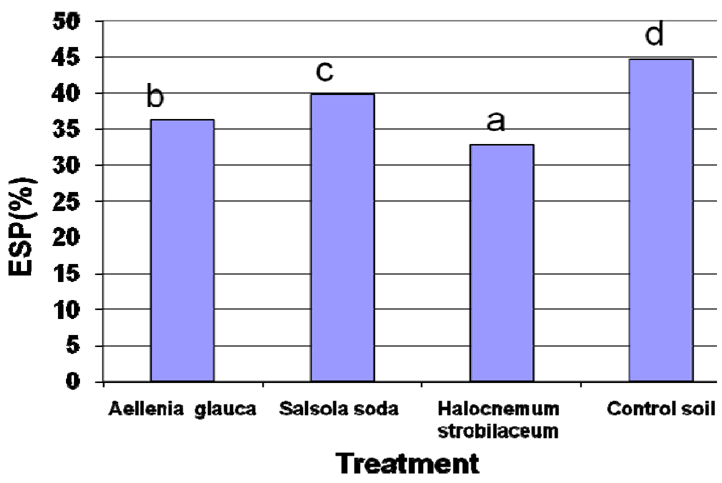

Fig.3. Mean comparison of soil planted with halophytes species and control soil ESP

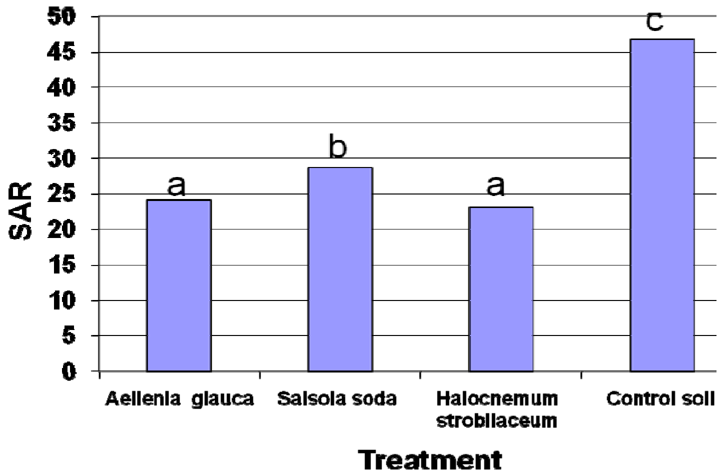

Fig.4. Mean comparison of soil planted with halophytes species and control soil SAR

According to Fig.1 all three species have significantly reduced the EC in comparison with control soil. Also there is a statistical significant difference between the EC of soil planted with *A. glauca* and *S. soda* . The EC of soil planted with *A.glauca* , ,*S. soda* and *H. strobilaceum* have reduced 11.2 (40.58%), 8.77 (31.77%) and 10 dS/m (36.2%) respectively.As shown in Fig.2, all three species have significantly reduced the pH in comparison with control soil and statistically significant difference between the pH of soil planted with *S. soda* and *H. strobilaceum* is seen.
According to Fig.3 all three species have significantly reduced the ESP in comparison with control soil and there is a significant difference between three species. The ESP of soil planted with *A. glauca* , ,*S. soda* and *H. strobilaceum* have reduced 8.5 (18.97%), 4.67 (11%) and 12 (26.78%) respectively.The SAR of soil has significantly reduced by all three species (Fig.4). There is significant difference between the SAR of soil planted with *S. soda* and other species. *The* SAR of soil planted with *A. glauca* , ,*S. soda* and *H. strobilaceum* have reduced 22.74 (48.59%), 18.1 (38.67%) and 23.67 (50.57%) respectively.

Discussion

According to the above results all three species are able to reduce soil salinity and sodicity. Salinity (EC) was decreased by *A. glauca* more than the other two species and it can be concluded that *A. glauca* absorbs more soluble salts than the other two species. ESP was decreased by *H. strobilaceum* more than the other two species. For SAR decreasing, *A. glauca* and *H. strobilaceum* are better than the *S. soda*.
The reason of ESP**,** SAR and pH decreasing is sodium uptake by halophyte species. The mechanism of sodium uptake is CO_2 production by roots, dissolving natural $CaCo_3$ in soil and resulting in the release of calcium and substitution of calcium instead of exchangeable sodium. Thus if the only soil problem is salinity, we can solve this by *A. glauca* planting and if soil is saline and sodic , it can be amended by *H. strobilaceum* planting.
The results show that soil salinity and sodicity reduction is not desirable. So these species must be planted consecutively until soil salinity and sodicity reduce to suitable level. With this method for soil reclamation, will not be required to soil leaching with chemical materials and construction of underground drainage networks. Hence it is recommended that in regions where such problems are encountered, native halophyte species are identified and studied for soil salinity and sodicity reduction.

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Wind Erosion as the Criteria of Soil Degradation in the Coastal Zone of Azerbaijan

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Abstract

This work studies the correlation of degradation of soils subject to the strong anthropogenic impact with soil deflation. The degree of soil and sand deflation as per the types of agricultural land is proposed as one of the criteria for determining the extent of soil degradation. Continuous local wind erosion occurs without strong winds and is unnoticed with simple observations, however, it slowly destroys the soil, reducing fertility. Studies have shown that there is a close correlation between exposure of soil to wind erosion and soil degradation (fertility decline, worsening conditions for the vegetation and decrease in yields), and which can be defined by degree of soil exposure (deflation) to wind erosion. As the criteria to quantify the degree of soil deflation the reserves of humus, total nitrogen, phosphorus, total absorbed bases, and the amount of water-stable aggregates >0.25 mm are taken. These are closely related to productivity and yield of bio-and agricultural lands. These quantitative indicators are closely linked to the resistance of soil to wind erosion. Of the types of agricultural land the strongly deflated ones are the winter pastures, slightly and semi-fixed sands with plant cover of 15-20 and 25-35% respectively, and with removal of fine-grained sand particles between 321-610 tons/ha. Moderately-strong degree of deflation is typical for winter pastures on salt-marshes with plant cover of 10%, where the removal of particles reaches 320 tons/ha. Plough land with conventional tillage, where the removal of particles is 90-170 tons/ha, has an average degree of deflation.

Key words: wind erosion, deflation, intensity, correlation, degradation.

Introduction

Wind erosion is one of the criteria for soil degradation on the coastal zone of Azerbaijan. Environmental fundamentals are in contradiction between society and the natural environment. To mitigate this conflict, and then reduce it to a minimum the rational land use system is necessary.

This paper presents some results of an original field study conducted on Salyan plain on determination of the extent of soil surface degradation under the influence of wind erosion in coastal areas of Azerbaijan, exposed to the strong anthropogenic influence. The researched region has soil and sandy soils, low moisture content in the topsoil, vegetation thinning, temperature and wind conditions that contribute to the wind erosion process. Under the influence of economic activity the anthropogenic-accelerated process of wind erosion develops. Routine and local wind erosion occurs without especially strong winds. This erosion is imperceptible at the surface with simple observation, yet it is slowly and continuously destroys the soil, and reduces its fertility.

The extent of degradation of the soil surface is a qualitative assessment based on the quantitative characteristics of the components and properties, climate and other factors that directly affect the stability of the soil to wind erosion.

Area of field work included Salyan plain which is a large coastal agricultural area of Azerbaijan, typically characterized by strong wind regime. Salyan plain is located in the southeastern part of the Kura-Araz lowland, on the right bank of the lower reaches of the Kura River in the east and adjacent to the Caspian Sea.

The study is intended to be an input to the assessment and implementation of soil protection technology based on the material erosion survey of the territory.Improper agricultural practices in this area leads to a decrease in soil fertility and crop yields.

The plain is characterized by a flat surface with a slight slope towards the sea, lies below sea level (20-26m). The main landforms are ancient and the old channel, natural levees, flat alluvial fans of rivers, interconal depression, etc. Relief is mostly of saline-eolian genesis. Modern coastline has a typical eolian relief of the sand, which is characterized by medium sand and shell and small bumps, flat sandy fields. Dense network of irrigation canals is present across the plane. The formation of the modern topography is directly related to the fluctuations of the Caspian Sea level and the formation of alluvial deposits by Kura River. Morphologically, Salyan alluvial-marine plain is a very young form - approximately 8000 years. Alluvial deposits are presented by sands, sandy loams, loams and clays, all of which are easily subject to wind erosion (Museyibov, 2002).

For most of the coastal zone of Azerbaijan climate is of semi-desert and dry steppe type with mild winters and dry hot summers. High temperatures, low rainfall, high evaporation, the frequent strong winds contribute to the manifestation of the intense wind erosion, especially during years when the air temperature does not drop below 17ºC (May-October). The average temperature in January is positive (+3-8ºC), and the average July temperature reaches 27.5ºC. The annual rainfall in the Salyan plain averages 280-300 mm, with a minimum in summer months. Annual evaporation rate is 940-960 mm.

Prevailing wind regime for the coastal Azerbaijan is formed by NE air flows. On Salyan plain their likelihood and the frequency decreases towards inland. These winds reach 9-15 m/s in average in warm season (Apr-Oct). Southern winds which carry hot dry air is the second-prevailing (6-23 days a year) air flow.

The natural cover of vegetation is represented mainly by the plain desert and semi-desert formations. Here there is a gradual transition from the most primitive types of saline sand vegetation to desert, semidesert, and meadow.

Soils of Salyan plains consist of following types and subtypes: meadow gray saline, meadow gray saliferous, meadow grey, meadow marsh, saline soils and fixed sands.

Meadow gray saline desert soil is the main type of Salyan plains occupying 49% of the area. These soils are used for grain and feeding crops, and cucurbits; in recent past cotton growing. These soils are deflated to the medium and low degree at 11.8% of area (Gahramanova, 1989).

Meadow gray saliferous soils developed sporadically on the background meadow gray saline soils-. They occupy 27% of the Salyan plain, and similarly used for grain, feeding crops, and cucurbits. Deflation to the medium and low degree is also of 11.8% of the soil area.

Saline soils cover 9.3% of the plain. The most dynamic are the puffed saline soils, which are usually have little or no vegetation to secure (see Fig. 1). Loose structure of the upper horizon of salt accumulation contributes to a more intensive removal of dust-salt mixture by wind, compared to conventional soil under the same environmental conditions.

Sands consist of fixed (3% of all sands by area), semi-fixed (55%) and low-fixed (42%) types. This coastal strip of the plain is a valuable winter grazing territory.

In general, Salyan plains have weak deflation resistance, further aggravated by wide-scale growing of annual crops.

Figure 1. Puffed saline soil

Materials and Methods

Estimation of soil deflation degrees, the intensity of the wind blow-off, count and composition of wind-sand flow, dynamics of soil and sand moisture in Salyan plain were conducted by comparative empirical stationary methods. In determining deflation degrees of soils of grazing ground and pastures Kuznetsov (1971) classification has been adapted as a basis. According to it, low-deflated soil is degraded up to ¼ of horizon ‘A’, and strongly deflated is the soil with horizon ‘A’ completely degraded.

Measurement of blow-off of fine-grained sand/ soil particles was carried out on the discount areas of 100 m2 (10×10m) in 3 replicates using measuring sticks (h = 50cm). Thickness of layer of sand or soil blown away by wind for a certain period of time was measured and averaged over the area.

The intensity of the soil blow-off were determined in weight by volume, while the change of wind speed in the surface layer (at heights of 0.1, 0.5, 1.0, 1.5 m) were measured by Fuchs anemometer type MS-13.

The pattern of natural overgrowing of sands and soils were analysed on the 4m^2 plots three times a year. Plants are counted by species and projective cover rate (in %) for the soil type is established.

Basic physical and chemical properties of soils and sands were acquired in laboratory conditions. The data were used to analyse chemical and water-physical properties of soils, determine deflation degree and estimate extent of soil degradation.

Results and Discussion

The study of the intensity of deflation in different agricultural areas showed that the spring-summer period (April-August) with 15-16 cases of north-eastern and eastern winds at critical speeds (> 4 m/s) at the surface of tilled plots with conventional tillage lead to intensive removal of fine material at rate of 90-170 t/ha. Removal from arable land with deep plowing without soil overturning constituted 40-90 t/ha, from fallow land 25-45 t/ha, sparse grass pasture 26-38 t/ha, puffed saline soil 240-400 t/ha, from the surface of the semifixed sand 280-470 t/ha, and low-fixed sands 320-610 t/ha.

Depending on the nature of the agricultural land surface the wind erosion has been manifested with different intensity. In the puffy saline soil without vegetation coverage the fine particle is blown off in far larger volumes than from all other soils in this zone. Such intense blowing is facilitated by the presence of the upper coagulated crust formed during drying of the upper horizon of saline soil. With increasing temperature the entire crust becomes loose material and is easily blown out.

A correlation has been found between the intensity of wind erosion with the form of plowed up plots. On the plowed plots with deep ripping on continuous and different widths (50, 25, 15, 10, 5m) patches with alternating buffer strips of perennial grasses (10 m), the removal of fine grains was respectively: 155, 59, 32, 23, 14 t/ha. With the narrowing of the width of the plowed strips, wind erosion intensity reduces due to increased soil moisture, corrected by width ratio of plowed patches and buffer strips.

The wind speed on all the lands depends on the height of vegetation, surface condition, which causes the uneven effect of wind on the ground. Consequently, the intensity and nature of the blow-off does vary. It was also confirmed that change in wind speed and the intensity of wind erosion is strongly influenced by artificial forest belts on the plains.

The relationship was found between intensity of wind erosion / sand deflation and the degree of vegetative overgrowth of the surfaces. Individual specimens of plants favour the formation of eolian accumulative sand relief.

Studies have shown that there is very specific, tight correlation between the exposure of soil to wind erosion and the soil degradation (reduction in fertility, worsening conditions for the vegetation development and reduced crop yields), and which can be defined on the basis of levels of exposure (deflation) of soil to wind erosion.

Only reliable data on the removal of fertile fine soil particles from the surface and defining its correlation with the natural properties of soil can provide a scientific basis for evaluation of the soil surface the degradation under the influence of wind erosion.

Based on deflation levels of different soil types it became possible to qualitatively classify these soil types by degree of degradation. This classification is given in Table 1.

Table 1 Classification of soils by level of degradation

Deflation levels of meadow gray soils and sands by type of agricultural lands			Classification of soils by degree of degradation
Type of agricultural land	*Definition by level of deflation*	*Removal t/ha*	
Fallow land, with vegetation projective cover of 50%, near-village grazing ground	Negligible	0-5	Very low
Fallow land, near-village grazing ground with vegetation projective cover of 10 to 20 %	Low	6-50	Low
Arable land	Moderate	51-70	Moderate
Winter pasture with vegetation projective cover of 10%, saline land	Moderate-strong	171-320	Stressed
Winter pasture, low and semi-fixed sands, with vegetation projective cover of 15-20% and 25-35%, respectively	Strong	321-610	Critical

It should be noted, that there are different criteria for assessing the degradation of soil and sands, e.g. salt content, carbonate content, industrial pollution of soil. In this study, only one of the criteria was taken: the deflation of the soil surface under wind impact.

Acknowledgements

I would like to thank professors M.A. Museyibov and R.Y. Guliyev for the enormous scientific support and mentorship and dedicate this article to their blessed memory.

The article was translated into English thanks to my nephew A. Mehdiyev.

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Impact of Ground Based Skidding on Residual Trees in Caspian Forests

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Abstract
Mechanical injuries were examined after skidding in hardwood stands. The effects of main factors on stand damage should be well understood by the logging managers to plan proper skidding operations with minimum damage. In this study, Residual stand damage after skidding operations were evaluated in two compartments with different harvest intensity 56 ha stands extracted by Timber jack 450C in Caspian forests of Iran. The main factors (i.e. harvest intensity, basal area per hectare) that effect stand damage were examined. There was no strong relationship between amount of damage occurring to residual trees and the number of residual trees per hectare and residual basal area per hectare, but there was a strong relationship between amount of damage occurring to residual trees and distance to skid trail.

Keywords: Caspian forests, ground based skidding, logging damage.

Introduction
Mechanized skidding is becoming more common in Caspian forests instead of traditional skidding due to economic factors. In managing forest resources, one of the most desirable stand types in terms of sustaining the biodiversity is uneven-aged mixed forest where many trees and shrubs can live together with harmony. Logging prescriptions are increasingly necessary for intensive management of Caspian forests. Unfortunately, logging operations produce residual stand damage that may adversely affect timber growth and value. In uneven aged mixed forests, forest managers mostly apply selection system which ensures and sustains uneven-aged forests, consisting of single trees or group of trees with various age, height, and diameter classes. In selection system, the stand is divided into cutting blocks and each block is periodically (e.g. period of 10 years in Iran) treated by implementing either single tree selection cutting or group selection cutting method. The single tree selection cutting favors growth of shade tolerant species (e.g. beech) while group selection favors the regeneration of light demanding species (e.g. maple). In mixed forest containing both shade tolerant and light demanding species, group selection cutting should be applied. After implementing selection cutting method, trees are extracted. Each harvesting system can cause distinctive damage to remaining trees during logging operations. In applying selection method, inadequate and poor skidding operations may cause serious damages on residual stands due to existence of various tree species with different age classes. The injured residual trees loss considerable amount of timber volume and economical value, and they become more vulnerable to insect and fungus attacks. During the skidding operation minimizing the damage to residual trees is important to maintaining stand vigor and timber quality (Fajvan et al., 2002). Nikoie (2007) indicated that about 1.9% of residual trees receive one type of damage during skidding operation in Caspian forests. Physical damage to roots and boles can result in loss of vigor and growth reduction to trees that may have benefited from reduced competition (shigo, 1985). Damage to residual trees also can reduce timber value because of volume loss caused by wood discoloration or decay. The size and severity of the wound, time since injury, and type of species damages are directly correlated with the amount of decay (Hesterberg, 1957, Shigo, 1979). Damaged trees are also more susceptible to radial and ring shakes, especially in oaks (Fajvan et al.2002). Dvorak, 2005 found that the percentage of injured trees in individual age classes ranged from 1.5 to 2.38% in mountain areas. Yilmaz&Akay, 2008 stated that the main factors that effecting residual stand damage are tree species, location, size, and type of damage. In this study a skidding operation conducted in an uneven-aged mixed forests was studied to examine the stand damages by considering variable factors including tree species, and location, size, and type of damages. The main objectives were to: (1) quantify the extent of damage incurred following skidding in a Caspian forests, (2) identify potential areas for improvement to practice.

Material and methods

Study area and stand characteristics

Study area of 55.8 ha is located in compartment 225 of Namkhaneh district in Kheiroudkenar forest which is in the north of Iran and managed by university of Tehran. In the study area, average elevation and ground slope are 1145m and 26%, respectively. The study area consists of an uneven aged mixed forest where beech (Fagus orientalis L.) and Hornbeam (Carpinus betolus) are dominant trees with scattered alder (Alnus subcordata) trees and very rare maple (Acer spp.) trees. In the study area, the tree diameter classes showed an irregular distribution. In order ensure sustainability of uneven-aged mixed forest, selection system has been applied by performing single and group selection cutting operations within 10 years intervals. In the logging operation, trees were first fallen by using chainsaw and then transported to the landing areas by using wheeled skidder Timberjack 450C. Approximately 12.7m3 of timber per hectare (3.3 trees/ha) was extracted during the operation.

Measuring residual stand damage

After finishing the skidding operations, a 100% field survey was done to collect data of all residual trees in the study area. All trees greater than 7.5 cm DBH and within 2m of the berm edge of skid trails were assessed. The stand damages on trees were assessed by considering variable factors including tree species (beech, hornbeam, maple, and alder), location (root, 0-0.3m, 0.3-1m, and higher than 1m), size (0-200cm2, 200-500cm2, and >500cm2), and intensity of damages (bark damaged, bark squeezed, wood visible not damaged and wood visible damaged). The highest risk for decay is given for trees with injuries in the area of the felling cut and the root collar. Damages on superficial roots or above the root collar (higher than 0.3 m) get less often infected by wood destroying fungi (Meng, 1978). Total of 94 residual trees with breast height diameter of 7.5cm or greater were considered in data collection. The number of beech, hornbeam, maple, and alder trees were 6(6.4%), 72(76.6%), 8(8.5%), 8(8.5%), respectively.

Results and Discussion

Tree species

The results indicated that the number of injured beech, hornbeam, maple, and alder trees were 6(12.5%), 35(72.9%), 2(4.2%), and 5(10.4%), respectively. 100% of the beech trees received the damages because their bark thicknesses are relatively thinner than that of hornbeam and alder trees. All of the skidding injuries were happen in the lower section of the stem. In general, skidding injuries could penetrate deep into the wood and cambium due to thin bark of beech trees. To reduce skidding damage, loggers should be experienced and well trained for effective and preservative skidding operations in Caspian forests.

Location of damage

The results indicated that the percentage of damages on root, 0-0.3m, 0.3-1m, and >1m are 33%(38 injuries), 33%(38 injuries), 25.2%(29 injuries), and 8.7%(10 injuries), respectively. 66% of the damages caused by skidding operation were on lower sections (root and 0-0.3m) of the trees. When skidding damages in most of cases occurred in root and stump level, biotic agents such as fungus and insets easily attack wood through injuries, especially which close to the ground (lilienau, 2003).therefore, injured trees infected by fungus and insects become subject to considerable amount of value loss in long run. Han and Kelloge (2000) suggested that artificial tree protection rigging such as rub pads should be used to prevent damage on stump and stems. Yilmaz and Akay (2008) stated that small size slash material can be located around the lower tree parts to provide a protection layer. Stump height should be low since high stump on skid trails can force skidder to move around the stump, which leads to damages on the trees along the skid trails.

Table2. The summary of stand damages based on location of damage

location of damage	Root	0-0.3	0.3-1	>1
No. of injuries	38	38	29	10

Size of damage

The size of damages was evaluated by considering average width, length, and area of the injury. In skidding operation damage width was larger than damage length due to frequent contact between skidded logs and residual trees. The damage size can be the most significant factor of deterioration. Aho et al. (1989) reported that the larger injuries results in more and rapid deterioration process. The studies indicated that wider and shorter injuries can cause more volume loss than that of thinned and longer injuries. Besides, wider injuries can reduce the diameter growth. Isomaki and Kallio (1974) reported damage width 5-10cm and 17-35cm reduce the diameter growth by 10% and 35%, respectively. Furthermore, recovery from the wider injuries takes longer period of time than of time than of thinner and longer injuries.

Table2. The summary of stand damages based on size of damage

Size classes(cm^2)	0-200	200-500	>500
No. of injuries	37	49	29

Intensity of damage

The results indicated that about 38.3% (44damages) of the injuries occurred on tree barks, resulted in cambium exposed. About 61.7% (71 damages) of the damages was seen to be stem or wood injuries. Yilmaz and Akay (2008) stated that Residual trees with wood injuries become more vulnerable to insects and fungus attacks. Isomaki and Kallio(1974) indicated that the depth and size of the injuries on the wood greatly affect the diameter growth. They reported that diameter growth can be reduced by 10% and 20% due to surface injuries and deep wood injuries, respectively.

Table2. The summary of stand damages based on intensity of damage

Intensity of damage	Bark damaged	Bark squeezed	Wood visible, not damaged	Wood visible, damaged
No. of injuries	21	23	39	32

Conclusion

The residual stand damage from a skidding operation was studied in Caspian forests to investigate the effects of various factors such as tree species, and location, size, and type of damages. In Caspian forests, timber extraction is generally performed by selection cutting method which may cause serious stand damage during skidding operations. Therefore, the effects of specified factors on stand damage should be well understood to plan proper logging operations with minimum damage. The logging managers should implement predetermines straight skidding trails before entering the stand. In extracting timber from a stand consisting of tress with thinner barks (i.e. beech), logging operations should be carried out with extra precautions. Tree protection tools (i.e. rub pads) should be used to reduce damages on stump level and stem level sections. In skidding operations, damage size should be kept as small as possible to minimize potential deterioration on wood due to attacks of biotic agents. The loggers should be well educated about the important functions of uneven-aged mixed forests in sustainability of forest ecosystem. Then, adequately trained and supervised loggers should be employed in selection cutting operations to reduce stand damage.

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Assessment of polymer applications (PVA & PAM) on reclamation of salt and salt-sodium affected soils

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Abstract

Pore stability is very important for reclamation studies of alkaline soils. The objective of this study was to assess effectiveness of polymer applications [polyachriyamide (PAM) and polyviniylalcohol (PVA)] in removing of Na^+ from alkaline soils. Soil samples from different parts of Igdir plain were collected and treated with %0.01 g g^{-1} *(w/w)* H_2S0_4, PVA, H_2S0_4+PVA, PAM and H_2S0_4+PAM. Aggregate stability (AS), hydraulic conductivity (HC) and the amount of Na^+ removed from soil were determined. The results indicated that all treatments had significant effects on the measured characteristics. Aggregate stability of soil increased from 15.4% to 50.7, 39.8 and 20.1% with PVA, H_2S0_4+PVA and PAM applications with the increasing rates of 229, 159 and 31%, respectively. Similarly, HC increased with the rates of 9300, 9253 and 2382% with PVA, H_2S0_4+PVA and PAM applications as compared to the control (0.085 cm h^{-1}). The amount of Na^+ removed from soil was 5.49 mg h^{-1} for the control, but it increased up to 2225.2 with mg h^{-1} H_2S0_4+PVA application. The correlation coefficients between AS, HC and the amount of Na^+ removed from soil were r= 0.342**, 0.766** and 0.767**, respectively. The results of this study clearly indicated that the use of PVA in addition to H_2SO_4 had very significant affect on removal of Na^+ from alkaline soil.
Keywords: Alkaline soils, reclamation, PVA, PAM, hydraulic conductivity.

Introduction

Soil degradation processes cause reduction in plant productivity. Alkalization is a serious problem in where water-table is high and evaporation is much higher than the amount of annual precipitation. In reclamation of alkaline soils, different chemical, physical and biological methods are used in addition to relatively new techniques such as hydrotechical and electro-reclamation methods. The success of these methods mainly depends on the amount of exchanged Na and the effectiveness of Na removal from plant root region. Whatever the reclamation method is, it is much more important to improve soil's permeability and to protect soil pore stability in order to remove Na more effectively from the soil.

In recent years, different organic-sourced soil stabilizers including polyvinyl-alcohol (PVA), polyacriylamide (PAM) and humic acid (HA) are being intensively used for improving soil structural characteristics. Most of these studies indicated that application of synthetic organic polymers on to soil surface even with very low concentrations have positive effects on aggregate stability and soil structural characteristics (De Boodt, 1993; Sojka and Lentz, 1994; Imbufe et al., 2005). Aly and Letey (1990) applied PVA to poorly aggregated and Na-affected soils and reported that PVA increased micro-aggregate stability and improved formation of macro-aggregates. Pefferkorn et al. (1997) underlined that polymer application for stabilizing Na-affected soils is more effective if soil initially treated with Ca. Aggregate stability, infiltration and hydraulic conductivity of alkaline soils increased with PAM applications (Dodd et al. 2004). El Morsy et al. (1991) applied water with different Na adsorption rates on soil columns treated with or without polymer, and determined that PAM had great influence on increasing soil hydraulic conductivity. Dodd et al. (2004) applied different concentrations (0.2%, 0.001% and 0.00005% w/w) of PAM on alkaline and non-alkaline soils and found that polymer application increased the percentage of water stable aggregate, infiltration rate and hydraulic conductivity of soil. Piccolo et al. (1997) reported that humic acid (HA) application on soil with a rate of 0.05 g kg-1 decreased soil losses with a rate of 36 %, and increased aggregate stability and water holding capacity. Wallace and Wallace (1986) reported that water infiltration in alkaline soil with a soil pH of 9.9 could be increased at least 6 times by polymer application without replacement of Na with Ca.

The objectives of this study were to assess effectiveness of polymer applications [polyachriyamide (PAM) and polyviniylalcohol (PVA)] in removing of salt and Na+ from alkaline soils and to determine changes in physical characteristics of these soils.

Materials and Methods

Eight soil samples from 0-20 cm depth of salt and sodium affected areas in different parts of Igdir plain were collected, passed through 4 mm sieve and treated with %0.01 g g^{-1} *(w/w)* H_2S0_4, PVA, H_2S0_4+PVA, PAM and H_2S0_4+PAM. The samples were incubated for three days within plastic covered cups before analyzing. Particle size distribution was determined by the Bouyoucos hydrometer method (Gee and Bauder 1986), soil reaction using a glass electrode pH - meter (McLean 1982), $CaCO_3$ by the Scheibler calcimeter (Nelson 1982), organic matter by the Smith-Weldon method (Nelson and Sommers 1982), electrical conductivity using a conductivity meter in saturation extract (Rhoades 1982a), cation exchange capacity by the ammonium acetate method (Rhoades 1982b), aggregate stability using a Yoder type wet sieving analysis (Kemper and Rosenau 1986), and hydraulic conductivity by the constant head permeameter method (Klute and Dirksen 1986). The amount of Na removed from soil was calculated from the volume of leaching water and Na concentration.

Results and Discussion

The physical and chemical properties of the soils studied are given in Table 1. Clay content changed between 16.7% and 47.5%, pH between 8.8 and 10.3, electrical conductivity (EC) between 1.07 mS cm^{-1} and 47.8 mS cm^{-1}, exchangeable sodium percentage (ESP) between 1.95% and 29.51%.Soils 1 and 2 have no salt or sodium problems, 3, 4 and 5 are salt affected, and 6, 7 and 8 are salt and sodium affected soils.

Table 1. Some physical and chemical properties of soils studied.

Soil property		Soil numbers							
		1	2	3	4	5	6	7	8
Texture	Clay,%	17.9	47.5	23	31.4	16.7	22.2	22.1	22.0
	Silt,%	36.2	33.8	47.5	45.1	22.5	46.7	53.9	30.1
	Sand,%	45.9	18.7	29.5	23.5	60.8	31.1	24	47.9
Textural class		L	C	L	CL	SL	L	SiL	L
pH (1:2.5)		8.8	9.2	9.0	8.8	10.3	10.1	10.2	9.6
EC, mS cm^{-1}		1.07	1.67	5.43	26.70	34.30	47.80	25.80	43.50
ESP %		1.95	4.80	11.21	12.30	12.20	16.03	27.60	29.51
Organic matter, %		0.2	1.5	0.1	1.6	0.3	0.3	0.2	0.1
$CaCO_3$, %		9.5	10.6	11.5	8.9	9.7	9.3	10.3	8.4
CEC, cmol kg^{-1}		30.7	27.1	22.3	30.9	32.8	34.3	19.2	18.3
Exc. Na^+, cmol kg^{-1}		0.6	1.3	2.5	3.8	4	5.5	5.3	5.4

Aggregate stability (AS) of soils studied varied from 1.0% to 51.7% with an overall mean of 15.4%. The AS was higher than 40% only in Soil 1 and 2. All treatments had very significant effects on soil AS (Figure 1). Aggregate stability generally decreased with H_2SO_4 application. The AS of soils treated with H_2SO_4 decreased down to 8.2% with a decreasing rate of 46.6%. This was due to mineralizing effect of H_2SO_4 on organic matter and its reaction with $CaCO_3$. With PVA application, the AS increased at least with an increasing rate of 47.9% as compared to the control. On the average, the AS increased from 15.4% to 50.7 with an increasing rate of 229%. Similarly, the AS increased from 15.4% to 39.8% by an increasing rate of 158.7% with H_2SO_4+PVA application, on the average. Increasing in aggregate stability with H_2SO_4+PVA application was less than that of only PVA treated samples. The PAM application increase aggregate stability from

15.4% to 20.1% with an increasing rate of 30.8%. On the other hand, the PAM application on H_2SO_4 treated samples showed unclear effect on aggregate stability. The H_2SO_4+PAM application caused increasing in aggregate stability in 5 soil samples, but decreased in 3 others. In overall effect, the AS decreased from 15.4% to 12.5% with a decreasing rate of 18.6%. Among the treatments, the lowest AS was obtained from H_2SO_4 application (8.2%) and the highest from PVA application (50.7%). The order of treatments that have positive effects on the AS was as PVA>H_2SO_4+PVA>PAM.

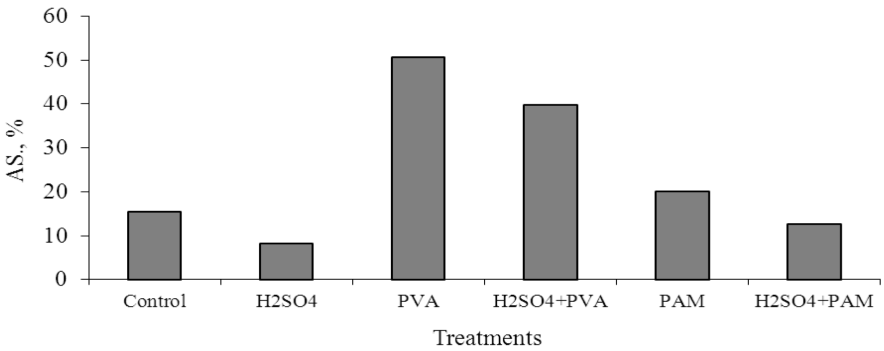

Figure 1. Effects of H_2S0_4, PVA, H_2S0_4+PVA, PAM and H_2S0_4+PAM application on soil AS.

Hydraulic conductivity (HC) of soils studied varied from $7x10^{-4}$ cm h^{-1} and 0,63 cm h^{-1}. The HC of Soil 1 was moderately low and the others were very low. 1.0% to 51.7% with an overall mean of 15.4%. The AS was higher than 40% only in Soil 1 and 2. All treatments had very significant effects on soil hydraulic conductivity (Figure 2). With H_2SO_4 application, the HC significantly increased. Although H_2SO_4 application mineralized organic matter and entered reaction with $CaCO_{3,}$ the HC increased because H_2SO_4 caused taking Na to solution from exchangeable surfaces. With PVA application, the HC changed between 0.04 cm h^{-1} (Soil 8) and 59.85 cm h^{-1} (Soil 1). On the average, the HC increased from 0.085 cm h^{-1} to 7.99 cm h^{-1} with an increasing rate of 9300%. The HC increased from 0.085 cm h^{-1} to 7.95 cm h^{-1} with an increasing rate of 9253% with H_2SO_4+PVA application. Increasing in hydraulic conductivity with H_2SO_4+PVA application was less than that of only PVA treated samples, but the difference between the means was not statistically significant.

The PAM application increase hydraulic conductivity from 0.085 cm h^{-1} to 2.11 cm h^{-1} with an increasing rate of 2382%. The H_2SO_4+PAM application increased hydraulic conductivity from 0.085 cm h^{-1} to 0.82 cm h^{-1} with an increasing rate of 865%. Increasing in hydraulic conductivity with the H_2SO_4+PAM application was less than that of obtained with only PAM. Among the treatments, the lowest HC was obtained from H_2SO_4+PAM (0.82 cm h^{-1}) and H_2SO_4 applications (1.00 cm h^{-1}) and the highest from PVA application (7.99 cm h^{-1}).

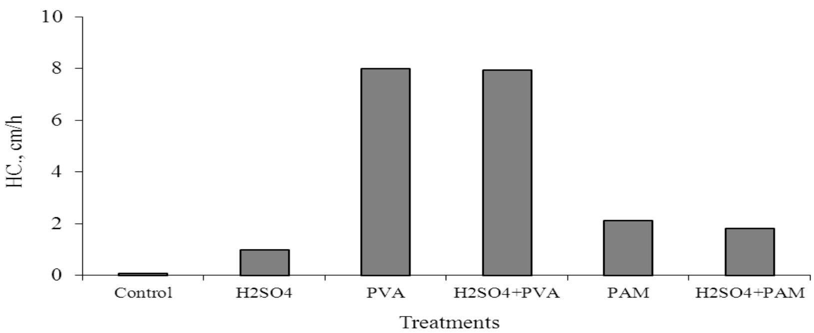

Figure 2. Effects of H_2S0_4, PVA, H_2S0_4+PVA, PAM and H_2S0_4+PAM application on soil HC.

In reclamation of sodic soils, the amount of water passed through soil colum in a specific time is very important in removal of salts and sodium. All treatments increased the amount of water passed through soil column in a specific time as compared to the control. While it was only 3.5 cm^3 h^{-1} for the control, it increased to 41.3, 331.7, 329.8, 89.2 and 34.3 $cm^3\ h^{-1}$ for the H_2SO_4, PVA, H_2SO_4+PVA, PAM and H_2SO_4+PAM applications, respectively. The order of effectiveness of the treatments on the amount of water passed through soil column in a specific time was as PVA>H_2SO_4+PVA>PAM>H_2SO_4>H_2SO_4+PAM. These results showed great agreement with the results of hydraulic conductivity.

The amount of Na removed from soil by leaching water showed significant differences among the treatments. Except in the samples; Soil 3 and 7 treated with H_2SO_4 and Soil 7 treated with the PAM, the amount of Na removed from soil was much more than the control in all other samples. In the control samples, the amount of Na removed changed between 0.015 and 39.20 mg h^{-1}, it changed between 2.82 and 118.02 mg h^{-1} with H_2SO_4 application (Figure 3). On the average, while the amount of Na removed was 5.49 mg h^{-1} in the control samples, it increased to 30.5 mg h^{-1} with an increasing rate of 456% with H_2SO_4 application. With PVA application, the amount of Na removed from soil, on the average, was 552.1 mg h^{-1} which is 9957 percent higher than the control. The amount of Na removed from soil increased from 5.49 mg h^{-1} to 2225.20 mg h^{-1} with an increasing rate of 40432% with H_2SO_4+PVA application. Similarly, the PAM application increased the amount of Na removed from soil, on the average, from 5.49 mg h^{-1} to 192.48 mg h^{-1} with an increasing rate of 3406%. The H_2SO_4+PAM application also increased the amount of Na removed from soil from 5.49 mg h^{-1} to 124.14 mg h^{-1} with an increasing rate of 2161%. Among the treatments, the H_2SO_4 application produced the lowest amount of Na removed from soil (30.5 mg h^{-1}) and the H_2SO_4+PVA application gave the highest amount of Na removed (2225.2 mg h^{-1}). The order of effectiveness of the treatments in removing Na from the soil was as H_2SO_4+PVA > PVA > PAM > H_2SO_4+PAM > H_2SO_4.

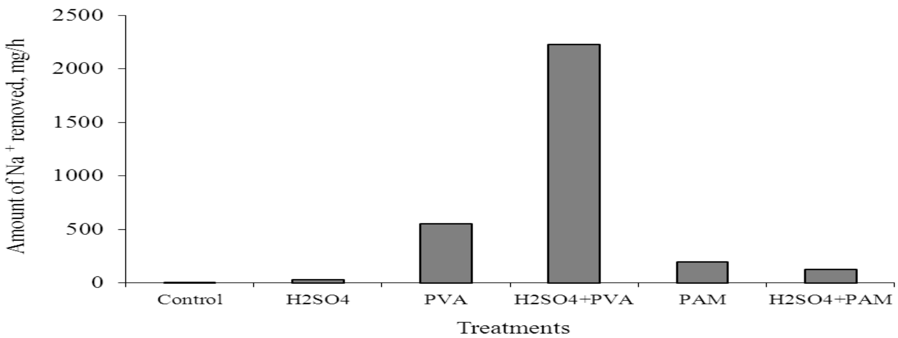

Figure 3. Effects of H_2S0_4, PVA, H_2S0_4+PVA, PAM and H_2S0_4+PAM application on the amount of Na removed from the soil.

Conclusion

The results of this study clearly indicated that;

1. The use of H_2SO_4 in reclamation of alkaline soils generally decreased soil aggregate stability. But aggregate stability significantly increased with PVA and PAM applications. The order of effectiveness of the treatments on improving soil aggregate stability was as PVA>H_2SO_4+PVA>PAM.
2. All treatments had very significant effects on soil hydraulic conductivity. Among the treatments, the lowest HC was obtained from H_2SO_4+PAM and H_2SO_4 applications, and the highest from PVA application (7.99 cm h^{-1}).
3. The order of effectiveness of the treatments on the amount of water passed through soil column in a specific time was as PVA>H_2SO_4+PVA>PAM>H_2SO_4>H_2SO_4+PAM. These results showed great agreement with the results of hydraulic conductivity.
4. Among the treatments, the H_2SO_4 application produced the lowest amount of Na removed from soil and the H_2SO_4+PVA application gave the highest amount of Na removed. The order of effectiveness of the treatments in removing Na from the soil was as H_2SO_4+PVA > PVA > PAM > H_2SO_4+PAM > H_2SO_4.

In conclusion, it is strongly recommended that H_2SO_4+PVA and/or PVA itself confidently be applied to alkaline soils in order to provide better physical conditions for effectively removing Na from soil.

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Water-holding Capacity of Different Inert Mediums in Growing *Lampranthus reptans* for Restoration of Land Degradation Areas.

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Abstract: Lampranthus are drought tolerant groundcovers commonly used in restoration projects as soil stabilizers being adaptable to a variety of habitats and soil types. Often symptomless but contaminated or infected soils on nursery plants introduce root rot Phytophthora into fields. This study trialled the water holding capacity of suitable mediums in growing plants to eliminate the possibility of transferring contaminated soils to restoration areas. Growth responses of *Lampranthus reptans,* an endangered, red listed species was collected and grown in five different inert mediums namely sand, silica sand, vermiculite, perlite, and gravel, in a closed hydroponic system in a greenhouse. Course river sand was used as the control. After 8 weeks growth responses of the plantlets grown in perlite showed the highest performance in fresh weight for both roots and shoots and more significant than the other mediums and the control while, both perlite and vermiculite had a higher dry mass. This difference in weight between fresh and dry mass, showed that the moisture content (g per plant) in roots and shoots of plantlets grown in perlite, was significantly higher than the control and the plants grown in other mediums. The results suggest that the controlled production of *L. reptans* is possible in a medium such as perlite, with a 69% water holding capacity. The future sustainability of successful habitat restoration projects can be successful without the risk of introducing Phytophthora root rot.
Keywords: Aizoaceae, endangered, fynbos, succulent, vygie

Introduction

The genus Lampranthus belongs to the family Aizoaceae (Klak, 2010; Trinder-Smith, 2003) and is known by the common name 'vygie' (Trinder-Smith, 2003; Trinder-Smith, 2006). It is comprised of 155 known species (Goldblatt and Manning, 2000) and occurs from Southern Namibia to the Eastern Cape of Southern Africa, with one species found in Australia (Goldblatt and Manning, 2000; Barkhuizen, 1978). It is well known for its brilliant and bright, shining flowers, which occur in a variety of colours (Barkhuizen, 1978; Trinder-Smith, 2003) with eighty recorded species occurring in the South Western Cape of southern Africa (Trinder-Smith, 2003). Of the 196 species of Lampranthus on the Red List of South African Plants 35 species are red listed as threatened, many of them due to agriculture and housing developments (Trinder-Smith, 2003, SANBI, 2009). Lampranthus are drought tolerant plants (Hitchcock, 2010; Smith et al., 1998), traditionally grown for the horticultural industry as a water-wise plant, often for rockeries (Smith et al., 1998). They grow in a variety of habitats, in different soils such as sandy soils along the coast, shale and loamy soils as well as rocky and sandstone soils at higher altitudes (Smith et al., 1998). *Lampranthus reptans* is an endangered (SANBI, 2009; POSA, 2009; Goldblatt and Manning, 2000; Van Staden, 2005) succulent groundcover used in restoration projects as a soil stabilizer (Cowell, 2010; Table Mountain National Parks, 2009). It is found growing along the Western Cape forelands, where the Cape Flats Sand Fynbos and Atlantis Sand Fynbos have both been listed as critically endangered (Biodiversity GIS, 2009; Holmes, 2008). It is necessary, to research new methods of growing plants used in restoration projects since there is the possibility that soil from the nurseries where the plants are grown, is contaminating the soil in the areas under restoration (Cowell, 2010). When planting into the field, it is necessary to limit this possibility (Cowell, 2010).
In recent years, the technique of soilless culture has evolved from being mainly a research tool to becoming a widespread cultural practice in greenhouses, with the aim to intensify production and reduce costs (Bruggink, 1987; Seawright et al., 1998; Maloupa et al., 1992; Samartzidis et al., 2005). Among the various soilless culture practices, growers have found that the use of substrate is the easiest to adopt (Samartzidis et al., 2005). A medium needs to be well-aerated and has to be able to retain enough water for healthy plant growth (Erstad and Gislerod, 1994; Chavez et al.,

2008). The medium must be chemically resistant, light in weight, inexpensive, free of pests and disease, abundant in source materials and have the strength to support the plant and maintain the crops growth (Chang and Lin, 2007). In hydroponics a standard fertilization routine is necessary to ensure a continuous nutrient supply and a constant target electrical conductivity (EC) (Savvas, 2002; Chavez et al., 2008, Seawright et al., 1998). Water is one of the components necessary for the process of photosynthesis to take place (Tinus, 1974). It is essential for growth in higher plants, and most of the water absorbed by plants is lost during the gaseous exchange process (Guo et al., 2006). The water-holding capacity of a medium is the point at which water is no longer draining freely and being lost from the medium due to the gravitational potential (Raviv and Blom, 2001). When deciding on or formulating soilless mediums, a high water-holding capacity must be coupled with good aeration. In the absence of limitations due to aeration, the most useful mediums are those that supply the most available water to the plant (Richards et al., 1986). Once the medium has reached its water-holding capacity, plants take up water by osmosis. The osmotic potential, which describes the forces between dissolved particles, mainly ions, and water molecules, can be estimated from the EC for common nutrient solutions (Raviv and Blom, 2001; Hanan et al., 1978).
The aim of this study is to investigate the growth of *Lampranthus reptans* response to the water-holding capacity of the different inert mediums while being grown in a hydroponics system, in order to determine the most suitable medium in which to grow this plant for restoration purposes.

Material and methods
Four week to eight week old rooted cuttings were transplanted into a hydroponic system in the research greenhouse at the nursery of the Cape Peninsula University of Technology in Cape Town, South Africa. The experiment started at the beginning of June and continued for twelve weeks. All soil was washed from the root area of the plants, and the root and stem lengths were measured and each plant weighed. The number of leaves on each plant was counted and the diameter of the base of each stem was measured. The plants were separated into five groups of ten. Each group was randomly allocated to a different inert medium, and the rooted cuttings were planted individually into 12, 5 cm pots, which had a square piece of 40% shade cloth (8 cm/8 cm) at the base as well as 118 g of gravel on top of the shade cloth. The inert mediums used as the treatments were gravel (993 g/pot); perlite (70 g/pot); vermiculite (98 g/pot); silica sand (770 g/pot) and as the control, sand (1150 g/pot). The groups were placed into separate gutters (200 cm), mounted onto a table (1.7 m × 0.7 m × 0.75 m). Drippers (2 L/hour), attached to spaghetti tubing feeding off a 20 mm irrigation pipe, per gutter system, delivered the nutrient solution to each pot. The excess solution drained into the gutter and flowed down the 40 mm PVC piping, back into the tank. The nutrient solution consisted of dH2O and CHEMICULT® [Chemicult Products (Pty) Ltd, 133 Camps Bay, South Africa, 8040] (2 g/L), with the pH maintained at 5.8. The nutrient solution was delivered twice a week before 12 pm, on a Monday for 20 minutes and on a Friday for 5 minutes. The greenhouse is fitted with Alunet (40% shade screen), where the temperature was monitored on a weekly basis. Midday temperatures fluctuated between 14 - 21°C.
On a weekly basis, the heights of the plants above ground level, from soil level to the tip of the tallest shoot, were measured. The number of nodes on the longest stem were recorded as well as the number of stems and leaves per plant and the stem width at the base of each plant. Statistical analysis was performed using the One–way analysis of variance (ANOVA), with the computations being performed with the software program Statistica. The Fisher least significance (L.S.D.) was used to compare significant treatment means *at* $P \leq 0.05$ level of significance (Steel and Torrie, 1980).

Results
Results show that the five different mediums significantly affected the number of stems per plant from week's five to eight. As shown in Table 1, the number of stems produced per plant during week 5, in perlite and vermiculite increased significantly ($P \leq 0.01$) beyond the control, sand; while gravel and silica produced fewer stems than the control. Week 6 showed significance ($P \leq 0.001$), with perlite producing the most stems followed by vermiculite and sand. Both week 7 and 8 were

significant (P≤0.05) with perlite having produced the most stems, followed by vermiculite, sand, gravel and silica sand.

Table 1: Effects of different mediums on the leaf number of *L. reptans*

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Medium	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Vermiculite	1.5±0.3a	1.3±0.2a	2.7±0.6a	3.2±0.8a	**4.5±0.9a**	**6.2±1.3ab**	**7.0±1.2ab**	**8.3±1.9ab**
Sand (control)	1.3±0.2a	2.0±0.3a	1.5±0.2a	3.0±0.9a	**3.2±0.7ab**	**4.0±0.9bc**	**5.5±0.8b**	**5.8±1.6b**
Silica	1.2±0.2a	1.3±0.2a	2.0±0.5a	1.0±0.0a	**1.0±0.0c**	**2.8±0.9c**	**4.8±1.2b**	**4.8±1.4b**
Perlite	1.7±0.3a	2.2±0.5a	2.0±0.6a	2.7±0.7a	**5.2±0.9a**	**8.3±1.0a**	**10.0±1.3a**	**10.7±1.4a**
Gravel	1.5±0.3a	2.2±0.5a	1.5±0.5a	1.5±0.5a	**2.2±0.7bc**	**2.3±0.7c**	**5.2±0.9b**	**5.3±1.0b**
One - Way ANOVA (F-Statistic)								
	0.4ns	1.4ns	0.9ns	2.1ns	**5.7****	**6.6*****	**3.7***	**2.6***

*: *P*≤0.05; **: *P*≤0.01; ***: *P*≤0.001; ns: non-significant. Values (Mean ± SE, n = 6) followed by dissimilar letters in a column are significantly different by Fisher Least significant difference (LSD) test at *P* ≤ 0.05.

Table 2: The effects of different inert medium on the leaf numbers of *L. reptans* plants.

Medium	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Vermiculite	**16.2±2.6ab**	**13.7±2.1b**	**28.8±7.4ab**	**34.8±8.0ab**	**43.3±8.3a**	**48.3±9.7a**	**56.3±11.6ab**	**69.3±16.1ab**
Sand (control)	**9.7±1.1c**	**16.7±1.7b**	**14.8±3.4b**	**29.7±5.1ab**	**19.8±4.7b**	**23.5±5.6b**	**40.5±7.2b**	**39.0±10.7b**
Silica	**12.2±1.1bc**	**16.8±2.7b**	**24.2±4.4ab**	**10.5±2.3c**	**9.3±3.4b**	**23.2±5.9b**	**36.3±8.8b**	**36.7±11.4b**
Perlite	**19.7±1.8a**	**27.2±3.8a**	**34.7±4.6a**	**37.3±4.6a**	**48.5±6.5a**	**58.3±7.3a**	**73.8±8.4a**	**87.5±11.3a**
Gravel	**13.2±1.8bc**	**28.0±3.2a**	**18.8±3.2b**	**20.5±3.4bc**	**23.7±3.6b**	**25.5±4.4b**	**41.5±6.4b**	**42.0±7.8b**
One - Way ANOVA (F-Statistic)								
	4.8**	**5.6****	**2.7***	**4.8****	**8.6*****	**5.8****	**3.2***	**3.6***

*: *P*≤0.05; **: *P*≤0.01; **: *P*≤0.001; ns: non-significant. Values (Mean ± SE, n = 6) followed by dissimilar letters in a column are significantly different by Fisher Least significant difference (LSD) test at *P* ≤ 0.05.

Leaf numbers per plant were significantly affected throughout the study period by the five mediums as shown in Table 2. During the test period, weeks 3, 7 and 8 had a significance level of (P≤ 0.05), while weeks 1, 2, 4 and 6 had a significance level of (P≤0.01) and week 5, a significance level of (P≤ 0.001). Perlite had the highest leaf count throughout the 8 week period and by week 8; vermiculite had the second highest number of leaves per plant. Results also showed that by week 8, plants grown in silica sand and gravel had on average, the same number of leaves as the control. The effect of the water holding capacity of the five mediums can be seen in the differences in stem length shown in Table 3. Results showed that the stem length increased significantly (P ≤ 0.01) by week 8. Perlite produced the longest stems, followed by vermiculite, gravel and silica sand. All four mediums outperformed the control. Table 4 shows the influence that the water holding capacity of each medium had on the fresh and dry mass of the roots and shoots of *L. reptans*, as well as the effect it had on their moisture content. The dry shoot mass showed a significant (P≤ 0.05) difference between the mediums, with perlite having the highest dry shoot mass, followed by vermiculite. Both perlite and vermiculite had a higher dry shoot mass than the control and silica sand while gravel had the lowest.

Table 3: The effect of different mediums on the stem length of *L. reptans.*

Medium	Week 1	Week 8
Vermiculite	9.4±1.2a	**21.7±1.2ab**
Sand (Control)	7.9±0.9a	**12.7±3.5c**
Silica	6.3±1.0a	**14.0±3.5bc**
Perlite	10.4±1.3a	**26.0±1.5a**
Gravel	8.5±1.3a	**19.5±2.8abc**
One - Way ANOVA (F-Statistic)		
	1.8ns	**4.2****

**: $P \leq 0.01$; ***: $P \leq 0.001$; ns: non-significant. Values (Mean ± SE, n = 6) followed by dissimilar letters in a column are significantly different by Fisher Least significant difference (LSD) test at $P \leq 0.05$.

Table 4: The effect of different media on the fresh and dry root and stem mass as measured in the glasshouse experiment during week 8, the final week of the experiment

		Fresh mass (g)			Dry mass (g)			Moisture content (g)	
Medium		Root	Stem		Root	Stem		Root	Stem
Vermiculite		**2.8±0.3b**	**3.8±0.8b**		**0.2±0.0a**	**0.3±0.1ab**		**2.6±0.3b**	**3.5±0.8b**
Sand (Control)		**2.2±0.7bc**	**2.8±0.8b**		**0.1±0.0b**	**0.2±0.0bc**		**2.1±0.7bc**	**2.6±0.8b**
Silica		**0.9±0.2cd**	**4.1±0.8b**		**0.1±0.0b**	**0.3±0.1bc**		**0.8±0.2cd**	**3.8±0.7b**
Perlite		**5.3±0.5a**	**7.0±1.1a**		**0.2±0.1a**	**0.4±0.1a**		**5.1±0.5a**	**6.5±1.1a**
Gravel		**0.2±0.0d**	**1.9±0.5b**		**0.1±0.0b**	**0.2±0.0c**		**0.1±0.0d**	**1.8±0.5b**
One - Way ANOVA (F-Statistic)									
		20.9***	**5.3****		**5.1****	**4.0***		**20.1*****	**5.2****

*: $P \leq 0.05$; **: $P \leq 0.01$; ***: $P \leq 0.001$; ns: non-significant. Values (Mean ± SE, n = 6) followed by dissimilar letters in a column are significantly different by Fisher Least significant difference (LSD) test at $P \leq 0.05$.

In Table 4, the fresh shoot mass, dry root mass and the moisture content of the shoots showed significance (P≤ 0.01). The fresh shoot mass of perlite was the highest while the other mediums were not significantly different to the control. Both vermiculite and perlite had a higher dry root mass than the control, which was the same as the other two mediums. Perlite had the highest shoot moisture content while the other 3 mediums had the same shoot moisture content as the control. The fresh root mass and the moisture content of the roots, showed a significant (P≤0.001) difference between the mediums (Table 4). Perlite had the highest fresh root mass of 5.3 g, followed by vermiculite, sand (control), silica sand and gravel. The moisture content in the roots of perlite was the highest. Vermiculite had the second highest root moisture content, followed by the control; while gravel had the lowest. Table 5 shows that the water holding capacity of the five different mediums is significantly (P ≤ 0.001) different. For both the wet and dry weight of the mediums, the control is the heaviest, followed by gravel and silica which are of the same weight; vermiculite, and the lightest medium being perlite. Perlite had the highest water-holding capacity, followed by vermiculite and sand. Both silica and gravel held the least amount of water with gravel having a water-holding capacity of only 0.9%.

Table 5: Moisture characteristics of the different mediums used in the glasshouse experiment.

Medium	Wet weight soil	Dry weight soil	Water held soil	WHC
		(g)		(%)
Vermiculite	**14.0±0.2c**	**5.6±0.2c**	**8.4±0.3a**	**60.1±1.6b**
Sand (Control)	**47.1±0.9a**	**39.9±0.8a**	**7.1±0.1b**	**15.2±0.3c**
Silica	**31.0±0.7b**	**30.4±0.7b**	**0.6±0.0d**	**1.9±0.1d**
Perlite	**6.7±0.4d**	**2.1±0.0d**	**4.6±0.4c**	**69.0±1.2a**
Gravel	**31.5±0.9b**	**31.2±0.9b**	**0.3±0.0d**	**0.9±0.1d**
One - Way ANOVA (F-Statistic)				
	544.6* **	**692.0*** **	**313.4*** **	**1356.7*** **

***: $P \leq 0.001$; WHC: Water holding capacity. Values (Mean ± SE, n = 6) followed by dissimilar letters in a column are significantly different by Fisher Least significant difference (LSD) test at $P \leq 0.05$.

Discussion

The results of this study showed that perlite improved the growth and yield of *L. reptans.* Similarly, Altman and Freudenberg (1983) found in the propagation of *Pelargonium graveolens*, that the rooting and growth of plantlets were found superior in perlite, which supported the greatest fresh weight accumulation of both roots and new leaves. Altman and Freudenberg (1983) ascribed this improved root formation and growth to the superior aeration and drainage of this particular substrate. In this study however, results showed that perlite, the lightest medium for both the wet and dry mass, had the highest water-holding capacity when compared to the other four mediums. This can be explained by the characteristics of perlite. Perlite, which has a coarse grain size, is made up of tiny closed air cells and the surface of the particle is covered with tiny cavities, which gives it a larger surface area (Baran et al., 2001; Chassapis et al., 2010; Silber et al., 2010). These surface cavities trap moisture, maintaining the air- water balance (Chassapis et al., 2010). Therefore, although it has the highest water-holding capacity, it does not become water-logged and it remains well aerated. Adema and Henzen (1989) found that the rate of growth of plants can be different in different mediums. An adequate supply of water is one of the most important resources required for plant growth and function (Guo et al., 2006; Roose and Fowler, 2004). Water stress therefore inhibits plant vegetative growth by limiting transpiration and the amount of nutrients drawn to the plant (Grove et al., 1988; Guswa, 2005; Ismail et al, 1994; Sadras and Milroy, 1995), and thus the different water-holding capacities of each medium influence the efficiency of the photosynthetic apparatus since the amount of available water is different in each medium. The depletion of soil water from the root zone affects the plant water status, thus affecting physiological and biochemical activities in the plant (Ismail et al, 1994). As seen in this experiment, gravel and silica sand had a low water-holding capacity, with gravel holding only 0.9% while perlite had a water-holding capacity of 69% and vermiculite a water-holding capacity of 60.1%. The importance of the water-holding capacity of soils in influencing the crop yield has been widely recognized (Lawes et al., 2009; Asseng et al., 2008). Our results clearly showed the effects that the water-holding capacity of a medium has on plant growth, since the leaf number, stem number and length as well as the total fresh and dry weight per plant, were higher in plants grown in perlite and vermiculite as compared to the control, gravel and silica sand. The high moisture content of both the roots and shoots seen in plants grown in perlite can be an indication of rapidly growing plants due to a higher water-holding capacity.

Conclusion

In this study, the investigation into different inert growing mediums for potted *L. reptans* plantlets has produced valuable results as the rate of growth increased with the increase in the medium water-holding capacity. Although in all aspects, plants grown in perlite showed the best growth performance, further studies can be done with various other supporting materials as well as combinations of these materials and tested during different seasons. Furthermore, the drainage rate and physical properties of the mediums used, the pH, the electrical conductivity (EC) and nutrient requirements in the hydroponic media on the growth of *L. reptans* need to be investigated.

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Taxonomic and Functional Characterization of Microbial Communities in Technosols Constructed for Reclamation of a Contaminated Industrial Wasteland

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Abstract
The construction of Technosols is an emergent technology based on the assemblage of technogenic materials such as treated soil, recycled waste and industrial by-products for ecological reclamation of degraded lands and waste recycling. Although this technology is in expansion, knowledge about the microbial communities in Technosols is limited, despite their central role in ecosystem functioning. This two year study characterized the structure and taxonomic diversity of the bacterial community in two types of Technosols constructed to reclaim sites that had been contaminated by polycyclic aromatic hydrocarbons (PAHs) and metals. The structure of the microbial community was analyzed by fingerprinting and the taxonomic diversity was assessed by 16S rRNA clone library sequencing. The results showed that the microbial community in the Technosols was very similar to that in natural soils with up to 50-80% Proteobacteria. However, real time PCR quantification of the abundance of ammonia oxidizers, nitrate-reducing and denitrifying microbial communities involved in nitrogen cycling revealed that bacteria and not crenarchaea were the dominant ammonia-oxidizers in the constructed Technosols. The spatial variability of the microbial community was high and decreased with time, suggesting an early pedogenesis of the Technosols leading to the homogenization of the microbial habitat. The study highlights the potential of constructed Technosols to perform important soil ecosystem functions and degraded land reclamation.

Keywords: Land reclamation; Technosols; contaminated soils; Nitrogen cycling; microbial community

Investigating soil fertility degradation using GLASOD model and geopedology, TMU and satellite imagery photomorphic working units

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Abstract

Soil is a valuable natural resource that in the short-time is considered as a non- renewable resource and its reclamations is difficult when degraded. Soil degradation can be defined as a loss or a reduction of soil fertility. Soil degradation refers to the processes by which soil declines in quality and makes it less fit for a specific purpose, such as crop production. It happens when soil loses its nutrients, or its organic matter. It also happens when the soil structure breaks down, or if the soil accumulates toxics from pollution. Soil degradation maps have been used as important sources of information in soil studies. In this research, working units provided by geopedology, terrain mapping unit (TMU) and satellite imagery were compared in providing soil degradation map by GLASOD model in Honam sub basin, Lorestan province, Iran. At each working unit location soil was sampled and quality control charts and soil degradation indices were analyzed. Results demonstrated that the accuracy of soil degradation maps resulted from geopedology and TMU methods were 68.9, 66.3%, respectively. In addition to accuracy and precision, economic and executive matters are the very important factors in preparing soil degradation map at national scale. Higher number of working units, replication of units and increasing field control points are the most important factors affecting on the map preparation expenses. GLASOD map resulted from TMU and geopedology methods had less number of working units compared to photomorphic units in ETM^+ image processing.

Keywords: Soil degradation, GLASOD, TMU, Geopedology.

Introduction

Land and soil degradation assessments have recently become more fashionable responding to environmental concerns in countries that have claimed its significant adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life.

Soil degradation includes reduction on soil productivity or its nutrients loss by soil erosion. According to a research on recognizing actual and potential dangers threatening soil fertility and causing erosion in north of Zimbabwe, it is possible to recognize the situation and introduce some recommendations before degradation take place (Oldeman, 1993). GLASOD is one of the most accurate and cheapest models for mapping soil degradation (Oldeman, 1993).

Tiessen et al. (2002) and Mbagwu (2003) have expressed that 85 percent of soil degradation is related to soil erosion and 15 percent is due to deforestation and destruction of the vegetation cover. Bakker et al. (2005) indicated that under intensive, mechanized agriculture yield reductions at the field scale are if the order of only 4% for each 0.1 m of soil loss.

Despite the plethora of literature that exists on the soil degradation field, most of them are focusing on direct measurement of nutrients in the sediments yielded from soil erosion. Considering scarcely documented researches in applying different work unit maps and their accuracy and precision, the present study has been conducted to compare working units provided by TMU, geopedology, and satellite imagery to map soil degradation by GLASOD model (Oldeman, 1993), compute soil degradation index, and draw quality control charts, within the Honam sub-basin of Karkheh river basin in the north of Lorestan province, Iran.

Materials and Methods
The study area is located in Honam, one of the sub-basins of Karkheh river basin, in the north of Lorestan province, Iran (Fig. 1). The 140 km^2 watershed lies between 33°44′51″–33°51′47″ N and 48°12′30″–48°28′45″ E. The annual precipitation is 560 mm falling mostly from December to March in the form of snow. The average temperature is 10°C, with a minimum of 4°C and a maximum of 22 °C respectively.

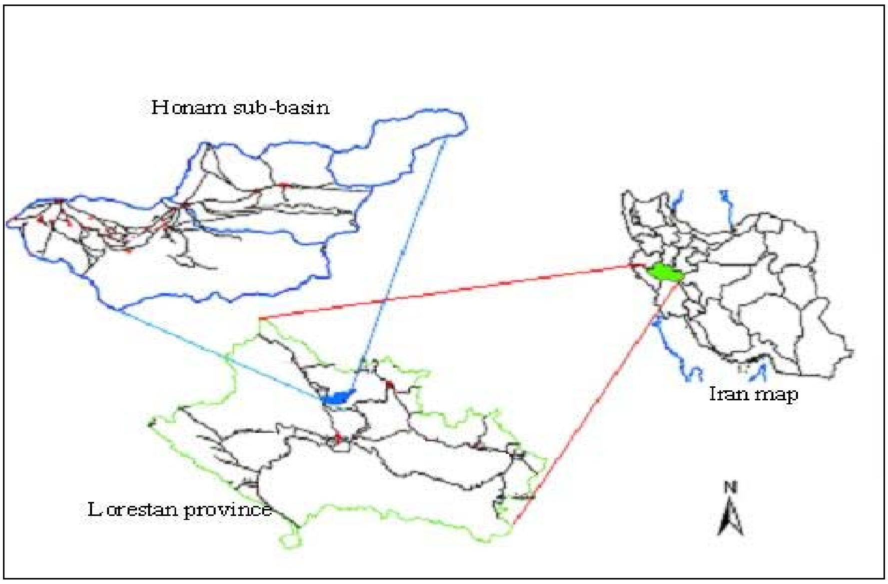

Fig. 1 The location of study area in Iran map

Three different methods were used to partition the study area into uniform polygons as working units. Terrain Mapping Unit (TMU) introduced by Meijerink (1988). Geopedology method introduced by Zinck (1988). Satellite imagery processing and on screen digitizing photomorphic units with special attention on colour, tone, texture, and drainage pattern.

Soil was sampled and analyzed in each working unit. It took place in 73, 107 and 74 locations in TMU, geopedology and photomorphic working units, respectively. Quality control charts were also prepared, using Ryan (1989) method, for organic carbon, total nitrogen, available phosphorus and potassium, bulk density, micro nutritious elements such as iron, zinc, manganese and copper in each sampling site. Soil degradation indices for soil fertility qualifications at each working unit were computed using Eq. 1 (Barrow, 1991).

$$SDI = \{(D/ND)\times 100\} - 100 \qquad (1)$$

Where *SDI* is the soil degradation index of each soil compounds (%), *D* is the amount of compound in soil sample, and *ND* is the compound's upper limit in non degraded site.
Equation 2 was used for investigating each method's accuracy.

$$A = \frac{\sum_{i=1}^{n} a_i c_i}{\sum_{i=1}^{n} a_i} \qquad (2)$$

Where *A* is map accuracy or map conformity with actual condition (%), a_i is working units' area (ha) and c_i is maximum area of each working unit that is uniform compared to actual conditions (percent). Accuracy of working units and Root Mean Squared Error of working units' accuracy were computed by equations (3) and (4).

$$AE = \left| Z_{(x_i)} - Z^*_{(x_i)} \right| \qquad (3)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}\left[Z_{(x_i)} - Z*_{(x_i)}\right]^{2}}{n}} \qquad (4)$$

Where AE is absolute error of the method or working units' accuracy, $RMSE$ is Root Mean Squared Error of working units' accuracy, $Z^{*}_{(x)}$ is working units' area (ha) and $Z*_{(x_i)}$ is working units' area (ha) that is uniform in actual condition.

The precision of each method was investigated by applying the working units' accuracy coefficient of variation (equation 5).

$$CV = \frac{S}{\overline{X}}.100 \qquad (5)$$

Where S is working units' accuracy standard deviation and $\overline{X}$ is method accuracy.

Results

Upper and lower control limits of organic carbon, total nitrogen, available phosphorus and potassium, bulk density, iron, zinc, manganese and copper are prepared for computation of soil degradation indices of all working units. As an example, Figs. 2 and 3 illustrate upper and lower control limits of organic carbon in each working unit of geopedology and TMU methods, respectively. Results showed that the accuracy of soil degradation maps resulted from geopedology and TMU methods were 68.9, 66.3%, respectively. Also, coefficient of variation of working units in Geopedology and TMU methods were 30.26, 25.58 %.

Results showed that there are 45 types of working units in 94 locations in geopedology method, 46 types of working units in 61 locations in TMU method and 74 types of working units in 167 locations in geopedology method.

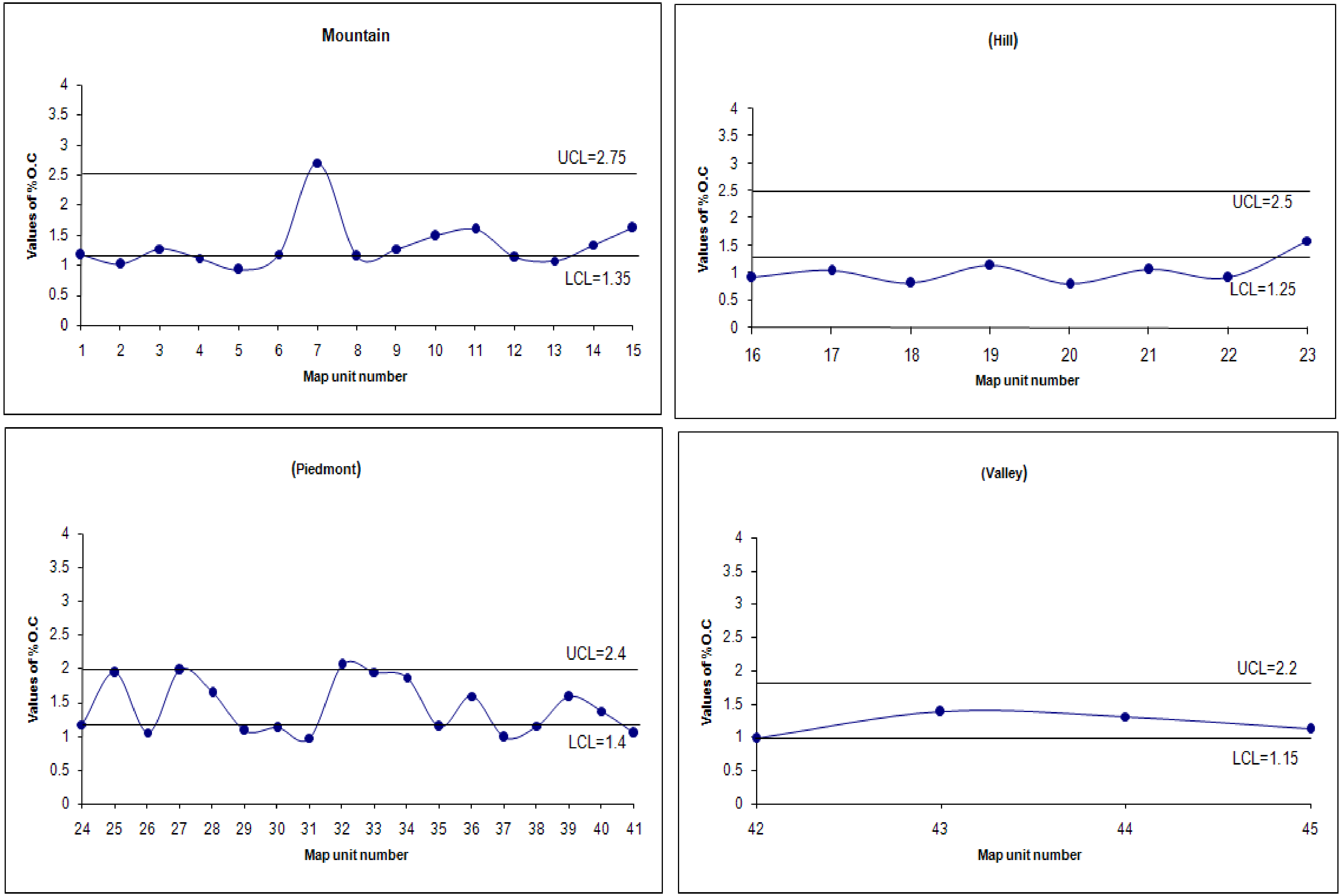

Fig. 2 Upper and lower control limits of organic carbon in each working unit of geopedology method

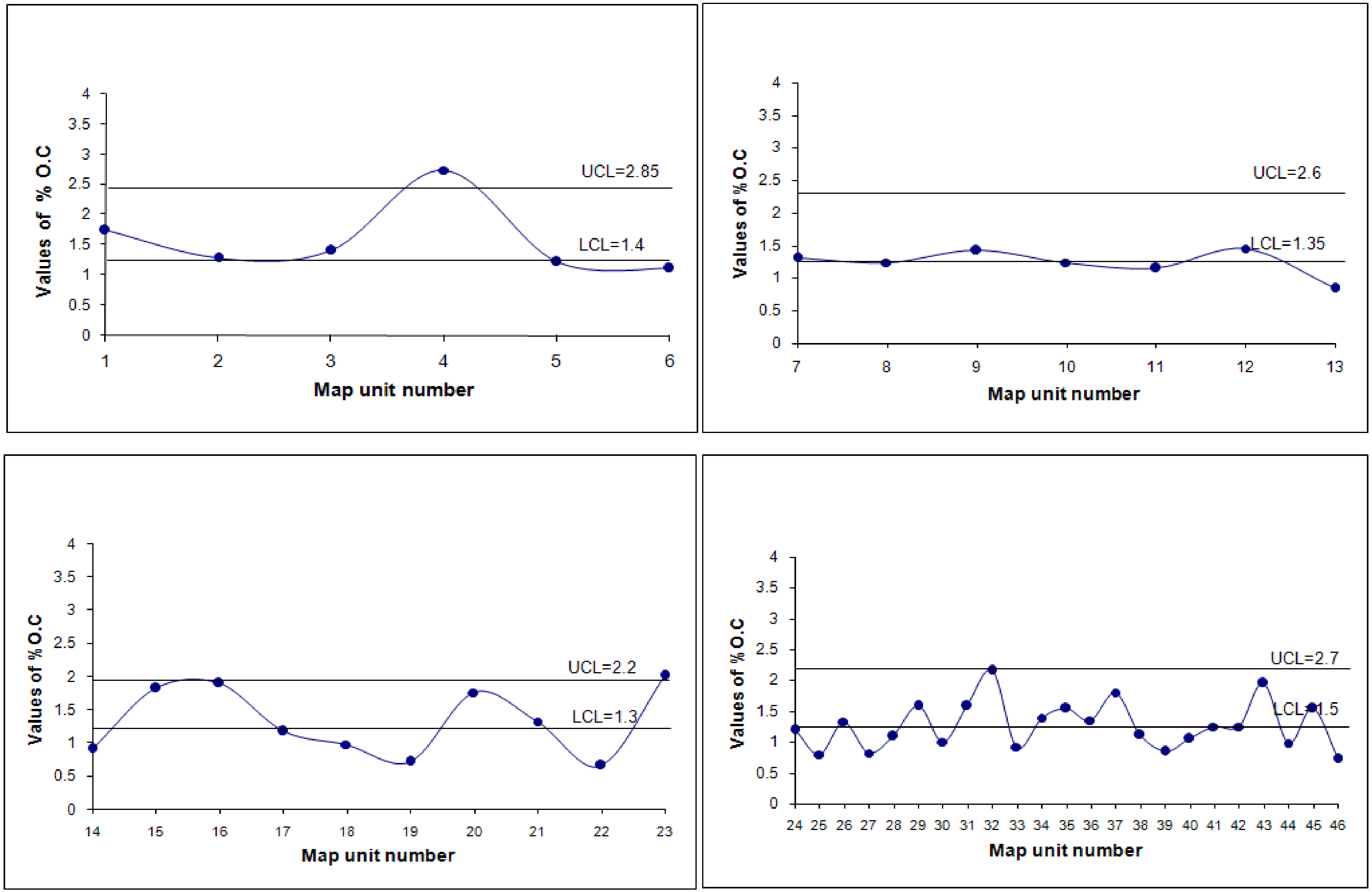

Fig. 3 Upper and lower control limits of organic carbon in each working unit of TMU method

Discussion

GLASOD map resulted from TMU and geopedology methods had less number of working units compared to photomorphic units in ETM+ image processing. The results showed that the degree of fertility degradation in Photomorphic units and ground control points were similar in 51 points from 69 points and are different in the 18 points. Therefore the accuracy of degradation maps of soil in the interpretation of satellite image units is estimated in 73.9%.

The results showed that the calculated t-value in the paired comparisons test is 0.48 and it is less than table-t at the five percent level (1.67). Therefore accepted the zero assumption based on no difference in the degree of fertility degradation of ground control points and Photomorphic units in five percent levels and they are not significantly different. Also, results showed that calculated Z-value at the Vilkaksen test is 0.47 and it is less than of table-Z in five percent level (1.96). Therefore accepted the zero assumption based on not different in the degree of fertility degradation of ground control points and Photomorphic units in five percent level and they are not significantly different. The results of degradation map accuracy of soil in the Photomorphic units and statistical tests shows that, this map was close to the ground truth and there is no significant differences with that and could be to use that for evaluate the accuracy and precision of soil degradation maps in the working unit determination methods.

Results showed that at the both methods instance points on TMU map there is no meaningful statiscal differences. Also, results showed that there are meaningful statiscal differences at the both methods instance points on geopedology map.

Acknowledgements

The integrity of soil degradation map resulted from geopedology method is more than soil degradation map resulted from TMU method. The accuracy of soil degradation map resulted TMU method is more than degradation map resulted from geopedology method. The highest soil degradation indices in the the Honam sub_basin were available phosphorus, Zinc, organic carbon and total nitrogen, respectively.

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Effect of Fertilizers on the Productivity of Crop Rotation and on Organic Matter in the Soil

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Abstract

Scientists' research has found that higher yields are obtained with combined application of organic and mineral fertilizers. Under the influence of fertilizer application and cultivation of certain crops in the rotation soil properties are changing, including organic matter. The purpose is to establish the effect of fertilizers on the productivity of crops in the rotation, and organic matter content in the soil. Investigations were carried out in the prolonged stationary experiment on the basis of the experimental field of SI "Perm Research Institute of Agriculture" in Lobanovo of the Perm region of the Perm Kray. Systems have an ambiguous effect of fertilizers on crop yield of crop rotation. There was significant increase in yield of grain crops and potatoes. For example, in the control variant (without fertilization) yields of spring wheat was 2.38 t/ha, organic system – 3.00, and mineral – 2.99, and organic mineral – 3.33 t/ha. Perennial grasses provided a slight increase in yield, but it is not proved mathematically. In calculating the balance of humus in the rotation, a positive balance recorded only in the version with organ mineral fertilizer system. For example, in the control variant (without fertilizer) the balance of humus was -0.55 t/ha, an organic system – -0.07, mineral system – -0.06, and organic mineral system – 0.02 t/ha. This method of calculating the humus balance does not reflect the real income of organic matter in soil, including humus. We found that the studied systems increase crop productivity and crop rotation and have an ambiguous effect on the content of humus in the soil.

Keywords: system fertilizers, soil, the productivity crops, organic matter

Introduction

The productivity of crops depends on many factors. The most effective, cheap and affordable agricultural practices increase crop yields is the cultivation of them in the crop rotation. Crop rotation allows the efficient use of predecessors and increase the economic and energy crop return on application fertilizers. V.V. Lapa and others (2011) note that the application of organic mineral system provide maximum productivity field rotation – 7.7-8.8 t/ha food unit.

The effect of fertilizers on yields crops depends on soil on which their cultivate. With all things being equal, than the fertile soil, the higher the level of crop yields. Soil fertility is an important property in evaluating the ability of soil to meet the needs of plants for nutrients and thus provide yields of agricultural crops. The degree agricultural transformation is determined based on the values of acidity, content of phosphorus, potassium, and total humus in the plow layer. Of these, the most permanent indicator of an organic matter content in the soil, the content of which has a direct impact on the stability and productivity of agricultural landscapes and can serve as one of the most important criteria for evaluation of soil fertility. When the agricultural use of arable land is important to understand the dynamics of humus under the influence of applied agricultural practices (Romanova, 2011; Tsytron, 2011)

Research has established that the annual loss of humus in the arable soils can reach from 0.5 to 1-2 % of the initial amount (Petel'ko, 2009).

In the Perm region formed podzolic soils with low humus content. Therefore, the primary task is to maintain and improve this figure. The sources of humus – are organic fertilizers, crop residues, green manure, etc. Under the influence of fertilizers and the cultivation of certain crops in the

rotation changes the content of organic matter in the soil. Selection of the proper fertilizers system in the crop rotation can provide not only high yields, but also a positive balance of humus.
Based on the foregoing, the goal of the work – to determine the effect of systems fertilizers on the productivity of crops in the rotation, balance and content of humus in the soil.

Materials and Methods
Studies on various systems of fertilizers on the productivity of crop rotation and changes soil fertility in long stationary field experiment, laid in 1971 on the basis of the experimental field of SI "Perm Research Institute," p. Lobanovo the Perm region of Perm Krai. Crop rotation with the next crop alternation: fallow, winter rye, wheat sowing with clover, clover, clover, barley, and potatoes. Accounting yields crop in the rotation was carried out in the fifth rotation.
Bookmark experience was performed using standard techniques described B.A. Dospehov (1985), as follows: 1. Without fertilizer (control), 2. Manure 10 t/ha, 3. NPK eq. 10 tons of manure 4. Manure 5 t/ha + NPK eq. 5 tons of manure. The experimental setup provides a comparative assessment of organic, mineral and organic mineral fertilizer systems. Repeatability options in the experiment fourfold, the location of the plots systematically. The area of experimental plots – 71.5 m^2, record plots – 46.4 m^2. Organic fertilizers are applied in two steps: in a clean pair and after the harvest of barley, under potatoes. Mineral fertilizers were applied to winter rye, spring wheat sowing with clover, barley and potatoes. Introduced by the dose of organic fertilizer was 80 t/ha, i.e. saturation of 1 hectare is 10 tons. In mineral system applied only fertilizer, saturation, which is equivalent to the amount contributed by the organic system, manure (10 t/ha). The fourth option provides applied for both organic and mineral fertilizers, but the total saturation was 10 t/ha. In the experiment applied manure (N = 0.3 %, P_2O_5 = 0.2 %, K_2O = 0.4 %), ammonium nitrate (N = 46.5 %), superphosphate (P_2O_5 = 46 %) and potassium chloride (K_2O = 60 %). The sod-podzolic soil heavy loam, in which at the beginning the crop rotation of the content of humus was 2.1±0.18 %, the reaction medium (pH_{KCl}) – 5.1±0.33, content available phosphorus – 89.6±12.6 mg/kg of soil and exchangeable K – 257.5±55.5 mg/kg soil.

Results and Discussion
When applied organic and mineral fertilizers have higher yields. High level of productivity of aboveground mass suggests inflow into the soil large amounts of crop residues after harvesting of crops.
The studied system had an ambiguous effect of fertilizers on the yield of crop rotation (Table 1).

Table 1. The effect of system fertilizers on the productivity crops, (t/ha)

Variants	Crops					
	winter rye	sowing with clover	clover 1 year	clover 2 year	barley	potatoes
Without fertilizer (control)	3,24	2,38	5,23	3,48	3,15	15,50
Manure 10 t/ha	3,59	3,00	5,67	4,04	3,91	20,80
NPK eq. 10 tons of manure	3,57	2,99	5,90	4,07	4,03	19,60
Manure 5 t/ha + NPK eq. 5 tons of manure	3,55	3,33	5,80	4,04	4,26	22,70
LSD_{05}	0,32	0,47	0,73	0,96	0,67	1,40

Mathematically a significant increase in yields in the application of various system of fertilizers observed in the cereals and potatoes. For example, the control variant (without fertilizer) yield of spring wheat was 2.38 t/ha, organic system – 3.00, mineral system – 2.99, and organic mineral system – 3.33 t/ha. A similar pattern was noted in the variants with barley. It is interesting to note that the use of an organic system for winter rye received the maximum yield increase (0.35 t/ha), while the mineral and organic mineral systems, respectively – 0.33 and 0.31 t/ha. Perennial grasses provide a slight increase in yield, but it is not mathematically proved.
For assessment efficiency applied of fertilizer systems necessary assess the productivity of crop rotation. The average productivity of plough land crop rotation under the influence fertilizer systems varied from 2.9 to 3.5 t/ha food unit in the year. In the variant without fertilizers collection

of fodder units per 1 hectare was 2.9 tons. When using fertilizers output the food units with 1 hectare of plough land increased by 14.3-19.8 %. The maximum productivity plough land of 3.5 t food units / ha on average per year was marked in the variant with organic mineral system.
Knowing the productivity of agricultural crops can be pre-determine the balance of humus in crop rotation systems using different fertilizers. Balance humus calculated by the difference between the formation of humus as a result of humification of root-stubble residues and mineralization. The data obtained are presented in Table 2.

Table 2. Effect of systems fertilizers on the balance of humus in the rotation, t/ha

Crop rotation	Variants			
	without fertilizer (control)	manure 10 t/ha	NPK eq. 10 tons of manure	manure 5 t/ha + NPK eq. 5 tons of manure
fallow	-1,00	-1,00	-1,00	-1,00
winter rye	-0,07	-0,01	-0,01	-0,01
sowing with clover	-0,21	-0,15	-0,15	-0,15
clover 1 year	0,93	1,02	1,07	1,05
clover 2 year	0,68	0,82	0,75	0,82
barley	-0,17	-0,07	-0,06	-0,02
potatoes	-0,71	-0,68	-0,68	-0,66
Total for crop rotation	-0,55	-0,07	-0,06	0,02

In the crop rotation, the positive of balance humus provide only perennial grasses 1 and 2 years of use. In the balance humus between the variants no significant differences were noted. For example, in the variant without fertilizers balance of humus under the clover 1 year of construction amounted to 0.93 t/ha, using organic fertilizer system – 1.02 t/ha of mineral – 1.07 and organic mineral system – 1.05 t/ha. A similar trend is noted on clover 2 year. In a clean pair and under potatoes observed maximum negative balance of humus -0,66-1,00 t/ha. Comparing the options with different systems of fertilizer may be noted that the organic mineral system slightly reduces the negative impact of the mineralization of humus.
Assessing the balance of humus in general in the crop rotation may be noted that the use of organic and mineral fertilizer systems humus balance was negative. The positive balance of humus is marked only in the variant of organic mineral fertilizer system. For example, in the variant without fertilizers humus balance was -0.55 t/ha, an organic system – -0.07, mineral system – -0.06, and organic mineral system – 0.02 t/ha.
This method of calculating the humus balance does not reflect the actual receipt of the organic matter in soil, including humus. The most accurate picture of changes in the content of this indicator shows the analysis of the soil. To determine the dynamics of humus in the soil, and the influence of the studied systems at him, were selected soil samples at the end of crop rotation on all variants of the experiment. Analysis of soil showed that applied fertilization promotes the significant accumulation of humus in the soil. When applied organic fertilizer humus content, as compared with the variant without fertilizers, increased by 0.43 %, mineral – 0.20 %, while combined application of organic and mineral fertilizers – by 0.29 %.

Conclusion

On the basis of studies on the effect of system fertilizers on the productivity of crops in the rotation and the content of humus in the soil can draw the following conclusions:
1. The productivity in the crop rotation through the use of fertilizers increased by 14-20 %. The maximum effect is obtained from the system organic mineral fertilizer (3.5 t/ha food unit in the year).
2. The positive balance of humus in the rotation is obtained only under perennial grasses (0.68-1.07 t/ha of humus). Mineral and organic system fertilizers do not provide a positive balance of humus for crop rotation. The positive balance of humus in general in the crop rotation is marked only in the organic mineral fertilizer system – 0.02 t/ha.

3. The most objective results obtained in the analysis of soil, which showed an increase in humus at using of all systems fertilizers. The maximum increase of humus marked in the variant with an organic fertilizer system (0.43 %), minimum – the use of mineral fertilizer system (0.20 %).

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Phytoremediation and its potential to remove hazardous elements from soil

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Abstract: The current remediation techniques of heavy metals from contaminated soil and water are expensive, time consuming and environmentally destructive. The phytoremediation is an environmentally friendly, green technology that is cost-effective and energetically inexpensive. Phytoremediation is an emerging technology, which uses plants and their associated rhizospheric microorganisms to remove pollutants from contaminated sites. Metal hyperaccumulator plants are used to remove metal from terrestrial as well as aquatic ecosystems. Phytoremediation can be used to remediate various contaminants including metals, pesticides, solvents, explosives, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and landfill leachates. Phytoremediation has been used for point and nonpoint source hazardous waste control. The effectiveness of heavy metals extraction from soil depends on the availability of metals for plant uptake and desirable establishment of plant under heavy metal stress. Therefore, in the present time, more researches about phytoremediation of heavy metals are concentrated on enhancement the bioaccumulation and resistance of plants through chemical (such as chelating agents) or biological (such as PGPRs) methods. In this article, we have a brief review on phytoremediation technology and some increasing methods of its efficiency.
Key words: Heavy metals, Phytoremediation, Metal hyperaccumulator plants, Plant growth promoting rhizobacteria (PGPR)

Introduction

The continued industrialization of countries (specially developing countries) has led to extensive environmental problems. A wide variety of chemical substances (e.g. heavy metals, pesticides, chlorinated solvents, fertilizers, etc.) have been detected in different biota such as soil, water, and air (Cheng, 2003). Although, heavy metals are natural components of soils at trace levels, activities such as mining, industry, and localised agriculture have contributed to undesirable accumulations of these metals at toxic levels in soil (Alloway, 1995). Pollution of Soils by heavy metals is one of the most important environmental problem due to the toxic effects of metals, their accumulation throughout the food chain and the additional risk of groundwater contamination (Peng et al., 2009). The term heavy metals refers to metals and metalloids which their density is greater than 5 g cm^{-3} and is usually expressive of pollution and toxicity (Adriano, 2001). At high concentrations, most metals have strong toxic effects on living organisms and are regarded as hazardous environmental pollutants (Chehregani et al., 2005). In view of the fact that heavy metals, unlike organic contaminants are not biologically degradable, they can remain in environmental bodies for a long term (Karami and Shamsuddin, 2010).

Metal uptake by crops growing in contaminated soil is a potential hazard to human health due to transmission in the food chain (Friesl et al., 2006). Some heavy metals at low doses are needed for plants growth as micronutrients, but in higher doses, they may cause metabolic disorders and growth inhibition for most of the plants species (Claire et al., 1991). However, Metals like Cd, Pb and Cr are not involved in any known biological processes and when present in high concentration in soil show potential toxic effects on overall growth and metabolism of plants (Agrawal and Sharma, 2006). The plant toxicity of heavy metals for flowering plants may appear as AS(III)~Hg>Cd>Tl>Se(IV)>Pb>Bi~Sb (Fergusson, 1990).

Toxic heavy metals cause DNA damage, and their carcinogenic effects in animals and humans are probably caused by their mutagenic ability (Baudouin et al., 2002). Exposure to high levels of these metals has been linked to adverse effects on human health and wildlife (WHO, 1997). As a result, many different remediation methods have been tried to address the rising number of heavy metal contaminated sites. Most of the traditional methods for remediation of heavy metals contaminated soils are either extremely costly (i.e., excavation, solidification and burial) or simply involve the isolation of the contaminated sites. In addition, some methods, such as soil washing, can pose an adverse effect on biological activity, soil structure and fertility, and incur significant engineering costs (Pulford and Watson, 2003). Recently, the use of plants and their associated microbial flora to remediate polluted soils in the process of phytoremediation, has appeared as an more reliable alternative method for remediation of heavy metals contaminated soils (Cho et al., 2009). This emerging biological approach, based on the capability of some plant species to take up and to concentrate pollutants in their shoots, is often simpler in design and cheaper to implement (Petra et al., 2009).

Remediation methods of heavy metals contaminated soils

There are generally four major soil remediation methods (Ward and Singh, 2004), namely:
1) Physical remediation: including thermal desorption, cement kiln, air stripping and incineration; 2) Chemical remediation: including encapsulation, solvent extraction, neutralization, oxidation-reduction and precipitation; 3) Bioremediation: including land farming, natural attenuation, biopiling, bioventing, bioaugmentation and bioreactor; 4) Phytoremediation: defined as the use of plants (including trees and grasses) to remove, destroy or sequester hazardous contaminants from various media such as soil, water and air (Prasad, 2003).
Physical, chemical and biological methods in many cases are expensive, labour intensive, and result in extensive changes to the physical, chemical, and biological characteristics of the treated soil. Physical and chemical remediation methods of contaminated soils are mainly applicable to relatively small areas and are unsuitable for very large areas such as a typical mining site or industrially/agrochemically contaminated soils (Khan, 2005). Phytoremediation, the use of hyperaccumulating plants to remove pollutants from the environment or to render them harmless (Raskin et al., 1997), with its lower cost and environmental friendly nature, has received increasing attention in the last decades (Salt et al., 1998). Phytoremediation is the use of plants to remove organic and/or inorganic contaminants from biota (phytoextraction), uptake and conversion into non-toxic gaseous forms (phytovolatilization), or stabilization of an inorganic into a less soluble form (phytostabilization). Unlike the previously mentioned conventional methods, phytoremediation is inexpensive, effective, can be implemented in situ, and is environmentally friendly. A special advantage of phytoremediation is that soil functioning is maintained and life is soil reactivated (Trapp and Karlson, 2001).

Metal hyperaccumulator plants

Plants have developed three basic strategies for growing on contaminated and metalliferous soils (Baker and Walker, 1990): 1) Metal excluders: These plants effectively prevent metal from entering their aerial parts over a broad range of metal concentrations in the soil; however, they can still contain large amounts of metals in their roots. 2) Metal indicators: These plants accumulate metals in their above-ground tissues and the metal levels in the tissues of these plants generally reflect metal levels in the soil. 3) Accumulators: These plant species (Hyperaccumulators) can concentrate metals in their above-ground tissues to levels far exceeding those present in the soil or in the nonaccumulating species growing nearby. According to Baker and Brooks (1989), hyperaccumulators should have a metal accumulation exceeding a threshold value of shoot metal concentration of 1% (for Zn, Mn), 0.1% (for Ni, Co, Cr, Cu, Pb and Al), 0.01% (for Cd and Se) or 0.001% (for Hg) of the dry weight shoot biomass. To date, more than 400 plant species belonging to 45 families with a high genetical capacity to accumulate and tolerate large amounts of heavy metals in shoots have been identified (Yang et al., 2004). They are classified as heavy metals hyperaccumulator species. Ideal hyperaccumulators require the characteristics of deep rooted, rapid growth and a high amount of biomass (Le Duc and Terry, 2005). However, in most of these species, the growth and shoot biomass production rates are insufficient and therefore not suitable for efficient phytoremediation (EBBS et al., 1997). Hence, Harbouring the genes that are considered as signatures for the tolerance and hyperaccumulation from identified hyperaccumulator plant species into the plants having high biomass provide a platform to develop the technology with the help of genetic engineering. This would result in transgenic plants that may have large biomass, and fast growth, a quality essential for removal of metal from soil quickly and in large quantities (Shah and Nongkynrih, 2007).

Categories of Phytoremediation

Phytoremediation of heavy metals is an emerging technology and four subsets of this technology are being developed (Pilon-Smits and Pilon, 2000):

1) Phytoextraction, in which metal-hyperaccumulating plants or high biomass producing plants in combination with chelating or acidifying agents are used to transport and concentrate metals from soil into the harvestable parts of roots and above-ground shoots (Brown et al., 1994).

2) Rhizofilteration, in which plant roots absorb, precipitate and concentrate toxic metals from polluted effluents (Dushenkov et al., 1995).

3) Phytostabilization, in which heavy metal tolerant plants are used to reduce the mobility of heavy metals, thereby reducing the risk of further environmental degradation by leaching into the ground water or by airborne spread (Kumar et al., 1995).

4) Plant assisted bioremediation (Phytodegradation/Rhizodegradation), in which plant roots in conjunction with their rhizospheric microorganisms are used to remediate soils contaminated with organics (Anderson et al., 1993).

Some enhancer methods of heavy metals phytoremediation

The critical aspects for the success of heavy metals phytoremediation are the adequate biomass production by plants and efficient transfer of metals from the roots of plants into their shoots. However, low-biomass production and slow growth of Most hyperaccumulator species, such as *Thlaspi*, *Urtica*, *Chenopodium*, *Polygonum sachalase* and *Alyssum*, make these plants impractical for use in phytoextraction (Puschenreiter et al., 2001). Hence, Phytoremediation by common hyperaccumulator plants is a relatively slow process. As a result, reduction of metal contents in soil to a safe and acceptable level may take some years due to small size and slow growth of most identified metal hyperaccumulator plants (Cunningham et al., 1995). Therefore, an alternative method for enhancement the phytoremediation efficiency is to use species with a lower metal accumulating capacity but higher growth rates, such as Indian mustard (*Brassica juncea*) (Glick, 2003) and Sunflower (*Helianthus annuus*) in combination with chelating agents (Chelate-assisted phytoextraction). This leads to enhance the concentration of soluble heavy metals in the soil and consequently an increase in the metal uptake of high biomass crop plants (e.g. *Brassica juncea*, *Helianthus annuus*, *Zea mays*, *Nicotiana tabacum*, etc.) (Di Gregorio et al., 2006). Several studies have documented the application of mobilizing/chelating agents, such as ethylene diaminetetraacetic acid (EDTA) to the soil is a efficient practice to increase the bioavailability, uptake and shoot accumulation of metal pollutants (Luo et al., 2008; Petra et al., 2009). However, the adverse effect of chelating agents on the plants growth and metabolism has not been considered. for instance, EDTA is The most commonly used and effective chelator (Ruley et al., 2006), that its biodegradation in the soils is poor (Luo et al., 2006). In addition, EDTA can decrease plant biomass, destroy the physiological barriers of the root, or inactivate transporter proteins to the extent that its metal mobilizing and translocation benefits are minimized (Luo et al., 2006). besides, many synthetic chelators are too expensive and result in loss of soil quality and groundwater contamination (Kos and Lestan, 2003).

another method for enhancement of phytoremediation is to provide heavy metals accumulator plants with associated rhizobacteria. The efficiency of phytoaccumulation may not only depend on the plant itself but also on the interaction of the plant roots with microbes and the concentrations of bio-available metals in soil (Wang et al., 1989). The rhizosphere provides a complex and dynamic micro-environment where microorganisms, in association with roots, form unique communities that have considerable potential for detoxification of hazardous waste compounds (De-Souza et al., 1999). Many microorganisms in the soil are able to solubilize ‘‘unavailable’’ forms of heavy metal-bearing minerals by excreting organic acids (Kalinowski et al., 2000). And many soil bacteria are tolerant to heavy metals and play important roles in increase bioaccumulation of heavy metals by plants (Idris et al., 2004).

Along with metal toxicity, there are often additional factors that limit plant growth in contaminated soils including arid conditions, a lack of soil structure, low water supply and nutrient deficiency. Therefore, improvement of plant growth under stressed growth conditions is critical to the optimum performance of phytoremediation of soils using both metal hyperaccumulator plant species and metal accumulating crops (Glick, 2003). Among the rhizosphere microorganisms involved in plant interactions with the soil milieu, the plant growth promoting rhizobacteria (PGPR), deserve special attention (Glick, 1995). Plant growth-promoting bacteria (PGPR) have been reported to be key elements for plant establishment under nutrient imbalance conditions (Egamberdiyeva and Hflich, 2004). PGPR can improve plant growth, plant nutrition, root growth pattern, plant competitiveness and responses to external stress factors (Egamberdiyeva and Hflich, 2004). Certain heavy metal resistant PGPR have exceptional ability to promote the growth of host plant by various mechanisms such as nitrogen fixation, solubilization of minerals, production of phytohormones and siderophores, and transformation of nutrient elements (Glick et al., 1999). Further, 1-aminocyclopropane-1-carboxylate (ACC) deaminase-producing bacteria play an important role in the alleviation of different types of stress in plants, including the effect of heavy metals by lowering the level of ethylene (Saleem et al., 2007). Therefore, improvement of the interactions between plants and beneficial rhizosphere microbes can enhance biomass production and tolerance of the plants to heavy metals, and are considered to be an important component of phytoremediation technology (Glick, 2003).

Conclusion

The pollution of soil and water with heavy metals is an environmental concern today. Metals and other inorganic contaminants are among the most prevalent forms of contamination found at waste sites, and their remediation in soils and sediments are among the most technically difficult. The high cost of existing cleanup technologies led to the search for new cleanup strategies that have the potential to be low-cost, low-impact, visually benign, and environmentally sound. Phytoremediation is a new cleanup concept that involves the use of plants to clean or stabilize contaminated environments (Jadia and Fulekar, 2009). In the past decade, phytoremediation has gained wide acceptance as an effective green technology as well as a rigorous field of research (Rajakaruna et el. 2006). But Phytoremediation is still in its research and development phase, with many technical issues needing to be addressed. The results, though encouraging, suggest that further development is needed. Phytoremediation is an interdisciplinary technology that can benefit from many different approaches (Prabha and Loretta, 2007). Research aimed at better understanding of the interactive roles among plants roots and microbes will help scientists to utilize their integrative capacity for soil decontamination. Further, genetic evaluation of hyperaccumulators growing in metal contaminated soil and associated microbes would provide the researchers with a gene pool to be used in genetic manipulation of other non accumulators and production of new transgenic plants (Hooda, 2006).

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Air Pollution Control Technique Using Soil Particles Aggregation by Bacterial Sedimentation of $CaCO_3$

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Abstract
Dust storms are great concerns not only due to their effects on both Middle East and global environment, but also due to the detrimental effects of dust particles on human health. The aim of the research was to study the role of *Sporosarcina pasteurii* bacterium on soil particles aggregation and sand fixation. Different concentrations of urea and calcium chloride (0.5, 1 and 1.5 M) were used continuously in sand columns with the diameter of 7.7 and height of 6.5 cm for periods of 12, 24, 48, 96, 192 and 288 hours. Calcium Carbonate Equivalent (CCE), penetration resistance, and thickness of crusts were determined to measure bacterial sedimentation of $CaCO_3$. Results showed that CCE increased from 8.8% in the original soil to 21.3% in 1.5 M-288 hours treatment and an increasing trend with time and $CaCl_2$ concentration was found. Besides, micromorphological observations of thin sections also showed that calcite crystals bridge the sand particles. Moreover, penetration resistance also showed the same trend (0.2 Mpa in original soil compared to 2 Mpa in 1.5M-96 hours treatment). The minimum crust thickness was investigated in 1M-12 hours treatment (3mm), but the maximum one was 40 mm in the 1M-288 hours treatment. Annova analysis and mean comparison of data showed that the effect of time and concentration on CCE penetration resistance and crust thickness was significant ($p< 0.01$). The ureaze produced by the bacterium in columns containing urea and Ca, caused urea hydrolysis to ammonia and CO_2. This reaction produces the carbonate which enhances calcite formation in pores and sand fixation. *Sporosarcina pasteurii* is used in ureaze production technique to reduce environmental pollution and detrimental effects raised by wind erosion in arid and semi-arid environments.
Keywords: Air-born particles, Dust storm, Sand dune fixation, *Sporosarcina pasteurii*, Wind erosion.

Introduction
Wind erosion in arid and semi-arid regions is of great concern. Dust storms induced by wind erosion cause non-favorable environmental effects on ecosystems. Soil fertility loss together with air pollution is among different results of dust storms (Natsagdorj et al., 2003; Wang et al., 2006).
From health and safety point of view, high concentration of particles in dust storms causes asthma and allergy. Besides, high concentrations of calcite in dust particles increase sneezing and coughing, long time exposure to Mg-rich particles causes depression and weakness, and Al-rich dusts even for short periods of time increase cough (Al-Hurban et al., 2010). Moreover, aerosols in the atmosphere affect insolation and climatic change at local and global scales (Wang et al., 2006).
Wind erosion control and desertification combat reduce air pollution and improve health and safety in societies. Sand fixation in arid lands has been used to reduce the destructive effects of wind erosion. There are three kinds of fixation including mechanical, chemical and biological. Biological fixation is of great importance from natural resources conservation point of view. One of the most important and useful biological sand fixation techniques is due to microorganisms.
Surface crust formation by lichens, mosses, cyanobacteria, green algae, small fungi, and bacteria has been used in arid regions to control wind erosion. The produced surface crust covers first centimeters of soil surface and increases soil roughness by providing micro topography (Belnap et al., 2001). Particle aggregation and cementation technique by soil microorganisms is recently among new technologies used for wind erosion. *Sporosarcina pasteurii* is one of the most ureaze producing bacteria that hydrolyze urea to ammonia and carbon dioxide which in turn increase soil pH. Carbonates and bicarbonates will be deposited as $CaCO_3$ bridging sand particles which could prevent detachment and transport of particles by wind (Ivanov and Chu, 2008). The biochemical equations of this process are as follows (Stocks-Fischer et al., 1999):

$$Ca^{2+} + Cell \rightarrow Cell\text{-}Ca^{2+}$$

$Cl^{-} + HCO_3^{-} + NH_3 \rightarrow NH_4Cl + CO_3^{2-}$
$Cell\text{-}Ca^{2+} + CO_3^{2-} \rightarrow Cell\text{-}CaCO_3\downarrow$

The present research aims at studying the effects of time and $CaCl_2$+ urea concentrations on calcite formation by *Sporosarcina pasteurii* as an endospore forming soil bacterium.

Materials and Methods

The experiment was performed as a factoriel completely randomized design with three replications (Figure 1). Three urea+$CaCl_2$ concentrations (0.5, 1 and 1.5 M) together with 6 time intervals (12, 24, 48, 96, 192, and 288 hours) were the factors used in the experiment.

-Microorganism and media

Sporosarcina pasteurii (formally known as *Bacillus pasteurii* (Yoon et al., 2001)) PTCCi 1645 was provided from Scientific and Industrial Research Organization of Iran. Selective medium culture of PTCCi 131 (including 15 g peptone from casein, 5g peptone from soymea, 5g NaCl, and 20 g urea in 1000 ml distilled water) in 30 ˚c was used for bacterial inoculation. KOH (1M) was used to fix the pH of culture on 8 prior to autoclaving and filtered sterile urea was added to culture later.

-Soil sample

An air dried sandy soil passed through a 2 mm sieve and routine physicochemical properties including soil textures (Gee and Bauder, 1986), pH, EC, and calcium carbonate equivalent (Nelson, 1982) were investigated.

-Microbiological consolidation of sand columns

Columns (6.5 cm height and 7.7 cm inner diameter) containing sterile sandy soils were used to determine CCE and penetration resistance of treated samples. Levels of 0.5, 1 and 1.5 M of urea and $CaCl_2$ mixture were uniformly added to the columns. The columns were placed in optimum temperature (25 – 30 ˚c) after inoculation (Figure 1). CCE (reverse titration), penetration resistance (using Eijkelkamp penetrologger SN) and surface crust thickness (using micrometer) were investigated for 12, 24, 48, 96, 192 and 288 hours treatments. Besides, thin sections of treated samples were prepared and observed by Olympus BH_2 petrography microscope.

-Statistical analysis

Annova analyses and mean comparison of data performed by Duncan Test of MSTAT-C Software.

Figure 1. Experiment design showing soil columns under different treatments.

Results and Discussions

Table 1 shows some physicochemical properties of the soil used for the experiment. Annova analysis showed that time, concentration treatments and their mutual effect on CCE were significant at 1 percent level. All of the soil columns treated with *S. pasteurii* had more calcium carbonate content than the non treated original soil. Mean comparison showed that CCE increases with time and $CaCl_2$+ urea mixture concentration (Figure 2 and 3). Different $CaCO_3$ values in various time intervals are due to continuous addition of inoculum and cementing flow. De Jong et al. (2006) also reported that the rate and content of $CaCO_3$ changed with continuous use of nutrient solutions and reactants. Moreover, the increase of $CaCO_3$ sedimentation due to increase of reactants (urea+ $CaCl_2$ concentration) has been reported by Nemati and Voordouw (2003) and Whiffin (2004).

Table 1. Some physicochemical properties of the soil sample

textural class	percent of particles			EC (dS/m)	pH	CCE (%)
Sandy	sand	silt	clay	0.7	8.38	8.83
	87	6	7			

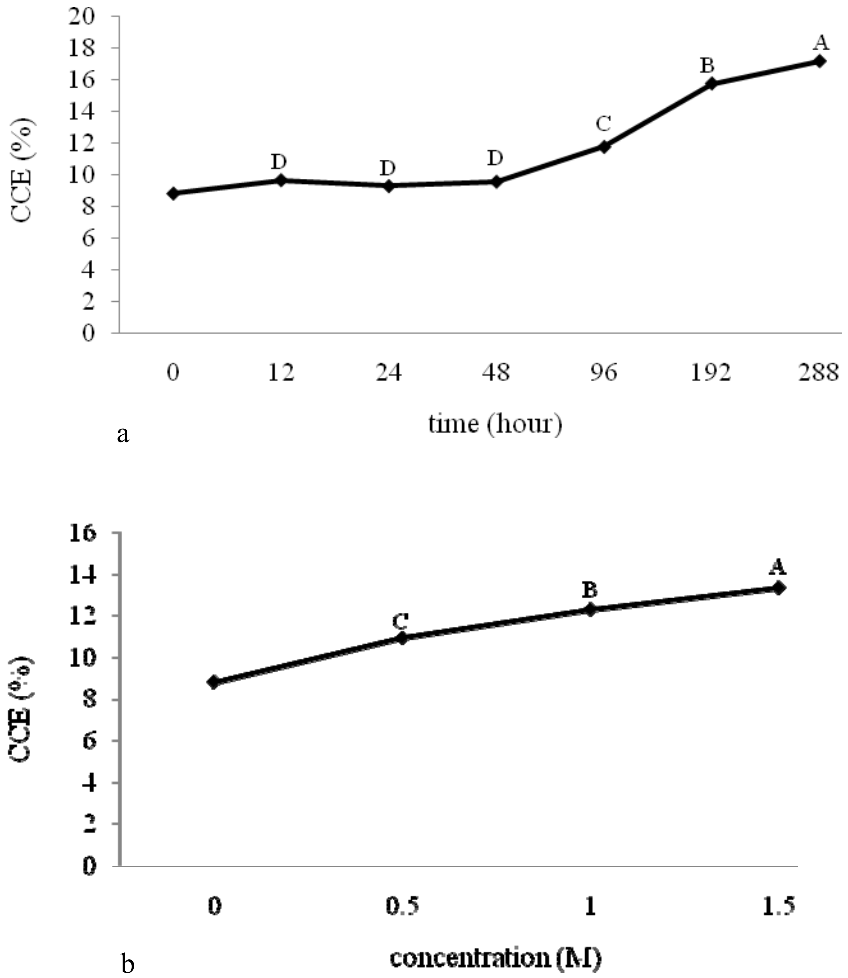

Figure 2. Effects of time (a) and concentration (b) on CCE

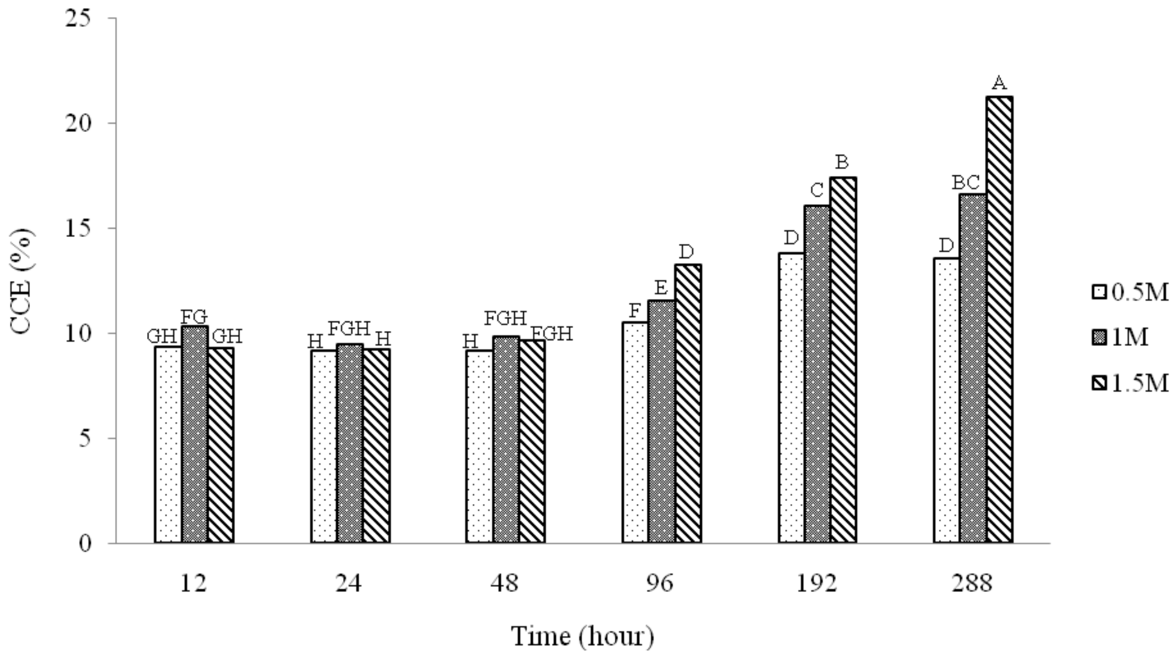

Figure 3. Effects of time and concentration on CCE

Moreover, micromorphological observation of thin sections prepared from treated samples proved calcite bridging between sand particles (Figure 4).

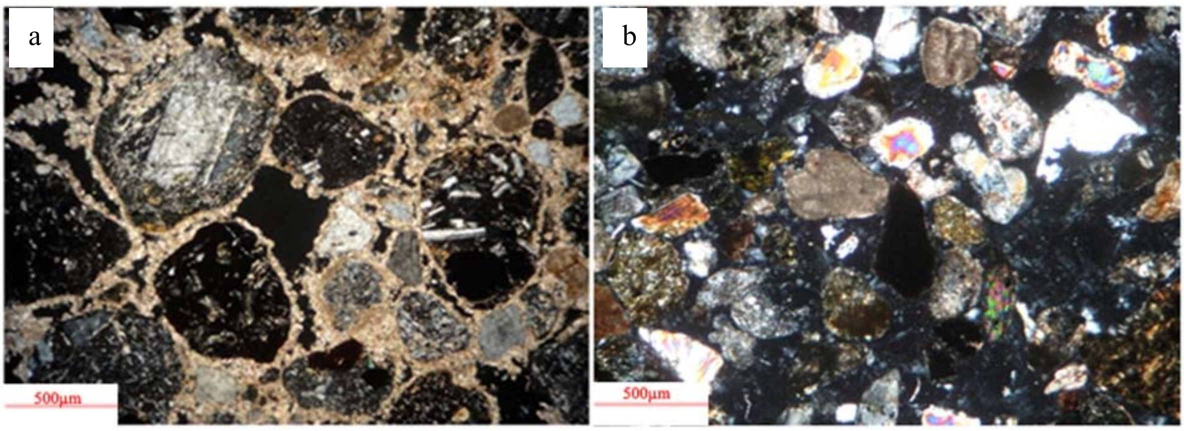

Figure 4. Thin sections (XPL) of sandy soil treated with *S. pasteurii* (288hr-1.5M) (a) and original soil sample (b).

Besides, time and concentration treatments and their mutual effects on penetration resistance of treated samples were significant at 1 percent level. Mean comparison showed that the pressure needed for cone index penetration into cemented layers significantly increased with time. 192 and 288 hours treatments in all concentrations used prohibited cone index penetration even with 2 Mpa pressures which was due to bacterial sedimentation of calcium carbonate (Table 2). Ramakrishnan et al. (2001) also reported the increase of soil resistance with increasing bacteria concentration.

Table 2. Mean comparison results of time and concentration on penetration resistance (Mpa)

	Time treatment				Mean
Concentration	12h	24h	48h	96h	
0.5M	0.27 C	0.61 B	0.44 BC	0.61B	0.48 B
1M	0.26 C	0.57 B	0.42 BC	2A	0.81 A
1.5M	0.56 B	0.57 B	0.42 BC	2A	0.88 A
	0.36 C	0.58 B	0.43C	1.53 A	Mean

Whiffin (2004) also showed that continuous addition of reactants and bacteria with time increase sedimentation and pressure resistance in sand columns.

On the other hand, cemented crust thickness was measured to determine the depth of bacterial activity. Time and concentration treatments affected formation of surface crust significantly (1 percent level). Besides, crust thickness at 1 M and 1.5 M concentration treatments increased 60.85% and 84.09% in comparison to 0.5 M concentration. Moreover, crust thickness in 288 hour treatment was 6.6 times more than 12 hours treatment (Table 3). Whiffin (2004) reported that the type and activity level of ureaze, type of sand, kind of medium culture, and injection pressure affect the cementation depth in the columns.

Table 3. Mean comparison results of time and concentration on crust thickness (mm)

	Time treatment						Mean
Concentration	12 h	24h	48h	96h	192h	288h	
0.5 M	4D	3D	4D	10CD	20BC	22B	10.50B
1 M	3D	3.66D	6.33D	21.33B	27B	40A	16.89A
1.5 M	6D	6D	4.66D	23.33B	38A	38A	19.33A
	4.33C	4.22C	5C	18.22B	28.33A	33.33A	Mean

Results of the study showed that biological sedimentation of calcium carbonate as bridging between sand particles improves aggregation. Surface crust formation induced by S. pasteurii conserves the soil surface from wind erosion and reduces air pollution and respiratory diseases.

Acknowledgements

Laboratory facilities and financial supports from Soil Science Department, Shahid Bahonar University of Kerman is highly acknowledged.

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The Effects of Land Degradation on Soil Quality Attributes In Central Zagros of Iran

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Abstract
Land degradation implies decline in quality and capacity of the life-supporting processes and environment moderation capacity of the ecosystem through adverse changes in all components including soil, vegetation, climate, hydrology, and terrain resulting from human actions. The objective of this study was to explores the effects of land degradation on soil quality attributes in central Zagros of Iran. For this purpose, two land cover were selected. A pasture with good vegetation cover of Agropyron species (PGV) and a pasture with decline cover of it beacause human activities (PDV). At each land cover, one profile (0-120 cm depth) was dug. Soil samples in each profile were collected from various horizons. In soil samples, soil quality attributes, inducing: organic carbon, cation exchange capacity, percent of sand, silt, clay and soil texture were determined. The results showed that PGV had moderate erosion and PDV had severe erosion. The amount of soil organic carbon, cation exchange capacity, soil depth and the increased in clay percent from A to B horizon were higher in PGV than PDV. Consequently soil classification (soil taxonomy) was Alfisols and Inceptisols in PGV and PDV respectively.
Concerning to the results, it seems that land degradation can increase soil erosion and decrease soil quality attributes.
Keywords: soil quality, soil erosion, land degradation

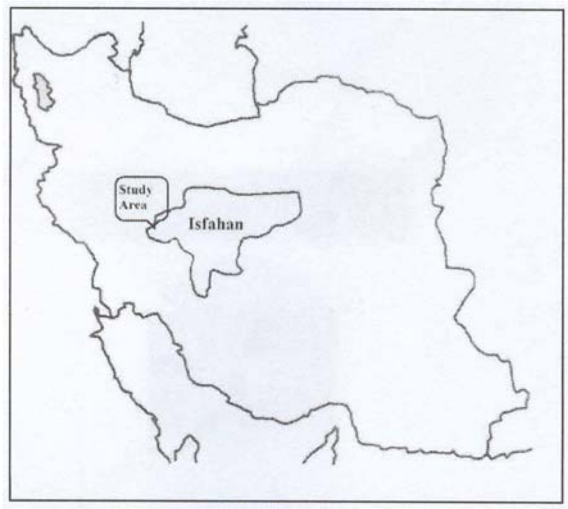
Introduction

Land degradation, a decline in land quality caused by human activities, has been a major global issue during the 20th century and will remain an important global issue for the 21 st century because of its adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life. impacts of land degradation are due to a decline in soil quality on site where degradation occurs (e.g. erosion) (Eswaran et al., 2001). Soil quality is a concept that integrates soil biological, chemical and physical factors into a framework for soil resource evaluation (Khormali et al., 2009). Soil quality indices are useful tools for assessing agronomic/ biomass productivity and ascertaining temporal changes in soil properties in relation to land use and management. Nael et al. (2004) investigated response of soil quality indicators and their spatial variability to land degradation in central Iran. Soil quality is defined as: "capacity of the soil to function, within the ecosystem and land-use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health"; therefore, it is one of the most important factors in developing sustainable land management and sustaining the global biosphere (Nel et al., 2004). Larson and Pierce (1991) defined soil quality as the capacity of a soil to function within the ecosystem boundaries and to interact positively with surrounding ecosystems. Gol et al. (2010) investigated the effects of land use/land cover change and demographic processes (1950 to 2008) on soil properties in the Gokcay catchment, Turkey. The result showed that it is important to understand effects of spatial and temporal changes of land use/land cover and demographic structure of their effects on landscape pattern and soil properties to dis-close the implications for land use planning and management.
The goal of this study is to investigate the effect of land degradation on soil quality attributes in pasturs.

Materials and Methods

Study Site

This study was conducted in the Boltagh watershed, located at 185 km west of Isfahan in the central Zagros of Iran between latitude (32° 2'and 33° 11' N) and longitude (49° 45' and 50° 28' E)(Fig. 1). The mean annual temperature and rainfall of this area is about 6°C and 487 mm, respectively. The climate is semi humid according to De Martonne method. Moisture regim in this region is xeric and temperature regim is mesic. Soil classification (soil taxonomy) is Inceptisols, Mollisols and Alfisols in whole area.



Figur 1. Location of the study area

Field Study

In order to study of soil quality attributes with usig of topograghy, plant cover and geography maps and survey the region, two profile (0-120 em depth) drilled: one in pasture with good vegetation cover of Agropyron species (PGV) and other in pasture with decline cover of it beacause human activities (PDV). Genetic horizons of each profile were separated and identified by field inspection. Profiles were described by using profile description guidance, and soil depth was specified. Then soil samples in each profile were collected from various horizons and after drying the sample in the shade, they were transfered to laboratory for some soil testing.

Laboratory Analysis

Soil pH and EC were measured by using a pH meter and an EC meter in a 1:1 soil/water ratio(Page et al., 1986). Soil organic carbon (SOC) was measured by the Walkley and Black method and soil organic matter (SOM) was measured by this formula: OM= 1.724* OC (Agronomy Society of America, 1982). Cation exchange capacity (CEC) was measured by sodium acetate at pH 8.2 (Chapman, 1965). Calcium carbonate ($CaC0_3$) was measured by using back titration method (Baruah and Barthakur, 1997). Soil texture and percentage of sand, clay and silt were determined using Hydrometer method (Baruah and Barthakur, 1997).

Results and Discussion

Organic Carbon (OC) and Organic Matter (OM)

Rangeland destroyed and degradation cause decrease of soil organic carbon (OC) and soil organic matter (OM) content. Organic matter is vital for the physical, chemical and biological functioning of soil. According to (table 1) and (table 2), organic matter content is 0.67 to 2.01 % in PGV and 0.13 to 1.54% in PDV that indicated decrease in this parameter from PGV to PDV. In investigating the effect of land degradation on soil quality attribute Y ousefifard et al. (2007), Hajabbasi et al. (2007) and Lemenih (2004) found thesame results that the deforestation and land degradation cause organic matter (OM) to be decreased. Mojiri et al. (2011) reported that rangeland destroyed and land use changes cause decrease of organic carbon (OC), organic matter (OM), total nitrogen (TN), available potassium (Kava), soil microbial respiration (SMR) and extractable Fe. Soil organic matter and soil nutrient depletion are among the major forms of soil degradation (Khormali et al., 2005).

Cation Exchange Capacity (CEC)

Rangeland destroyed and degradation cause decrease of soil cation exchange capacity content. According to (table 1) and (table 2), CEC is 18.73 to 28.66 Cmol/kg in PGV and 17.70 to 19.4 Cmol/kg in PDV and it means that degradation lead to decrease of CEC from PGV to PDV. This is in line with the findings of Yousefifard et al. (2007), Lemenih (2004). Sanchez-Maran on et al. (2002) reported that redusing CEC during land use change from Mediterranean pasture to dry land forming was 50%. Decrease in CEC reflects the textural and OM changes in deforestation (Khormali et al., 2009).

Calcium Carbonate ($CaC0_3$)

Rangeland destroyed and degradation cause increase of soil Calcium carbonate ($CaC0_3$) content. According to (table 1) and (table 2), $CaC0_3$ is 2 to 8% in PGV and 6 to 29%g in PDV and it means that degradation lead to increase of $CaCO_3$ from PGV to PDV.

Soil Solum Depth

According to (table 1) and (table 2), soil solum depth was more than 120 cm in PGV while it was only 69 cm in PDV. Furthermore the increased in clay percent from A to B horizon were 9.5% in PGV but only 2% in PDV and consequently soil classification according to key to soil taxonomy (2010) was Typic Palexeralfs and Typic Haploxerepts in PGV and PDV respectively. This represents a further evolution of the soil in PGV to PDV.

Erosion

There is an inverse relationship between soil quality and erosion. Erosion alters the biological, chemical and physical properties of the soil. Healthy, biologically functioning soil with intact structure is resistant to erosion (Gilley et al., 1997). As organic matter declines, so does the soil structure, so that the soil becomes more susceptible to physical erosion (Mojiri et al., 2011). Observations for instance: soil depth and soil taxonomy showed that amount of erosion in PDV is higher than PGV. Canopy cover of plant species and percentage of gravels on both land cover can also confirm this.

Table 1. Some soil chemical and physical properties in pasture with good vegetation cover of Agropyron species (PGV)

Horizon	Depth cm	EC ds/m	pH	$CaCO_3$ (%)	O.M (%)	CEC meq/100g	texture	sand (%)	clay (%)	Silt (%)	gravel (%)
A	0-10	0.22	7.4	2	2.01	18.73	Clay-loam	35.5	30	34.5	10
Btl	10-32	0.23	7.5	3	1.54	23.53	Clay-loam	29.5	39.5	31	5
Bt2	32-55	0.23	7.5	3	0.67	27.98	Clay	23.5	49.5	27	5
Bt3	55-78	0.23	7.9	4	0.74	28.66	Clay	23.5	47.5	29	15
Bt4	78-101	0.23	7.9	4	0.74	27.30	Clay	27.5	43.5	29	15
Bt5	+10l	0.29	7.8	8	0.74	24.90	Clay	25.5	41.5	33	15

Table 2. Some soil chemical and physical properties in pasture with decline cover of Agropyron species (PDV)

Horizon	Depth cm	EC ds/m	pH	$CaCO_3$ (%)	O.M (%)	CEC meq/100g	texture	sand (%)	clay (%)	Silt (%)	gravel (%)
A	0-18	0.19	7.7	6	1.54	18.38	Clay-loam	39.5	31.5	29	20
Bwl	18-40	0.19	7.7	10	1.54	19.40	Clay-loam	35.5	33.5	31	30
Bw2	40-69	0.19	7.6	16	0.87	19.40	Clay-loam	31.5	29.5	39	25
Ck	+69	0.20	7.8	29	0.13	17.70	Loam	31.5	21.5	47	25

Acknowledgments

The principal author thanks to Mr Rezaei Nejad for their help with field work and scientific comments. We also thank to Mr Keikaei for his helpful field assistance and also special thanks to my family for valuable help during to this research.

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Evaluation of land degradation using spatial modeling approach A case study in the wadi El Hallouf watershed (Médenine-Tunisia)

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Abstract
Land degradation constitutes a major concern of countries in the Sahelian region of North Africa and especially in Tunisia. This phenomenon is responsible for the degradation of the natural habitat and for the arable land disappearance. Therefore, it's important to study this phenomenon at spatial and temporal scales and analyze the interaction between the various elements of the environment in relation to soil dynamics and human activity.
In order to evaluate the effects of measures to mitigate land degradation, we used a new and innovative approach for modeling at regional scale. The PESERA model offers an explicit theoretical response based on erosion model, making use of land-use, topographic, soil and climatic data. Runoff is estimated. From the components, the model estimates water and sediment delivered to stream channels (Kirkby et al., 2003).
The study area covered the watersheds of *wadi* Oum Zessar and wadi Halouf (1226 km^2) which are localized in southeast Tunisia. According to the application of PESERA model, annual soil water deficits increase from the upstream to the middle and rich a value of 380 mm on the downstream. Due to quality of soil, land use, climate change and topography of the study area, the mean annual erosion is significant (2t/ha/yr) on the upstream. Olives and trees on jessour is the most representative of catchment conditions. Erosion, water deficit and runoff layers were more representative of catchment conditions. The model needs to be calibrated with field investigation, historical data and stakeholder knowledge. The historic spatio-temporal data related to vegetation are difficult to obtain.
Keywords: Land degradation, Pesera model, Erosion, Soil, hydraulic modeling.

1. Introduction

In the arid regions, Climate variability in combination with biophysical processes acting on the land may induce a reduction of resource potential and hence cause land degradation. Any forecasting attempt to increase societal early warning capacity has to take the interaction between climate and socio-economics on the land into account. Many projects integrated assessment model is a framework to develop policy support systems with the aim to support planners and policy makers having to deal with regional development and Land degradation. Using spatial models, policy makers can carry out an integrated assessment of the impact of different external factors and policy options on a number of indicators relevant to regional development and land degradation.
The PESERA model has been developed to provide a state of the art erosion risk assessment at a European scale (Kirkby et al, 2000). The model is based on a simple and conservative erosion model, which is disaggregated into components which depend on climate, vegetation, soil factors and topography (Fig. 1). The rate of sediment transport is estimated as a mean soil loss (Tonnes/Ha), obtained as a product of the model components. As the components are explicit, the impact of changes in land use or climate can also be clearly identified, so that sensitivity to changed conditions can be explored. The model is currently being applied at a 1 km resolution for the whole of Europe except for some areas where some data is missing. With data at finer resolution, the model may be applied at 250m or better resolution to areas of particular concern. There is also scope, using globally available data sources, to apply the model world-wide at a resolution of 10 km, although with some inevitable degradation of quality. The emphasis of the PESERA model is the prediction of hillslope erosion, and the delivery of erosion products to the base of each hillslope. Channel delivery processes and channel routing are explicitly not considered. The PESERA model is based on work carried out on regional scale indicators during the MEDALUS1 and MODEM projects. Regional scale indicators were originally developed within the MEDALUS project from previous concepts (Kirkby et al., 2003). The MODEM project set out to apply these regional scale indicators of desertification to interpret remotely sensed

images, and so assess current desertification and its sensitivity to future environmental change. The project output was seen as a key stage in the pre-operational development of an integrated planning tool for regional desertification across the Mediterranean area.

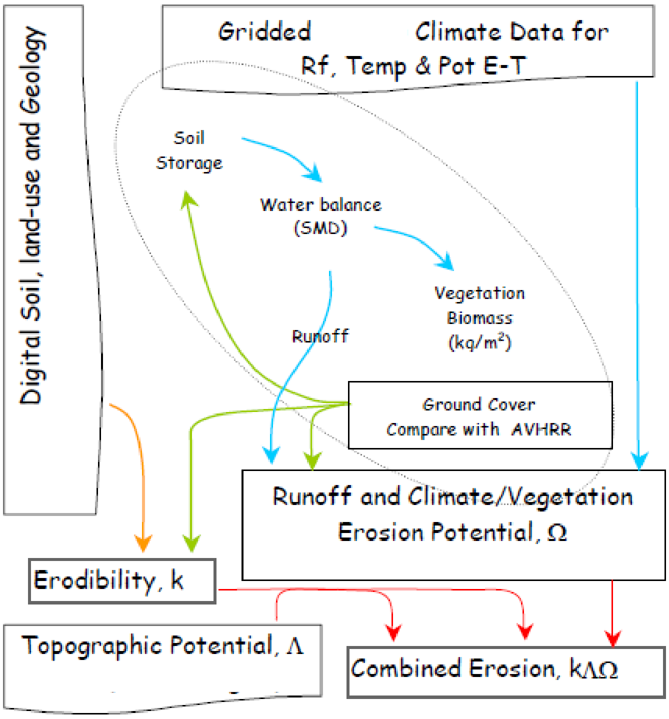

Figure 1: Data and component interactions at a point in PESERA model (Kirkby et al., 2003)

Mapping of land degradation serves to define the current limits of zones affected by the erosion phenomena and as source data to the decision-makers for the implementation of means to effectively fight against degradation of naturals resources.
The south of Tunisia, particularly the watershed of wadi El Hallouf, is strongly threatened by lad degradation amplified by population activities and overgrazing. Presently, the area of the zones affected by these phenomena is in progression. In fact, many factors of degradation (Wind, Rain, overgrazing, types of sols, etc.) are implicated in the increase of the infected area.

Erosion predictions from the PESERA model are reliant on estimating a stabilised vegetation cover and identifying the generation of overland runoff on a cell by cell basis. The PESERA_GRID coarse scale code distributes the point based indicator model across the Tunisian grid generating a series of physically based estimates of potential monthly erosion at a 90 m x 90 m grid resolution for the study area (watershed of wadi El Hallouf) (Fig. 2)

2. Materials and Methods

2.1. Data requirements for PESERA model

Local data is one of the important required information to compile the PESERA grids model to apply land use or climate scenario. When preparing local data, consideration should be given to: the projection and coordinates of data layers, units, such that they are consistent with the description and the range of values in the data layers.

The data base compiled to run PESERA_GRID at the study site scale (1200 km^2) been resampled to 100 m resolution utilising available data. These data layers have been derived from a number of sources (CRDA, IRA, Agriculture map,…). Where local data is available at higher resolution this local data can be utilised at the local scale. Therefore, it should be aware of the issues that surround the temporal and spatial quality of the regional data sets and consider there applicability when applying the data at a local scale as documented in the model validation. A full set of 128 input data layers are required in arcGrid format to execute the model. The data layers are divided to four type such as: Climate data, Land-use, crops and planting dates, Soil data and Topography

2.2. Study site

The study site belongs to the region of south eastern Tunisia (Fig. 2). It is a transect which stretches out from the Great Oriental Erg and the Dahar plateau in he west, crosses the Matmata mountains between Béni Khdache and Toujane and the open Jeffara plain, then the saline depression (Sebkhat) of Oum Zessar before ending into the Gulf of Gabès (Mediterranean sea). The SS covers an area of 1226 km^2 and the approximate coordinates of the central point are 33°16' N and 10°08' E.

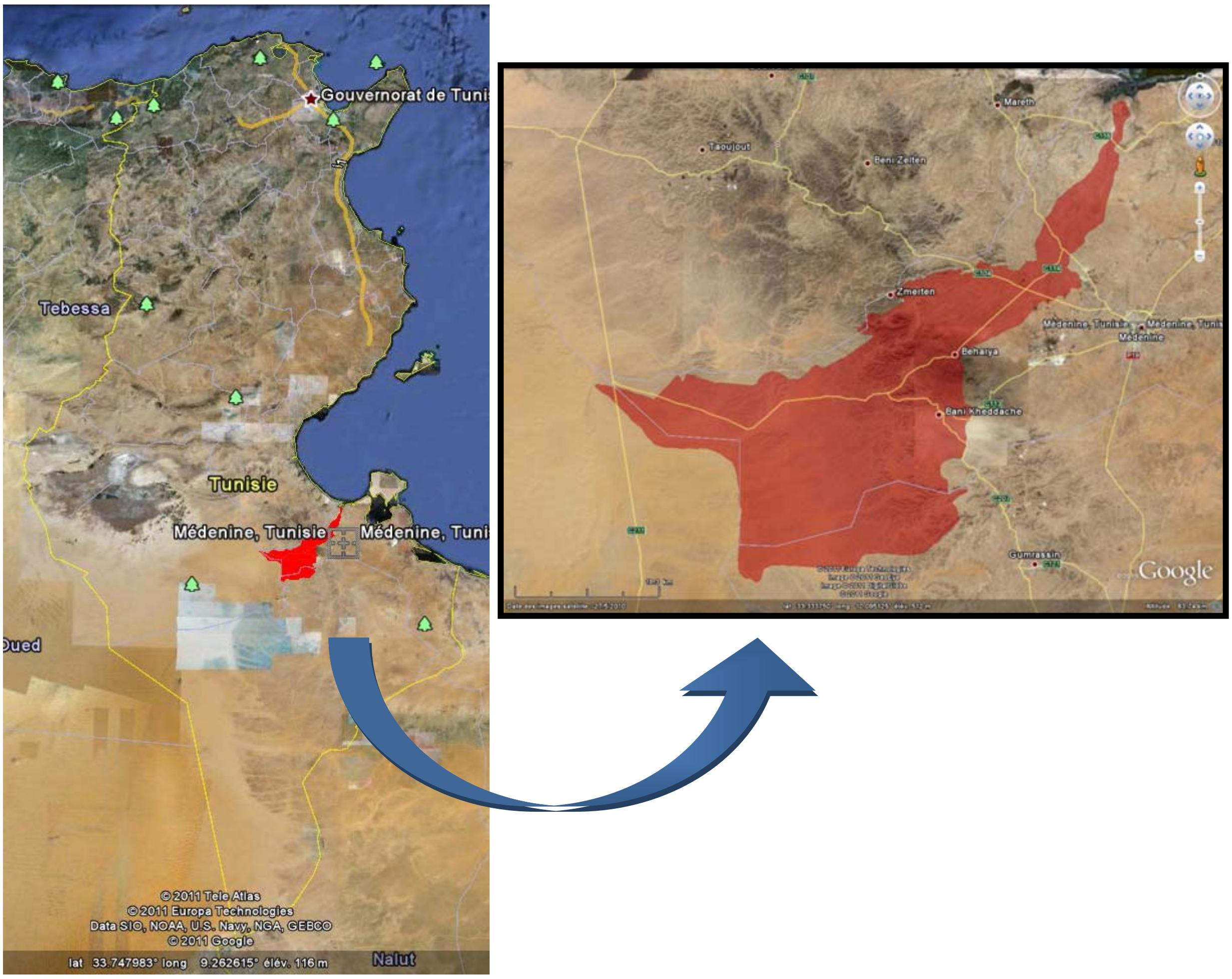

Figure 2: Study site location.

Theses catchments areas are drained by tow principal wadis : wadi Hallouf in the west part and wadi Oum Zessar. The last one runs out since the mountainous chain of Béni Khédache crosses the Northern county of Médenine and reaches the county of Sidi Makhlouf to flow in Sebkhas Oum Zessar before reaching the sea. The highest point of the watershed reaches an altitude of 713 m on the level of Jbel Moggar.

The climate in the study site is of the Mediterranean to Saharan type (Fig. 3). The coldest months are December, January and February with occasional freezing (up to -3 °C). June-August is the warmest period of the year during which the temperature could reach as high as 48°C. The temperature in the study site is affected by the proximity to the sea and the altitude.

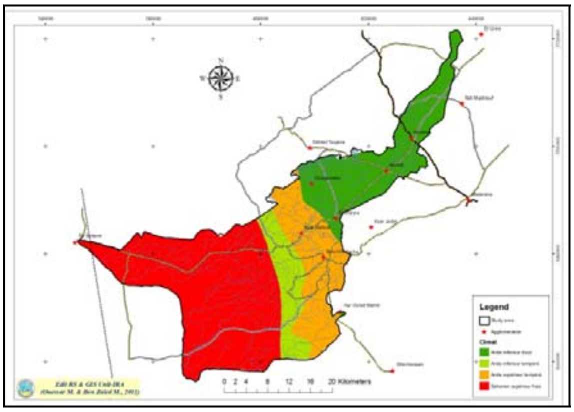

Figure 3: Bioclimatic map

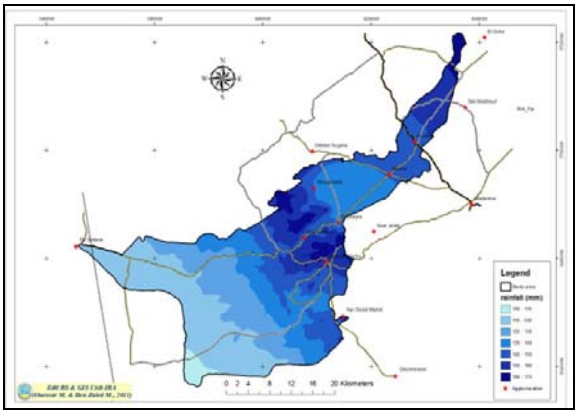

Figure 4: rainfall map of the study area

Having an arid climate, the rainfall in the study site is characterized by low averages, high irregularity (both in time and space) and torrential characteristics. It receives, on annual average, between 150 and 240 mm in the mountains and eastern parts but this amount decreases rapidly to less than 100 mm in the zones close to the desert (Fig. 4). The prevailing winds affecting the plain and the plateau are: in winter the cool and humid eastern/northeastern winds, and in summer the hot and dry southeastern winds, called *Chhili* or *Guebli*. With high temperature and low rainfall, the potential evapotranspiration (ETP) is very high (around 1321 mm/year) and the climatic water balance is negative almost around the year (Ouessar et al., 2006).

2.3. Land use

The study area is characterized by a high diversity of vegetation types. They are linked to several ecological groups whose major part is soil groups (Ouled Belgacem et al., 2003), but also influenced by human pressure. This could be explained by the important role of soil and man in the determination of the plant cover in these arid regions of Tunisia. The determination of these different vegetation types and the spacialization of the field data meaning the GIS permitted the establishment of the vegetation map (Ouled Belgacem, 2003).

The fruit trees are mainly olives and are found on jessour and tabias only. The cereals (winter barley and wheat) are grown episodically during wet years. The natural vegetation (ranges) was divided into three classes: mountain, plain, and halophyte (Fig. 5), because of their different phenology and grazing practices (Ouessar, 2007).

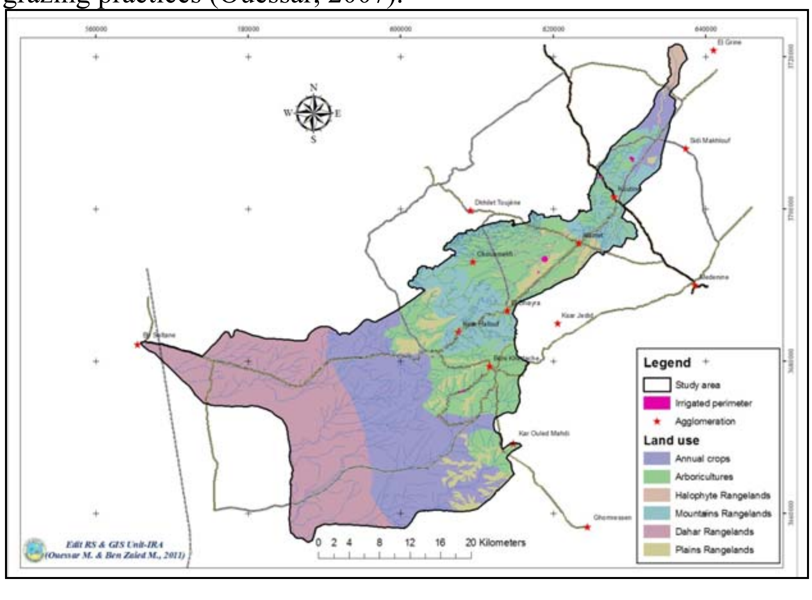

Figure 5: Simplified land use map.

2.4. Soil data

The soil map of the study watershed was extracted from the soil map of the region (carte agricole de medenine, 2002). It made by use, analyse and interpretation of provided imagery data, the soil map was elaborated according to the French soil classification (CPCS, 1967), (Fig. 6).
The soils are developed on a calcareous substratum in the upstream area and gypsum or gypsum to calcareous in the downstream area. The soil horizons are generally shallow, stony, unstructured with sandy to fine sandy texture.
Six main classes have been identified: sols minéraux bruts (d'érosion)(lithosols), sols peu évolués (Fluvisols), sols calcimagnésiques (Calcimagnesic), sols isohumiques bruns calcaires tronqués (Isohumic) and sols halomorphes et hydromorphes (solonchak and solonetz).

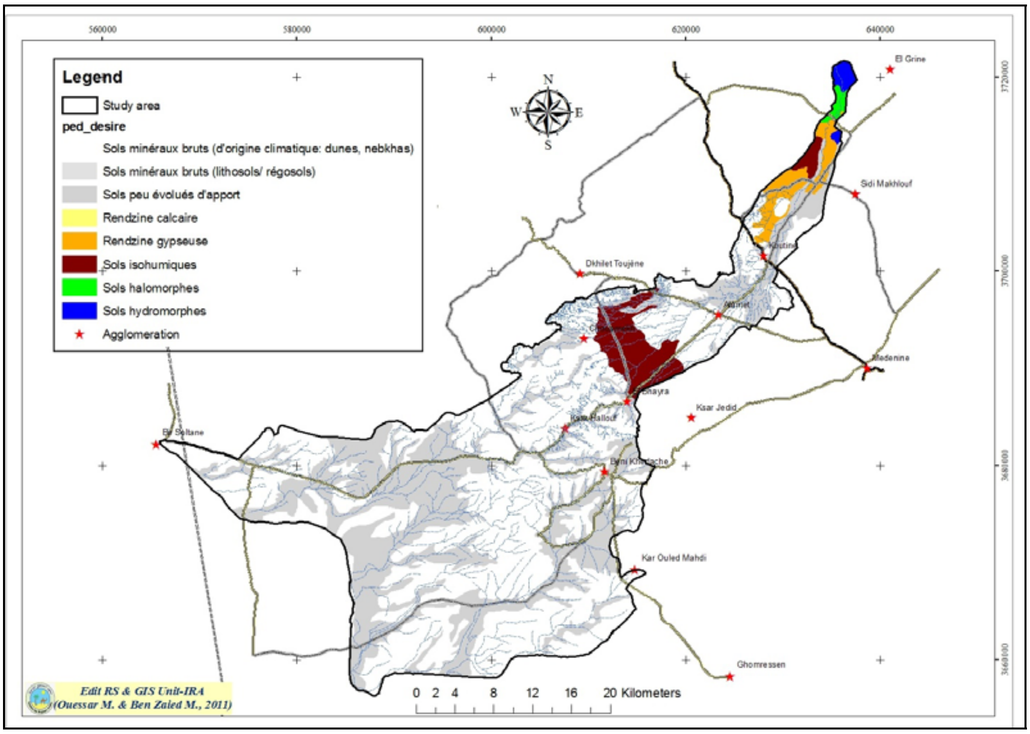

Figure 6: Soil map of the study area

3. Results and discussions

3.1. Erosion estimation by PESERA model

The Pesera model is used to predict and mapping erosion (t/ha/yr) using daily recordings of climatic data and local data base. Erosion rates estimated by the model are between 0 and 2 t/ha/yr. Maximum values are distributed on the mountainous zone of the catchment area whereas low and average values cover almost the totality of the study site. Results indicate that the majority area of wadi El Hallouf catchment is sensitive to erosion. In the map erosion can be divided in five classes (Fig. 7).

The zone strongly threatened by erosion (>0,1 t/ha/yr) cover 21% of the total catchment area, it is located in the mountainous chains. Land degradation is due to topography and absence of water and soil conservation techniques. The zone moderately affected by erosion (0,1 – 0,01 t/ha/yr) cover 34% of the catchment area. In this case of course, soil is generally affected by hydraulic erosion as well as wind erosion localized in the depressions characterized by sandy accumulations.

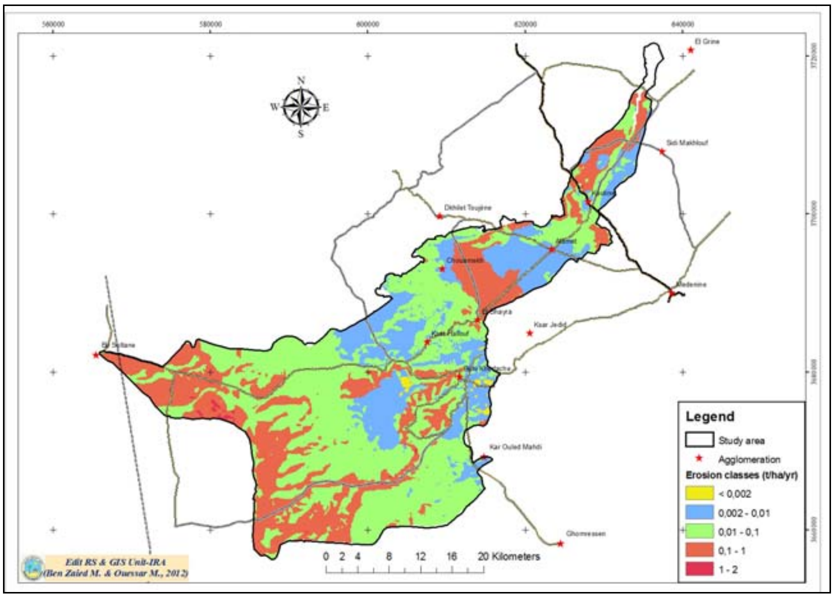

Figure 7: Erosion map of wadi El Hallouf watershed.

The less sensitive zone to erosion covers 43% of the total area. This rate corresponds mainly to the plains zone. In fact, soil and water conservation techniques reduce the effect of erosion. In summary, more then 50% of the study site are moderately to strongly threatened by erosion.

The wadi El Hallouf watershed is affected by erosion especially on winter, autumn and spring seasons (Fig. 8, 9 and 10).

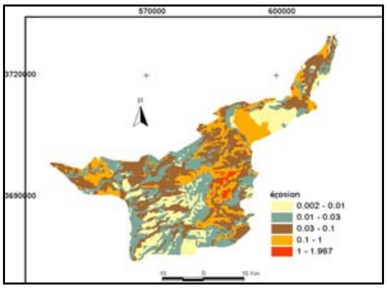

Figure 8: erosion on autumn season

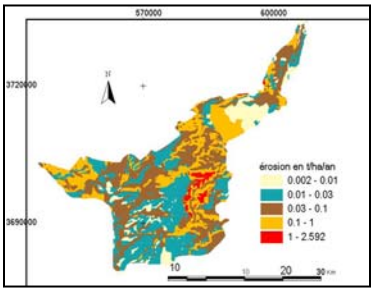

Figure 9: erosion on spring season

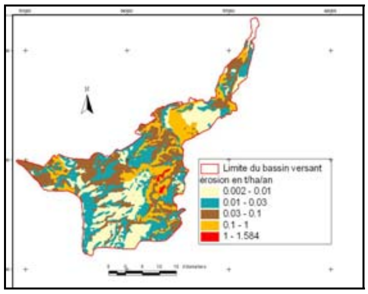

Figure 10: erosion on winter.

Spring and autumn seasons are more sensitive to erosion. Areas strongly affected represent respectively 28% on spring and 20% of the total area on autumn.

4. Conclusion

This paper outlines a number of pilot applications of hydraulic modelling to mapping erosion in arid areas.
The applications of the spatial model (PESERA) and the geographical information systems constitute good means of investigation to help the decision-makers in the fight against the erosion and the reasoned management of natural resources.
It is necessary to revise the current models concerning the physical, ecological and socioeconomic aspects of the lands degradation, for their integration in a framework of dynamic modelling and instruments of support for the decision. The visual interpretation combined with the digital processing of the local data with high resolution permitted to classify the territory studied on three classes of erosion (strongly, moderately and fairly affected).

This study shows that the use of spatial model and local data with high resolution allows the elaboration of a cartography which reports the state of land degradation under the influence of the erosion. These maps are essential for the rehabilitation of the study site, today strongly threatened by erosion.

Acknowledgements

This work was conducted within DESIRE and LADA projects.

The DESIRE project (2007-2011)(www.desire-project.eu/) is funded by the European Commission, VI Framework Program, 'Global Change and Ecosystems' and brings together the expertise of 26 international research institutes and non-governmental organisations (NGOs). This project is implemented by ALTERRA - research institute for the green living environment in the Netherlands.

*The LADA project (**www.lada.virtualcenter.org**): Land Degradation Assessment in Dry lands , it focus on the establishment and implementation of a comprehensive methodology for the assessment and mapping of land degradation. The LADA monitoring is carried out at three spatial scales (local, national and global), and considers land degradation status, drivers and impacts. Ultimately, LADA will provide a better understanding of the degradation phenomena, and will give indications for appropriate responses at all levels of scale.*

*WOCAT Approach (**www.wocat.net**) **:** The World Overview of Conservation Approaches and Technologies are a long-term global programme and network of SLM specialists. WOCAT has developed a methodology (WOCAT questionnaires and database) to document, evaluate, share, disseminate, and use knowledge about SLM, and has tested it over many years.*

We would like to thank Mr. G. van Lynden (ISRIC, Netherlands) and Liniger H.P and Schwilch G. (University of Bern, Switzerland) for their support.

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Investigation of degradation effects on some soil properties in the Caspian forests (a case study: Talesh - Iran)

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Abstract

In order to study effects of human activates on soils of natural ecosystems, two untouched and degraded sites were selected in Shafaroud forests, Guilan Province. Three sampling plots (one hectare in each site) were selected. Each plot divided to four sub-plots (10×10m). Soil samples were taken from the corner and center of each sub-plot in two soil depths (0-10 and 10-20 cm. After air drying, some soil properties such as pH, particle density, soil texture, organic carbon (OC), total nitrogen (Nt), available phosphorus, electrical conductivity, exchangeable Calcium+Magnesium and potassium were measured. The result showed that the soil texture in two sites was sandy loam. There was no significant difference between the pH, EC, K and N in the surface soil in two regions. Amount of organic carbon and available phosphorus in that soil layer significantly decreased in degraded soil. The exchangeable content of Ca + Mg has significantly decreased about 24 percent. In the subsurface soil, only the amount of exchangeable Ca + Mg was significant and other parameters were not significantly different from each other.

Key Words: degraded ecosystems, soil, human activates, Caspian forests

Introduction

Effective factors on degradation of ecological systems are widespread. Huttl and Schneider (1998) have been introduced various natural and anthropogenic factors such as climatically extremes, biotic stresses, selection of tree species, harvesting regimes, litter raking, off-site amelioration measures, former land use, air pollutant deposition and soil acidification, as caused by internal and external processes in degradation of forest ecosystems. Grazing and hoof action by elk significantly increased bulk density (from 0.87 gr.cm-3 ungrazed to 0.94 gr.cm-3 grazed), with greater effects on soils with fewer rocks (Binkley, 2003). Steffens et al. (2008) declares that Bulk density increased significantly with increasing grazing intensity. Organic carbon, total N and total S concentrations decreased significantly with increasing grazing intensity. Since neolithic colonization of the land, man has interfered with forests (Kilian, 1998).Kissling et al. (2009) were compared short- and long- term effects of human trampling on above-ground forest vegetation and soil physical, chemical and microbial characteristics in Switzerland. They found both similarities and differences in short- and long- term trampling effects.

Yousefi et al. (2009) revealed that rate of soil compaction effect on beech regeneration. Caspian forests also which called the Hyrcanian forests the most valuable forests in Iran-cover the northern slopes of the Elborz Mountain. In 1958 these forests were estimated at 3.4 million hectares (Jafari, 1997) but currently is estimated around 1.85 million hectares (Jafari, 2010). This area is rich in hardwood species. The role of these forests other than wood production is supportive and environmental and their vital function in soil and water sources conservation as well as natural balance distribution. Intensive grazing, over-utilization of forests as full and land use change are amongst the main causes of deforestation in this region. Understanding the effects of disturbance by human interferers on ecosystem processes is essential for the management of recreational areas.

Material and methods

The research was carried out in two untouched and degraded sites in the Caspian region of northern in Iran. The studied stands were located in Guilan province at 28° 38′N and 48° 49′ E, extending between 1200 and 1400 m a.s.l. with a mean precipitation of 990 mm. Soil type is forest brown soil and soil texture varies between sandy loam.

Dominant tree species were beech (Fagus orientalis Lipsky), Hornbeam (Carpinus betulus L.) Maple (Acer velutinum Boiss), Alder (Alnus subcordata C.A.M) and other broad leave species. Three sampling plots (one hectare in each site) were selected. Each plot divided to four sub-plots (10x10m). Soil samples were taken from the corner and center of each sub-plot in two soil depths (0-10 and 10-20 cm. After air drying, some soil properties such as pH and electrical conductivity (1:1), particle density(Pycnometer method), soil texture (Bouyoucos, 1962), organic carbon (OC) (Walkley and Black, 1934), total nitrogen (Nt), available phosphorus (Olsen et al, 1954), exchangeable Calcium+Magnesium and potassium(Kalra, and Maynard, 1991) were measured. Data were analyzed using T test by SAS software.

Results and Discussion

There wasnt a significant difference between the particle density, pH, EC, K and N on the surface soil (depths of 0-10) in two regions. But amount of organic carbon and available Phosphorus in that soil layer significantly decreased in degraded soil (Table1). Kissling et al. (2009) studies revealed that soil pH and soil organic matter content were not affected by short-term trampling, but increased with long-term trampling intensity.

Camping et al. (2002)studies showed that low to moderate grazing intensity has little affect on soil quality, however, oak tree removal resulted in a decrease in most soil quality parameters investigated (carbon, nitrogen, phosphorus, pH) within 5 to 15 years following tree removal.

Our study in the 0-10 cm soil depth shows that human interferers reduce P, Mg +Ca, O.C and organic matter in the forest soils.

Table1. Some properties of soil in depths of 0-10 cm in the study regions

Soil properties	untouched	degraded	T value
p.d (g cm-3)	2.26	2.27	-0.315ns
Pava.(mg/kg)	94.74	32.43	5.16**
Mg+Ca ex. (mg/kg)	20.80	15.87	3.3**
pH	6.11	6.04	0.579ns
EC(ds/m)	0.23	0.27	-0.99ns
O.C%	6.55	5.6	2.84*
O.M%	11.29	9.65	2.85**
Nt %	0.46	0.44	0.413ns
K ex. .(mg/kg)	501.66	448.64	0.906ns

***significant at the level of 0.05% **significant at the level of 0.01% ns non-significant at the level of 0.05%**

Available Phosphorus in the 0-10 cm depth soil of degraded site received from 94.74 mg/kg to 32.43 mg/kg and the exchangeable content of Ca + Mg has decreased about 24 percent (Fig.1).

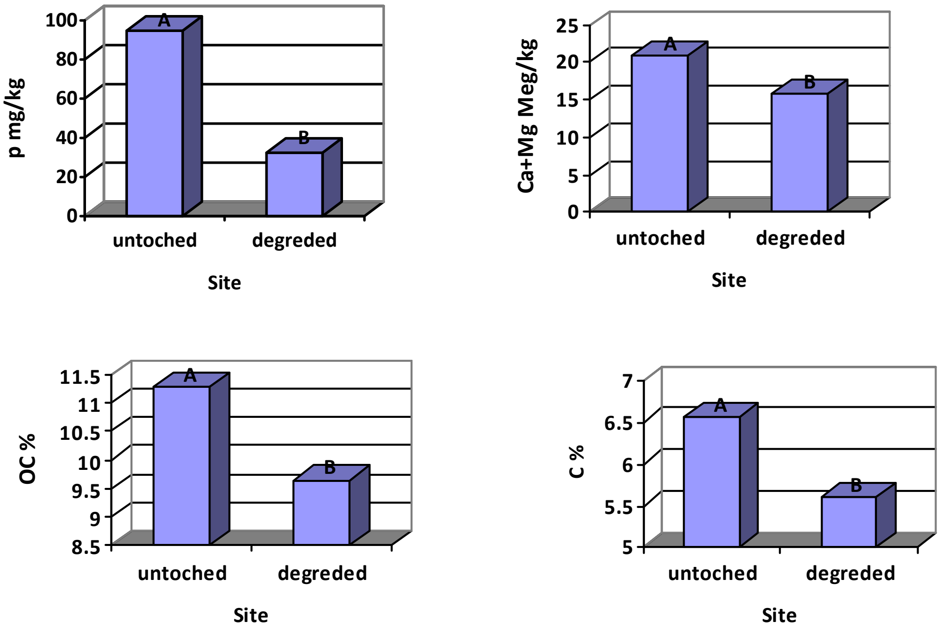

Fig.1.Some properties of soil in depths of 0-10 cm in the study regions

In the subsurface soil (in the 10-20 cm depth), only the amount of exchangeable Ca + Mg was significant and other parameters were not significantly different from each other. This results is similar to Augusto et al. (2002) studies that defines the composition of forest over story has an impact on the chemical, physical and biological characteristics of soil. This impact was highest in the topsoil. Although particle density wasn't significant difference in the both of the sites in two soil depths, Bulk density as important factor, increased significantly in human activates that was shown in researches of Steffens et al. (2008), Kissling et al. (2009), Tripathi & Singh (2009) chen et al.(2010).

Table 2. Some properties of soil in depths of 10-20 cm in the study regions

Soil properties	untouched	degraded	T value
p.d (g cm-3)	2.41	2.42	-0.175ns
Pava.(mg/kg)	19.27	11.95	1.46ns
Mg+Ca ex. (mg/kg)	15.73	9.8	7.4**
pH	5.59	5.63	-0.458ns
EC(ds/m)	0.13	0.13	0.181ns
O.C%	2.34	2.31	0.098ns
O.M%	4.03	3.98	0.095ns
Nt %	0.19	0.2	-0.526ns
K ex. .(mg/kg)	217.05	147.85	1.58ns

***significant at the level of 0.05% **significant at the level of 0.01% ns non-significant at the level of 0.05%**

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The Effect of Soil Produced From Volcanic Rocks Alteration on the Mass Movement in South West of Ardabil, Iran

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Abstract
The area under study is located in south west of Ardabil and North West of Iran. The area is mountainous with steep slopes. The area rocks are of volcanic type with acidic composition and are Miocene at age. The surface of these rocks has been altered to soil with several meters in thickness. Abundance of joints and faults are the main factors in this alteration. The created soil is usually of clay minerals. This clay belongs to kaolinite group with high plasticity index. Due to weak drainage, it keeps moisture for longer period of time. The water tables in the area are typically higher, which gives rise to a large number of springs in the area. The vernal heavy rains saturated clay soils. This process created a soil mass 600 meters long and 300 meters wide moving 15 meters horizontally and 8 meters vertically. The mass has moved differently in different points giving rise to various fissures in the body of the mass. These fissures are several meters deep. The moved mass is located 47°, 53′, 23″ to 47°, 53′, 44″ eastern longitude and 37°, 58′, 38″ to 37°, 58′, 51″ northern latitude.
Keywords: alteration, clay, mass movement, plasticity index, Ardabil

Introduction
The area under study is located 47 kilometers southwest of Ardabil (Fig. 1). The Ardabil-Sarab main road passes through the area. This is a mountainous area with harsh morphology. The steepness of the ground here has given rise to numerous scarps. The Baligloo River in the southern part of the area is fed by a lot of springs on its way beside the main waterways.

Figure 1. Location of area under study in northwest of Iran

Materials and Methods
Features of the moved mass: The moved mass is located 47°, 53′, 23″ to 47°, 53′, 44″ eastern longitude and 37°, 58′, 38″ to 37°, 58′, 51″ northern latitude. It is 600 meters long and 300 meters wide and is extended northeast-southwest being parallel with the river and the road. The mass has been transported and circulated in northeastern part. The scarp formed as a result of this movement is 5-20 meters high. The strong slope of this scarp is about 75 degrees. The rate of the movement varies in different points, which has caused numerous fissures in the mass. The movement of mass has been stopped as a result of contact of toe with the eastern riverside. This has blocked the river flow and

formed a lake in the back of the moved mass (Fig. 2). Moreover, the adjacent road has been displaced and has experienced a lot of fissures (Fig. 3).

Figure 2. Lake formation in the back of the moved mass due to obstruction of the river flow

Figure 3. Road displacement accompany the moved mass

The moved mass is also characterized by deep fractures which are more than 1 meter wide (Fig. 4). The fractures vertical to the movement direction are formed by tension due to mass movement whereas the parallel fractures are the result of shearing, lack of homogeneous movement in different parts of the mass (Fig. 5). The moved mass has damaged the road and has moved it 8 meters vertically and 15 meters horizontally.

Geology of the area: The area, like most of the Azerbaijan areas, is formed of volcanic rocks. The chemical composition of these rocks is acidic. Rhyolite, rhyodacite and tracite are most dominant in this part. The rock sequence is tracite in lower part and rhyolite-rhyodacite in upper part though it is difficult to recognize them on the surface of the ground due to alteration. This is because there is soil 0.5-1.5 meters thick on these rocks. These rocks are Miocene in age. The abundance of joints and faults is the main reason for the alteration of the area rocks. This process leads to the formation of various secondary minerals. Kaolinite, alonite and zeolite are the most common types in this regard. Due to these phenomena, the volcanic rocks in this area have been subjected to severe physical and chemical changes and have lost their homogeneity.

The mass movement factors: The area rocks are volcanic and have abundant joints and faults. These fractures are of two types: those which are the result of cooling and those which are tectonical and secondary. These fractures in general, as weak points in rock masses, have made the area tectonically active. The area is rich in terms of water resources. The existence of a lot of rivers here is a good evidence for this fact. What is more, the abundance of springs in the area as well as the formation

Figure 4. Deep fissures in the moved mass

Figure 5. Tension fractures (!) and shearing fractures (2)

of the new ones in the mass movement location indicates the shallowness of water tables (Fig. 6). This phenomenon causes the alteration of rocks in the first place and changes them to soil. Second, it gives rise to the movement of the soil through the saturation of the soil.

The soils from alteration of acidic volcanic rocks are composed of clay minerals, with kaolinite forming the highest percentage. These clays have expanded as a result of hydration and due to weak drainage stay moist for a long period of time. The moist mass has moved down due to high plasticity

index, ground slope and weight force. That is why most of the mass movements take place in the vicinity of the rivers and lakes where the water tables stay higher than the surrounding areas and saturate them easily.
There was an exceptional heavy rain two weeks before the mass movement, which saturated clay soils. Also the movement took place in spring, when the snow and ice start to melt and the resulting water penetrates into the ground. These parameters led to the saturation of the soil from alteration of the volcanic rocks and due to its plasticity property it was isolated from the part which did not receive any humidity and moved downward. The steepness of the ground in the area is another very important factor in this movement. That is why most of the displacements take place in mountainous areas.

Figure 6. A new spring formed in the movement location

Results and Discussion
The existence of masses with high plasticity properties, remarkable steepness of the ground and the abundance of water in the area are the leading factors in the mass movement. The mass movement is more probable in the mountainous areas because the steepness of the ground facilitates this movement. Since mountainous areas are rich in water and raining rate, the composition of the ground plays a significant role in mass movement. Type of the ground is one of the risk factors in the mass movement. Fine-grained materials from alteration of the rocks, especially clays, which have a high plasticity index, trigger this phenomenon.
The above-mentioned issues should be considered in the construction activities especially road and railroad constructions which pass through the mountain foot and necessary measures such as improper manipulation of the ground, unnecessary constructions in the high-risk slopes, decreasing the slope of the area, removing the fine-grain formations from the ground surface, creating proper drainage system and using suitable plants should be taken in this regard. These measures should be supported by careful research and investigation as well as good knowledge of the area.

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A regional Land Capability scheme to promote sustainable land planning and to prevent land degradation. The case of Sardinia (Italy)

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Abstract

Sardinia is region characterized by considerable geological and morphological complexity. This complexity is also reflected by the possible agricultural and forest use of the soils.
In 2006 the regional Government of Sardinia issued a Landscape Regional Plan (Piano Paesaggistico Regionale, PPR), to which every municipality has to conform its local planning. This implies that municipalities are called to improve their knowledge of the local land resources, including the urban areas and the historical heritage. A prominent role is assigned to the soils and to the sustainable planning of the soil use.
In this context, the need was highlighted to carry on new soil surveys and to produce harmonized soil maps. With this aim in view, a process was launched to first harmonize the survey and mapping approaches, along with the land evaluation schemes. The latter were oriented to implement an adapted Land Capability (LC), which was designed to support a GIS-oriented approach. The adopted LC model takes into consideration a range of soil and land properties.
The objective of the LC implementation is to provide a tool for territorial planning to the regional government. This will enable the protection and conservation of the soils most suited to agriculture, which during the last year have been often under threat by urbanization and unsustainable land development strategies.
The model is being tested on representative sample areas (around 120,000 ha overall), which were subjected to soil survey and mapping at the 1:50,000 scale.
The model outcome, along with the soil profile and laboratory data, will be made available, through a web-base database, to all the Sardinian users.

Keywords: Land Capability, land planning, sustainable soil management, Sardinia.

The Effects of Paddy Field Consolidation on Soil Quality in Guilan Province, Iran.

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Abstract
Paddy Field Consolidation (PFC) is one of the most important running programs of the Ministry of Jihad-Agriculture in Guilan province located in the northern part of Iran. PFC practiced to land leveling, amalgamate small plots, and construct agricultural irrigation and drainage systems and farm roads. In spite of these benefits some of constructions in land consolidation lead to severe soil disturbance that alters the soil physical, chemical and biological properties. The objectives of this study were to characterize the impacts of PFC on soil quality indices of four sites used for irrigated rice (*Oryza sativa L.*) production four years after the land consolidation. Results showed an increased in bulk density, clay percentage and EC while organic matter, silt percentage, N, P, K, pH, soil bacterial community, respiration, and microbial biomass carbon (MBC), and consequently soil quality were decreased. Microscopic pictures of buried slides showed reduction in soil microorganism communities and diversity, too. Declined soil quality will make uniform field and crop management more difficult and deterioration in soil fertility and crop yield. But Precision agricultural technologies may aid in the restoration of uniform productivity and soil fertility to predisturbance levels.
Keywords: Soil Quality, Paddy Field, Land Consolidation

Introduction

Soil quality is the integrated effect of management on most soil properties that determine crop productivity and sustainability**.** Good soil quality not only produces good crop yield, but also maintains environmental quality and consequently plant, animal and human health (Sharma, et al., 2005). Because improper management can lead to deleterious changes in soil function, a need for tools and methods to assess and monitor soil quality was recognized (e.g., Doran and Jones, 1996). Land consolidation (LC) is one of the managements that can change soil quality in paddy fields. LC is a tool for supporting rural development and improving the effectiveness of land cultivation (Sklenicka, 2006). There are four types of engineering constructions in LC projects in Iran. The first type is amalgamating small plots into large plots by taking out the ridge of the field to increase the arable area and to increase the manageability of mechanized agriculture (Engineering I). To eliminate the elevation differences among the small plots, the amalgamated plots should be leveled. Land leveling is second type of construction in land consolidation (Engineering II). Land leveling involves altering the field to create a constant slope of 0 to 0.2%. To creating this desired slope soil can be moved by either cutting or filling. The third type is the engineering construction of agricultural irrigation and drainage channels (Engineering III). The fourth type is the engineering construction of roadways (Engineering IV). LC can lead to improvements in irrigation and machinery access, land productivity (Monke et al., 1992), increases in labor productivity (walker et al., 2003), and scale economies (Monke et al., 1992). Also a reduction in land fragmentation through consolidation will be reduced problems like labor time (Bonner, 1987), land loss, transportation costs, pest control and land supervision (Crecente et al., 2002). In spite of all benefites, LC projects and specially land leveling have some disadvantages, too. It can destroy the native habitat, influences the relative ecological process (Luo and Zhang, 2002), increases the potential ecological risks (Yang, 2003; Yu, et al., 2009), and imposes direct threats on the regional biodiversity (Chen et al., 2005). LC Projects cause an alteration in soil physical and chemical properties. In these projects, surface soil layers on the high land shift away to fill in the low land, so, it makes decrease in soil layer thickness, soil aeration, soil nutrient, soil fertility (Ye and Wu, 2002) and lead to soil erosion (Cai et al., 2006) Amiri et al. (2004) suggested the implement of land integrating operation and the conversion of fields with small terraces to a great plot leads to the increase in heterogeneity of surface and subsurface soil and changes in N, P, K and soil effective

depth. LC Projects decreased Total N and extractable P level (Walker et al., 2001), decline organic C, rice yield (Hisatomi et al., 2002), and changes in soil pH (Miller, 1990). Unger et al. (1990) observed increasing in clay content in cutting areas towards filling areas after land leveling and changing in textural class from a clay loam in cut areas to a silt loam in filled ones. Brye et al. (2006) observed after land leveling fungal biomass, and fungal/bacterial biomass ratio decreased. Despite the effect on the fungal/bacterial biomass ratio, hence a significant alteration of the soil microbial community structure, soil bacterial biomass was unaffected by land leveling. Atashnama et al. (2007) showed that with decreasing in soil organic matter, N and C, Microbial biomass carbon is decreased, too.
The objective of this study was to investigate effects of PFC on the soil physical, chemical, biological properties and consequently soil quality in some regions of Guilan province.

Materials and Methods

In November of 2008, four sites were selected around Rasht and Someesara cities in Guilan province for soil sampling in which land consolidation was performed 4 years ago. Guilan is located in northern part of Iran, and rice is the main cultivated crop in this province covered about 230,000 ha. The average precipitation of the area is 1359 mm and the average relative humidity equals to 82%. Thermal regime of the region is Thermic and humidity regime is Udic (Ramezanpour, 1990). The studied sites were Shekarsara, Moaf oumandan, Pasikhan, and Kotamjan located between 49^{o} 15’ 26.6″ to 49^{o} 42’ 33.8″ eastern longitude and 37^{o} 15’ 33.3″ to 37^{o} 24’ 59.1″ northern longitude (Fig. 1).
In each site, eight soil samples (four paired) were collected from 0-20 cm soil surface of adjacent consolidated and traditional lands. Overall 32 composite soil samples were collected and transported to the laboratory. Soil Samples were air dried, crushed and sieved to pass a 2-mm mesh screen for measuring soil physical and chemical properties. To determine soil bulk density, samples were collected by a single 5-cm-diameter soil core. The soil-core samples were oven dried at 70˚ C for 48 h, and weighed for bulk-density determination. In addition a second set of samplings was carried out for biological tests. Samples were kept cool and within 1 day of collection were sent to the lab. Collected samples in biological lab were preserved in refrigerator in 4°c.
Total N was measured by Kjeldahl method (Bremner and Mulvany, 1982), extractable K by ammonium ion replacement method (Richards, 1954), extractable P (Olsen and Sommers, 1982), electrical conductivity (EC) and pH in saturated extraction and organic matter measured by wet oxidation (Walkley and Black, 1984), bulk density (Blake and Hartge, 1986), soil texture by hydrometric method (Gee and Bauder, 1986), soil respiration by titration method (Alef, 1995), microbial biomass carbon (MBC) by fumigation incubation method (Powlson and Jenkinson, 1976), buried slide in soil *and* Viewing organisms present Under the microscope *(*Rossi and Cholodny, 1938), the most probable number of bacteria (MPN) (Kakran, 1950), was also measured. Results were analyzed according to paired t-test and SAS software was used.

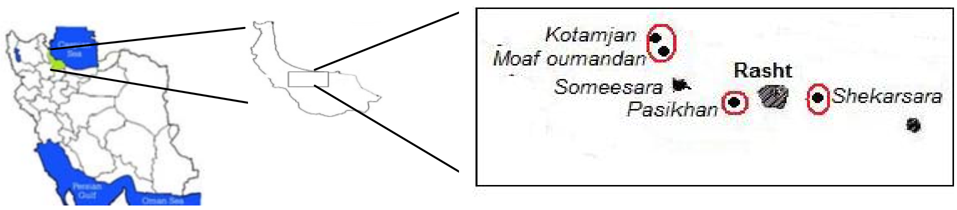


Figure 1. Location of study region within Iran and in Guilan province.

Results and Discussion

Physical indices

Results showed significant differences between clay and silt percentages after land leveling but the difference in sand were not significant (table 1). The average percentages of clay, silt and sand were 47.9, 38.7 and 13.3% respectively in the traditional fields, and were 57.2, 30.1 and 12.7% respectively in consolidated soils. The increase in clay and the decrease in silt percentages in the consolidated fields are probably due to expose of subsurface soil with higher clay at the surface which is in conformity with Brye *et al.* (2003). According to the obtained results although consolidation operation led to significant differences in clay and silt percentages, soil texture remained clay in both conditions.

Table 1. Soil physical characteristics in consolidated and traditional lands.

□b g/cm3	% sand	% silt	% clay	Method
1.67	12. 7	30.1	57.2	consololidated soil
1.4	13.3	38.7	47.9	traditional soil
0.001	0.28	0.0063	0.0072	Significant

Results showed a significant difference in bulk density between traditional and consolidated fields (table 1). The average bulk densities in traditional and consolidated soils were 1.4 and 1.67 g cm^{-3}, respectively. The value of soil bulk density was lower in traditional fields partly due to higher levels of organic matter. Such differences also can occur as a result of soil operations (Haj Abbasi et al., 1997, Emadi et al., 2008), due to such operations subsoil with higher bulk density exposed (Brye et al., 2003). Another main reason is that traffic by heavy machineries leads soil compaction. Although the increase in bulk density may reduce water requirement for rice production especially in the paddling period, but rice roots like other plants should penetrate into the soil at lower depths and use water and nutrients, but this hardly occurs in consolidated soils since their macro porosity is lower than micro porosity and discontinuous porosities are more.

Soil chemical indices

In consolidated soil OM amount was 2.96% but in traditional obtained 4.36% (Table 2). Decrease of OM in consolidated soils in comparison with traditional ones occurred due to: i) land leveling operation, and removing or disturbing surface soil which possesses a great deal of organic matter, ii) establishment of drainage systems in consolidated soils and exiting waste water from soil, soil aeration improved, OM oxidation and decomposition increased and its amount decreased in return (Brye et al., 2003; Bewket and Stoosnijder, 2003).

The level of OM is high in traditional lands due to increase in fresh plant material and their slowly decomposition at soil top layer. Soil operation performed in consolidated lands intensifies the decomposition and mineralization of OM through separating and crushing soil clods and put OM in exposure to microbial attack (Sparling et al., 1992; Haynes, 1999; Shepherd et al., 2001).

Soil electrical conductivity increased as a result of land consolidation project while pH decreased (Table 2). Soil pH and EC were 6.9, 0.97 ds m^{-1} respectively in consolidated and 7.09, 0.75 ds m^{-1} respectively in traditional soils. Soil pH indicates alkalinity or acidity of the soil and can be changed by different managements (NRCS, 1998). Soil pH affects several factors such as nutrients availability, heavy metal mobility, and soil micro organism activities. After land leveling, subsoil is exposed at surface and leads to significant changes ($p < 0.01$) in pH (Robbins et al., 1997).

According to the results, there were significant differences ($p < 0.01$) between N, P and K levels of the traditional and consolidated lands (Table 2). The average levels of these elements were 0.36%, 30.3 and 181.3 mg kg^{-1} respectively in traditional soils and 0.24%, 27.8 and 152.5 mg kg^{-1} respectively in consolidated soils. About 95% of total N in soil consists of organic N which converts to ammonium by microbial activity (Mlakuti and Homaei, 1992). So, decrease in N level in consolidated soils can be related to decrease in OM in these paddy fields.

The reasons for reduction of P level in consolidated soils are: 1) Exposing of subsoil containing lower P level than the upsoil because of low mobility of P and its accumulation in surface soil. 2) P availability is higher in soils with more micro organisms such as fungi, because of higher ability of fungi in displacing and mobility of P than bacteria (Kucey et al., 1989). Since the number of micro organisms particularly fungi in traditional soils is more than consolidated ones.

The level of available P in such soils is more too. 4) P fixation in soil increases with the increase of clay percent (Stevenson and Cole, 1999). So, after land leveling and the removal of surface soil, which had a high level of P, subsurface soil with high percent of clays lies at surface, in such condition soil P decreases.

Table 2. Soil chemical characteristics in consolidated and traditional lands.

pH	EC ds/m	N %	P mg/kg	K mg/kg	OM %	Method
6.9	0.97	0.24	27.8	152.5	2.96	consolidated soil
7.09	0.75	0.36	30.3	181.3	4.36	traditional soil
0.0005	0.002	<.0001	0.0058	<.0001	0.0001	Significance

After land leveling, subsoil exposure lead to the lack of elements N, P, K (Whitney et al, 1950, Eck, 1987, Robbins et al., 1997). Available K showed intensive changes in farming units after land leveling which are a result of two factors including; inappropriate use of surface soil for road construction and the lack of man skill in implementing operation. During land consolidation, surface soil with a high concentration of organic and nutritional elements is removed and transported for road construction and subsurface soil which is poor lies on top.

Biological indices
Results from buried slide in soil and microbial population
The obtained results from MPN experiments and microscopic pictures of buried slides showed more number and diversity of bacteria, fungi, actinomycetes and nematods in traditional soils (Fig.2). In traditional soils, gram-negative bacteria, gram-positive bacilli with terminal spore, filamentous bacteria (such as actinomycetes) and nematodes were observed, but in consolidated soils gram-positive bacilli and in one case filamentous gram-positive bacteria observed (Fig.3). Soil disturbance as a result of land consolidation lead to the decrease in surface horizon thickness and reduction in OM content in tillage layer and finally reduce biological activities strongly (Tavakoli et al., 2008). Accumulation of OM in the soil affects the soil microbial population and thereby increases the potential of microorganism activities in the soil. More fungi and actinomycetes distributions in traditional soils in comparison with consolidated land indicate that OM in these soils is probably more decomposable. In addition, obligate and facultative anaerobic bacteria play the main role in OM decomposition and nutrient cycle in consolidated soils.

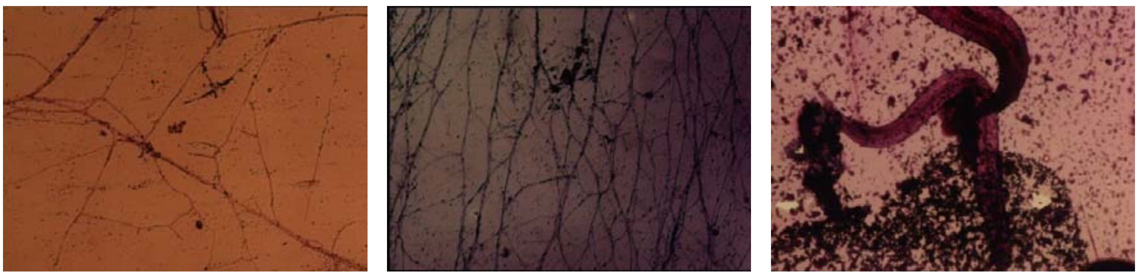
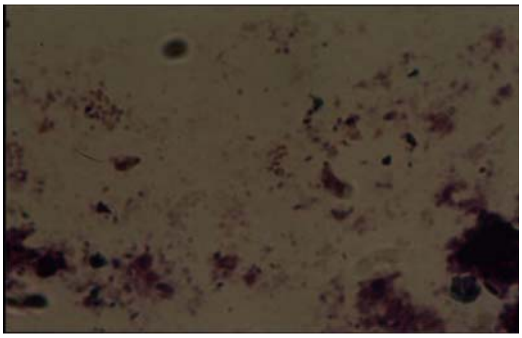


Fig. 2. Results of burid slide (pictures from left): Actinomycets (×40), fungal mycelium community (×40), Nematoda in traditional soils (×10)



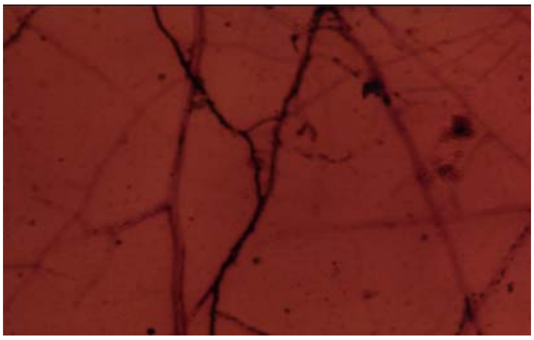


Figure 3. a: Conidia string in consolidated soils (×40) b: actinimycets in consolidated soils (×40)

Microbial respiration

Results showed significant differences in traditional and consolidated soil respiration (Table 3). The values in traditional and consolidated soils are 12.3 and 8.6 mg $Co_2.g^{-1}$ dry soil respectively.

High rate of respiration in traditional paddy soils is related to high content of OM in these soils, micro and macro organisms and plant roots activities. Another cause of high microbial respiration rate in traditional lands is the optimum conditions for microbial activities such as enough supply of organic carbon which is used as an appropriate bed by micro organisms and the high actinomycete, bacterial, and fungal populations in these soils.

Microbial respiration leads to release of nutrients from OM which is essential for plant growth. OM is the key of soil stable fertility and has fundamental effects on its biological properties.

Table 3. Soil biological characteristics in consolidated and traditional paddy fields

Resp mg $Co_2.g^{-1}$	MPN	MBC %	Method
8.6	0.72	0.07	consolidated soil
12.3	1.33	0.1	traditional soil
0.0012	<.0001	0.0017	Significance

Microbial biomass carbon (MBC)

significant difference and low level of MBC in consolidated soils compared with traditional is because of the low amounts of organic matters in this soils, MBC level increased with the increased in C, N and OM contents (Sagar et al, 2001), and increased in bacteria and fungi communation (Lovell et al, 1995).

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A Survey on Satellite Data Potentials in Dust monitoring

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Abstract
In arid and semi-arid region, dust storms occur frequently. Dust storms have a major impact on the air quality of the densely populated areas and are important to the global dust cycle. In extreme cases, they result in the loss of human lives and disruptions of social and economic activities. Masses of dust due to its harmful effects on the environment, agriculture, human health, the hydrologic cycle, climate, soil quality and human life are important and taken into consideration. Due to specific optical properties of dust particles, satellite observed radiances carry the spectral signatures of dust particles that are different from molecular, cloud, and underlying surface. Based on these differences, various detection schemes have been developed to distinguish dust. In practice, the detection is based on the analysis of reflectance in visible bands or brightness temperature (BT) in IR bands. The magnitude of the difference in reflectance or BT in selected bands can be used to infer the signature of dust. This is the essence of aerosol imagery detection algorithms. In this paper, we introduce a detection algorithm of dust storms, for satellite multi-channel imagers by combing visible channel radiances/reflectance with IR channel brightness temperatures.
Keywords: Remote Sensing, Satellite Data, Dust, Indices

Introduction

Mineral dust plays an important role from a climate study point of view, as do anthropogenic aerosols, especially when we consider the global trend of desertification caused by land development (Sokolik & Toon, 1996; Tegen & Lacis, 1996). Dust storms are very dynamic, as a result the particle size of aerosols and the concentrations vary significantly (MacKinnon and Chavez, 1993). Dust storms are generated by strong winds lifting particles of dust or sand into air from regions that are mainly deserts, dry lakebeds and semi-arid desert regions (El-Aakary et al., 2005). Dust aerosol has a significant effect on the atmospheric radiation budget because of a large emission amount (Albrecht, 1989; Bréon et al., 2002; DeMott et al., 2003; Huang et al., 2006; Rosenfeld & Nirel, 1996; Rosenfeld et al., 2001; Twomey et al., 1984).

Aerosols perturb the Earth's energy budget by scattering and absorbing radiation and by altering cloud properties and lifetimes. They also exert large influences on weather, air quality, hydrological cycles, and ecosystems (IPCC. Climate Change, 2007). Such dust storms can also pose a serious health risk for people with respiratory disorders (Huang et al., 2007).

Thus it is imperative to be able to monitor dust storms and predict their evolution. Detection of these highly variable aerosol events is challenging because of: episodic features, short lifetimes, multiple-scales, and strong impact of local surface and meteorological conditions (Zhao et al .,2010). Mineral dust particles can directly alter solar and Earth radiation in both visible and infrared (IR) spectral regions through scattering and absorption processes. Due to specific optical properties of dust particles, satellite observed radiances carry the spectral signatures of dust particles that are different from molecular, cloud, and underlying surface. Based on these differences, various detection schemes have been developed to distinguish dust (Tanré, 1991; Ackerman, 1989; Li, 2001). Several techniques have been proposed for detecting mineral dust and using thermal–infrared observations (Ackerman, 1997; Legrand et al., 2001; Prata, 1989; Prata &Grant, 2001). Detection is based on the brightness temperature differences (BTD) either in two or three channels. Ackerman (1997) argued that a combination of three IR channels near the 8, 11, and 12 μm bands is likely to provide a more robust way to identify dust. Ackerman (1997) demonstrated that analyzing BTD between the 8 and 11 μm channels against BTD between the 11 and 12 μm channels enables to discriminate dust from the clear sky over both oceans and lands temperatures.

El-Askary et al (2003) used MISR images for detection of large dust storms. MISR is characterized by its ability to observe at different viewing angles and hence identification of dust storms is greatly improved (El-Askary et al., 2003). This is attributed to the fact that dust storm events are difficult to be detected in the nadir-viewing angle, while easily detected in the off-nadir angle

views due to the thicker depth of atmosphere. MISR has the potential to enhance the detection of small dust storms, thus it might be helpful in early detection of dust storms (El-Askary et al., 2003). In addition, combining the information from different views could be useful in discriminating between dust clouds and regular clouds. Moreover, different view-angles of MISR make it possible to set limits on particle
shape, size and composition, as well as aerosol amount (El-Askary et al., 2003).
Zhao et al (2010) introduced a detection algorithm of dust storms,for satellite multi-channel imagers by combing visible channel radiances/reflectances with IR channel brightness. In this algorithm Dust detection is performed only for daytime (defined as solar zenith angle < 80 degrees). In this algorithm also Different detection schemes are developed for land and ocean.

Dust Detection over Land
Dust detection over land is not performed over snow and ice or in the presence of higher ice clouds due to bright surface perturbation on the aerosol signal. The specific visible reflectance and IR brightness temperature tests currently implemented are (Zhao et al 2010):

(1) Good data test for BT and R:
• R0.47μm, R0.64μm, R0.86μm, R1.38μm > 0
• BT3.9μm, BT11μm, BT12μm > 0K

(2) BTD and R tests:
• BT11μm − BT12μm ≤ −0.5K & BT3.9μm − BT11μm ≥ 20K & R1.38μm < 0.055 (screen for pixels that are water cloud free. If these conditions are not met, then the pixels are cloudy and terminate testing)

(3) Dust test:
• If BT3.9μm − BT11μm ≥ 25K then dust
• If MNDVI < 0.08 & Rat2 > 0.005 then dust

(4) Thick dust test:
• BT11μm − BT12μm ≤ −0.5K & BT3.9μm − BT11μm ≥ 25K & R1.38μm < 0.035
• MNDVI < 0.2

The above conditions (1) and (2) are used to remove bad observations and cloudy pixels, respectively. For condition (3), if BT3.9μm − BT11μm ≥ 25K is satisfied, the pixel is flagged as dust laden. Two tests are used to indicate the presence of optically thick dust in condition (4) (Zhao et al.,2010).

Dust Detection over Ocean
Dust detection over ocean is not performed over sea ice or in the presence of higher ice clouds. The specific tests currently implemented are as follows(zhao et al 2010):

(1) Good data test:
• R0.47μm, R0.64μm, R0.86μm > 0
• BT3.9μm, BT11μm, BT12μm > 0K

(2) BTD and R tests plus uniformity texture tests:
• 4K < BT3.9μm − BT11μm ≤ 20K • R0.47μm ≤ 0.3
• MeanR0.86μm > 0 and StdR0.86μm ≤ 0.005 (identify water cloud)

(3) Dust test:
• if BT11μm − BT12μm < 0.1K and -0.3 ≤ NDVI ≤ 0 then dust

• if R0.47μm/R0.64μm < 1.2 then dust
• if BT3.9μm − BT11μm > 10K & BT11μm − BT12μm < −0.1K then dust

(4) Thick dust test:
• BT3.9μm − BT11μm > 20K (define potential thick dust regime)
• if BT11μm − BT12μm ≤ 0K and −0.3 ≤ NDVI ≤ 0.05 then heavy dust

Since dust over ocean is more uniformly distributed than cloud and less reflective than cloud, uniformity test (StdR0.86μm ≤ 0.005) and reflectance test (R0.47μm ≤ 0.3) are added to BTD test (4K < BT3.9μm − BT11μm ≤ 20K) to separate better the dust from cloud over ocean (Zhao et al., 2010). The detection algorithm has been tested using measurements from MODIS (Salomonson et al., 1986). Results will be presented below to demonstrate the performance of the algorithm (Zhao et al .,2010). Aside from the comparison of the detection results from MODIS observation with the corresponding MODIS RGB images, the results are also compared with the aerosol optical thicknesses (AOT) and aerosol fine mode fraction (FMF) retrieved from the MODIS radiances using a physically based algorithm for a further check on the performance of detection(Zhao et al.,2010).

Conclusions

Dust particles form a major composition of the aerosol concentration in any dust outbreak; detection of their presence, distribution and transport has been carried out using remote sensing data over different regions of the electromagnetic spectrum. Due to specific optical properties of dust particles, satellite observed radiances carry the spectral signatures of dust particles that are different from molecular, cloud, and underlying surface. Results shows it is possible to combine both visible and infrared techniques to determine the presence of a dust storm.

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Effects of Rice Husk Compost Application on Some Soil Physicochemical Properties and Tomato Yield

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Abstract
In this study, effects of rice husk compost (RHC) application on some physicochemical properties of sandy clay loam textured soil and tomato plant yield were investigated. Rice husk compost including 38.32 C/N rate was applied as organic conditioner to the 0-20 cm soil layer at 0, 3, 6 and 9 % doses with three replications in a randomized plot design. Changes in moisture content of the soils were measured using TDR on a daily basis. Irrigation was made to keep soil moisture content around the field capacity (FC) when plant available water content decreased in a rate of 30%. Soil samples from the plots were taken at the beginning, 40 and 100 days of the experiment. While the highest bulk density value (1.020 gr/cm^3) was determined in the control application, bulk density values in 3, 6 and 9% doses of RHC applications decreased as follows 0.807, 0.677 and 0.589 gr/cm^3, respectively. While the lowest FC (32.45%) and permenant wilting point (PWP) (22.75%) values were determined in the control application, the highest FC (40.0%) and PWP (26.55%) were in 9% doses of RHC application. According to the control treatment, the RHC applications decreased soil pH and exch. Ca content, and increased EC, exch. Mg, K and Na, available P values. Tomato yield in 6% doses of RHC application (7.612 ton/da) was significantly higher than that in control treatment (6.548 ton/da). The RHC treatments improved soil physicochemical properties and increased tomato yield under irrigation conditions.
Key words: Rice husk compost, soil properties, tomato yield.

Introduction

It is known that approximately 65–70 % of soils in Turkey contain low or very low organic matter. This low ratio of organic matter content affects soil physical and chemical properties adversely (Demirtaş, 2004). However, a good plant development is related to soil physical and chemical properties. The common way to improve and sustain of soil physicochemical properties is the addition of organic-based materials to soils (Bender et al, 1998). For this reason, vegetable and animal originated materials should be used as organic fertilizers in agriculture after converting to organic fertilizer by maturing properly (Kacar and Katkat, 1999). Organic matter deficiency in soils is one of the most important factors in soil degradation. Organic matter in soil affects soil physical properties in all textural soil groups (Haynes et al., 1991). Mixing green manure or plant residues into soils causes an increment in organic matter content and a decrease in bulk density (Tirlok et al., 1980; Boparai et al., 1992). Organic matter application to soil increases field capacity, permanent wilting point and available moisture content of soils (Gupta et al., 1977).

Aggelides and Londra (2000) reported that chemical properties of soils positively affected by the application of compost. Organic carbon, EC and exchangeable cations increased with increasing organic matter application. Mature well-decomposed compost is a continuous source of organic matter, carbon, nitrogen, phosphorus, potassium and many microelements in soils and also encourages the plant growth. The objective of this study was to determine effects of rice husk compost (RHC) application on some physicochemical soil properties and tomato yield in sandy clay loam textured soil.

Materials and Methods

Rice husk was composted with manure under aerobic conditions in the greenhouse of Agricultural Faculty in Ondokuz Mayıs University for 13 months. Some properties of the organic residues used in the compost process were given in Table 1.

Table 1. Some properties of the organic residues used in the study

	C, %	N, %	Natural Moisture, %	C/N
Rice Husk	46.303	0.376	15.000	123.146
Manure	33.146	2.789	73.000	11.884
Rice Husk Compost	21.138	0.552	35.785	38.320

The study was conducted in the experimental field of Agricultural Faculty of Ondokuz Mayıs University between June 1, and August 31, 2010. The rates of 3, 6, 9% of rice husk compost (RHC) were applied to the plots (2.0 x 1.0 x 0.2 m) in a randomized plot design with three replications. Sümela F1-RN tomato variety was used in the experiment as plant material. Eight tomato seedlings were planted in each plot. Changes in soil moisture content were measured using a TDR on a daily basis. Deficiencies in soil moisture content were completed by irrigation when plant available water in soil decreased to 30%. Soil samples were taken from the plots at the beginning, 40 and 100 days of the experiment.

After the soil samples were air dried and passed through a sieve with 2 mm size opening, some soil characteristics were determined as follows; particle size distribution by hydrometer method (Demiralay, 1993), soil reaction (pH) in 1:1 (w:v) soil water suspension by pH meter; electrical conductivity ($EC_{25°C}$) in the same soil suspension by EC meter (Kacar, 1994); exchangeable cations by ammonia acetate extraction (Kacar, 1994); and available P by extraction with 0.5 M $NaHCO_3$ at pH 8.5 (Olsen ve ark., 1954). Organic matter (OM) content was determined by modified Walkley–Black method (Kacar, 1994). Moisture contents in field capacity (FC) and permanent wilting point (PWP) were determined at a pressure plate apparatus under 1/3 and 15 atm pressure after soils reached a hydraulic balance state. Bulk densities (BD) were determined on undisturbed soil samples (Tüzüner, 1990). TARIST package program was used for statistical analysis of data. Significant differences between means were shown with LSD test (Yurtsever, 1984).

Results and Discussion

Bulk density values of the soils decreased with RHC application according to the control treatment (Figure 1a). The highest bulk density value (1,020 gr/cm^3) was obtained in the control treatment while the lowest BD value (0,589 gr/cm^3) was in the 9% of RHC treatment. Adding green manure or plant residues to the soils to improve their physical properties cause an increase in organic matter content and a decrease in bulk density (Tirlok et al., 1980; Boparai et al., 1992). In numerous studies, it is reported that addition of organic matter to soils decreases soil bulk density values (Chenu et al., 2000; Marinari, 2000; Loveland and Webb, 2003). Candemir and Gülser (2011) determined very significant negative correlations between organic matter content and bulk density values of soils in their studies. Anikwe (2000) determined that addition of rice husk at increasing doses to the clay textured soil decreased bulk density and increased porosity of soils.

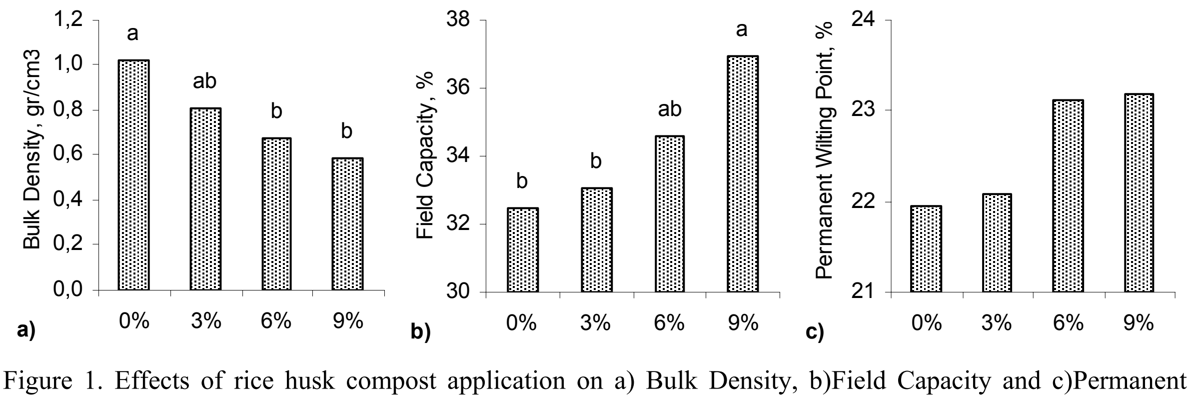

Figure 1. Effects of rice husk compost application on a) Bulk Density, b)Field Capacity and c)Permanent Wilting Point of the soil (LSD_{BD} = 0.260)

Field capacity and permanent wilting point values of the soil increased with RHC treatments compared with the control (Figure 1 b and c). While the highest FC (36,96%) and the PWP (23,18 %) were determined in 9% of RHC treatment, the lowest FC (32,45%) and the PWP (21,96%) were found in the control treatment. Addition of organic matter to soils increases water holding capacity with increasing field capacity and available moisture content (Gupta et al., 1977).

OM content of the soil significantly increased according to the control treatment with RHC application (Figure 2a). While the highest OM content (6.06%) was determined in 9% of RHC treatment, the lowest OM content (3.82%) was obtained in the control. The 9, 6 and 3% application rates of RHC increased OM content of the soil as 59.06, 41.41 and 18.09% according to the control, respectively. Soil pH values of the soil significantly decreased with RHC application according to the control treatment (Table 2). Soil pH values with the 9, 6 and 3% application rates of RHC treatments were determined as 7.66, 7.51 and 7.57, respectively. CO_2 released into soil atmosphere due to decomposition of organic wastes can be converted into carbonic acid (H_2CO_3) by reacting with water (H_2O) and decreases soil pH (Sağlam, 1997). Candemir and Gülser (2011) also reported that application of different agricultural wastes, especially tea waste, decreased soil pH values in different textured soils. EC values of the soils significantly increased with RHC application according to the control treatment (Table 2). While the highest EC (1.20 dS/m) was determined in 9% of RHC treatment, the lowest EC (0.98 dS/m) was obtained in the control. The 9, 6 and 3% application rates of RHC increased EC of the soil as 22.54, 17.90 and 4.05% according to the control, respectively. Many researchers reported that addition of organic matter and compost to the soils increased electrical conductivity, significantly (Eigenberg et al., 2002; Candemir and Gülser 2011).

Exchangeable Ca values of the soil decreased according to the control treatment with RHC application, (Table 2). While the lowest exch. Ca (36.88 me/100 g) was determined in 9% of RHC treatment, the highest exch. Ca (38.20 me/100 g) was obtained in the control. Organic waste applications cause an increase in biological activity and biomass in soils. Ca is one of the most important components of the biomass after nitrogen, phosphorus and potassium (Alexander, 1977). On the other hand, exch. Mg values of the soil significantly increased according to the control treatment with RHC application (Table 2). While the highest exch. Mg (13.49 me/100 g) was determined in 9% of RHC treatment, the lowest exch. Mg (11.70 me/100 g) was obtained in the control.

Table 2. Effects of rice husk compost treatments some chemical properties of the soil.

	pH (1:1)	EC, dS/m	OM, %	P, ppm	Exchangeable cations, me/100 g K,	Ca	Mg	Na
K	7,76 a	0,98 c	3,82 c	57,61 b	1,96 b	38,20	11,70 b	0,45 b
3%	7,66 ab	1,02 bc	4,51 bc	86,51 ab	2,76 a	37,13	12,66 ab	0,52 ab
6%	7,51 b	1,15 ab	5,40 ab	103,16 a	2,86 a	37,76	12,45 ab	0,53 ab
9%	7,57 b	1,20 a	6,07 a	109,63 a	2,96 a	36,88	13,49 a	0,59 a
LSD	0.150	0.150	0.951	38.540	0.787	ns	1.182	0.092

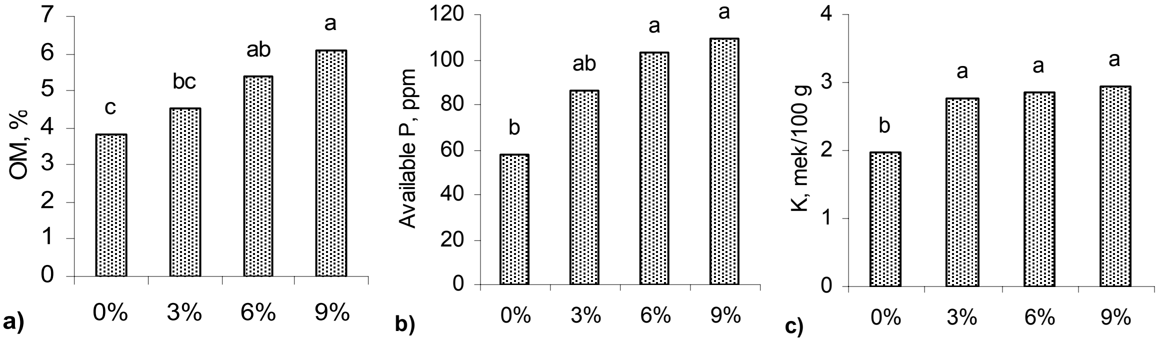

Figure 2. Changes in OM, Available P and Exchangeable K With Application of RHC in Different Doses

Available P, exch. K and Na contents of the soil significantly increased with RHC application according to the control treatment (Table 2, Figure 2 b and c). According to the control treatment, exch. K values of the soil increased with the 9, 6 and 3% application rates of RHC as 50.88, 45.93 and 40.83%, respectively. Whalen et al. (2000) reported that manure treatment increased available K and Mg contents of the soils. Candemir (2005) reported that application of different agricultural wastes increased available K, Mg and P contents in different textured soils. According to the control treatment, available P contents of the soil increased with the 9, 6 and 3% application rates of RHC as 90.31, 79.08 and 50.18%, respectively. Organic acids as a decomposition product of organic matters provide plant available nutrients, particularly phosphorus and micro-elements (Güneş et al. 2000). Vavoulidou et al. (2004) reported that as a result of organic treatments into the soils, productivity levels of soils increased with the increase of available P amounts.
Tomato yield values increased with RHC application according to the control treatment, (Figure 3). The highest plant yield (7.61 ton/da) was obtained with the 6% application rate of RHC. According to the control treatment, tomato yields increased with the 9, 6 and 3% application rates of RHC as 10.31, 16.25 and 5.21%, respectively. Anaç et al. (1999) reported that tomato yield increased by 20% using agricultural waste compost in the cultivation. Aydın et al. (2001) investigated the effects of compost, farm yard manure and chemical fertilizer on tomato yield for two years. They found that the average yield of tomato increased by 61% with chemical fertilizers, 39 to 107 % with application doses of garbage compost and 54% with farmyard manure applications.

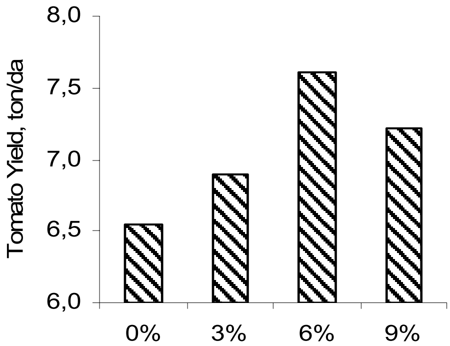

Figure 3. Effect of rice husk compost treatments on tomato plant yield , ton/da

Conclusion

The RHC applications improved soil physicochemical properties and increased tomato yield. RHC added into the soil as an organic matter source increased the FC, PWP, EC, OM content, exch. Mg, K and Na, available P contents, and decreased the BD, soil pH and exch. Ca of the soil. The tomato yields were higher in RHC treatments than in the control treatment. It was determined that RHC can be used as a soil conditioner to improve soil properties, sustain agricultural production and obtain high crop productivity. Recycling rice husk in agricultural lands by composting provides soil fertility and sustainability, and also makes a great contribution to the environment ecologically.

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Ozone, Hydrogen Peroxide and Persulfate Combined Application for Chemical Oxidation of Polychlorinated Biphenyls in Contaminated Soil

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Abstract:
The contamination of soil with polychlorinated biphenyls-containing industrial fluids is a worldwide environmental problem due to their high persistence. Chemical oxidation is one of the effective technologies in degrading an extensive variety of hazardous wastes for the remediation of soil at waste disposal and spill sites. A 300-min treatment of soil with ozone or persulfate without amendments resulted in 50% of polychlorinated biphenyls removal, miserable changes in soil pH and unsubstantial decrease in dehydrogenase activity, allowing using that as the effective treatment step in the soil decontamination.
Keywords: Clophen A30, soil treatment, chemical oxidation

Introduction

Polychlorinated biphenyls (PCBs) are synthetic organic chemicals that have been used as dielectric fluids in transformers, coolants and capacitors and as ingredients in lubricants, PVC plastics, paints, adhesives, sealants and pressure sensitive copy paper. Since the 1970s, production of PCBs has been banned because of their carcinogenicity and other adverse health effects; however, PCBs persist in the environment. Thus, there is a need to develop effective treatment methods for their degradation.

Chemical oxidation is an innovative technology for degrading of different contaminants in various environment matrixes. Chemical oxidation for the soil treatment can be applied both *in situ* (treatment of soil in place) and *ex situ* (after soil excavation). Matching the remedial oxidant is an extremely important step in the successful remediation of contaminated soil. Ozone, hydrogen peroxide and persulfate are popular remedial chemicals used for the soil decontamination.

In spite of the influence of persulfate on PCBs degradation was not reported yet, there are several studies, where ozone (Cassidy et al., 2002; Hong et al., 2008; Javorska et al., 2009) or hydrogen peroxide (Aronstein and Rice, 1995; Carberry and Yang, 1994) were effectively used for remediation of PCB-contaminated soil/sediment. However, a complex approach involving joint application of several chemicals may be necessary for remediation of heavily contaminated soil. Thus, the efficacy of the single and combined application of ozone, persulfate and hydrogen peroxide for PCBs degradation in soil was evaluated in the present study.

Materials and Methods

Soil sample preparation and characterization

Natural topsoil (0-20 cm) was dried over-night at 30 °C in a circulating air drying-oven before the spiking and sieved through a 2.0-mm sieve. Several characteristics of soil are presented in Table 1.

Table 1. Several soil characteristics.

Parameter, unit	Value, mean ± standard deviation
pH	7.3
Total extractable iron (mg kg^{-1})	1900 ± 500
Ferrous iron (mg kg^{-1})	12.1 ± 0.9
Ion-exchangeable Fe(II) fraction (mg kg^{-1})	2.0 ± 0.3
Organic carbon (mg kg^{-1})	460 ± 30
Sand (%)	45.5
Silt (%)	52
Glay (%)	2.5

The identification of the soil texture was based on the principles established by ISO 14688-1,2 (2002, 2004) using a laser scattering particle size distribution analyser (LA-950, Horiba). pH was measured according to EPA method 9045C (1995). Total organic carbon content of soil was was determined by ISO14235 (1998). Ferrous iron and ion-exchangeable Fe(II) fraction were extracted according to the procedure presented by Tessier et al. (1979). Total extractable iron in the soil was extracted according to the method of Heron et al. (1994). Dehydrogenase activity (DHA) in the soil before and after the treatment was measured by triphenylformazan (TPF) production according to ISO/FDIS 23753-1 (2002). Chloride ion in soil filtrate was measured using an ion chromatograph (761 Compact IC, Metrohm).

Soil treatment

Soil of 30 g with 18 mL of liquid (bi distillate water or solutions of persulfate and/or hydrogen peroxide) was ozonated without pH pre-adjustment. The ozonation was carried out in a semi-continuous bubble column with 0.05 L of volume (29 cm high and 1.5 cm in diameter). Gas flow rate was 1.0 L min^{-1}. The initial and residual concentrations of ozone in the gas phase were measured at 258 nm using a PCI-Wedeco ozone monitor. The concentration of ozone in the feed-gas was 5.0 ± 0.2 mg L^{-1}.

In the experiments on the soil treatment with persulfate and/or hydrogen peroxide alone, 30 g of soil were mixed with 18 mL of the solution and treated without pH pre-adjustment and stirring in the cylindrical glass reactor with a 0.2-L of volume.

All the experiments were carried out in duplicates at 20 ± 1^{o}C. Results are presented with ± standard deviation of the mean (n = 2).

Residual hydrogen peroxide in soil filtrate treated by titanium sulfate with pertitanic acid formation was measured photometrically at 410 nm (Eisenberg, 1943). Residual persulfate was measured photometrically at 446 nm as o-dianisidine-peroxydisulfate complex (Sof'ina et al., 2003).

PCB-containing oil extraction and the concentration measurement

Electrical insulating oil, identified as Clophen A30 – commercial formulation of PCBs congers (19.73% of two-ring PCBs, 48.33% of three-ring PCBs, 24.55% of four-ring PCBs, 6.21% of five-ring PCBs and 1.18% of 6-ring PCBs and the overall chlorine content of 41.3% (Schulz et al., 1989), was derived from an old capacitor. The chromatogram of Clophen A30 obtained by Shimadzu gas chromatograph mass spectrometer (GCMS-QP2010 Plus) is presented in Fig. 1.

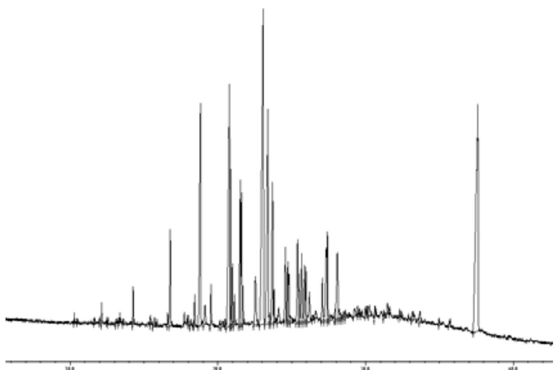

Figure 1. The chromatogram of PCB-containing oil – Clophen A30 obtained by GCMS.

Soil was dried with anhydrous sodium sulphate prior to extraction. Dried soil was soaked in the mixture of *n*-hexane and acetone (1/1, v/v) and placed for the extraction to a reciprocal shaker over-night. Then, a vortex extraction procedure three times per 3 min was used. Joined hexane extracts were mixed (1/1, v/v) with internal standard - nonane dissolved in *n*-hexane with the concentration of 0.6 g L^{-1}. The measurement of PCBs concentration was carried out using a FocusGC, Finnigan GC-FID (Goi et al., 2011).

Results and Discussion

Non-accompanied ozonation of PCB-contaminated soil resulted in 50% of PCBs removal (Fig. 2).

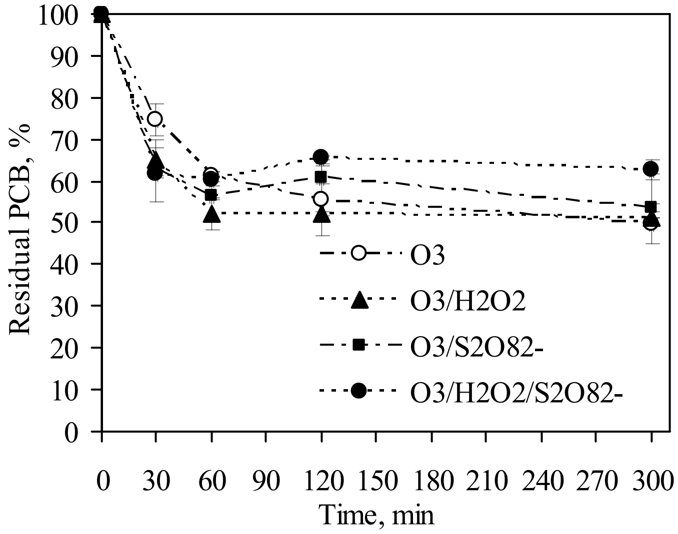

Figure 2. PCB-containing oil residual in soil treated with the systems utilized ozone (soil/H_2O_2 or soil/$S_2O_8^{2-}$ of 1/0.0005 and soil/H_2O_2/$S_2O_8^{2-}$ of 1/0.0005/0.0005, weight ratio).

The joint application of ozone with hydrogen peroxide or persulfate enhanced the degradation of PCBs during the first 30 min of the treatment; however, further degradation was retarded resulting in similar (~50%) removal of PCBs after 300 min of the treatment (Fig. 2). The ozone consumption reduced with the addition of the chemicals (hydrogen peroxide or persulfate) within 120 min of the treatment only. Further ozone consumption increased, resulting in the higher value than that obtained by non-accompanied ozonation (Table 2). In addition, near-complete consumption of persulfate (Table 2) and hydrogen peroxide was achieved within 300 min of the treatment with $O_3/S_2O_8^{2-}$ and O_3/H_2O_2, respectively.

Table 2. Ozone consumed during the soil treatment.

Treatment system	Ozone consumed doses, g O_3 kg^{-1} of soil			
	30 min	60 min	120 min	300 min
O_3	0.48±0.12	0.86±0.015	1.40±0.20	1.88±0.05
O_3/H_2O_2 (soil/H_2O_2=1/0.0005, w/w)	0.56±0.09	0.68±0.02	1.47±0.04	2.45±0.41
$O_3/S_2O_8^{2-}$ (soil/$S_2O_8^{2-}$=1/0.0005, w/w)	0.36±0.01	0.67±0.02	1.24±0.02	2.76±0.03
$O_3/H_2O_2/S_2O_8^{2-}$ (soil/H_2O_2/$S_2O_8^{2-}$ =1/0.0005/0.0005, w/w/w)	0.28±0.02	0.66±0.08	1.30±0.20	2.43±0.33
O_3/H_2O_2 (soil/H_2O_2=1/0.0025, w/w)	0.70±0.08	0.90±0.17	1.23±0.00	2.37±0.14
$O_3/S_2O_8^{2-}$ (soil/$S_2O_8^{2-}$=1/0.0025, w/w)	0.46±0.06	0.78±0.07	0.99±0.07	2.08±0.00

In spite of the increased consumption of both ozone and persulfate (Tables 2 and 3) within 300 min of the treatment, combined usage of all three chemicals, ozone, hydrogen peroxide and persulfate, did not improve the PCBs removal (Fig. 2).

Table 3. Persulfate consumed during 300 min of the treatment.

Treatment system	Residual $S_2O_8^{2-}$ after 300 min of the treatment, g kg^{-1}	$S_2O_8^{2-}$ consumed during 300 min of the treatment, % of initially added
$S_2O_8^{2-}$ (soil/$S_2O_8^{2-}$=1/0.0005, w/w)	0.065	87
$H_2O_2/S_2O_8^{2-}$ (soil/H_2O_2/$S_2O_8^{2-}$=1/0.0005/0.0005, w/w/w)	0.096	81
$O_3/S_2O_8^{2-}$ (soil/$S_2O_8^{2-}$=1/0.0025, w/w)	0.081	97
$O_3/H_2O_2/S_2O_8^{2-}$ (soil/H_2O_2/$S_2O_8^{2-}$=1/0.0025/0.0025, w/w/w)	0.032	99
$O_3/S_2O_8^{2-}$ (soil/$S_2O_8^{2-}$=1/0.0025, w/w)	0.176	93

A five-fold increase of the weight ratio of hydrogen peroxide or persulfate to soil from 0.0005/1 to 0.0025/1 retarded the PCBs degradation (Fig. 3) indicating in possible excess of oxidizing chemicals. The decrease in the ozone or persulfate consumption was also not observed (Table 2). Reduced removal of the contaminant with elevated chemicals consumption makes no sense in application of elevated dosages of oxidizing chemicals (hydrogen peroxide or persulfate).

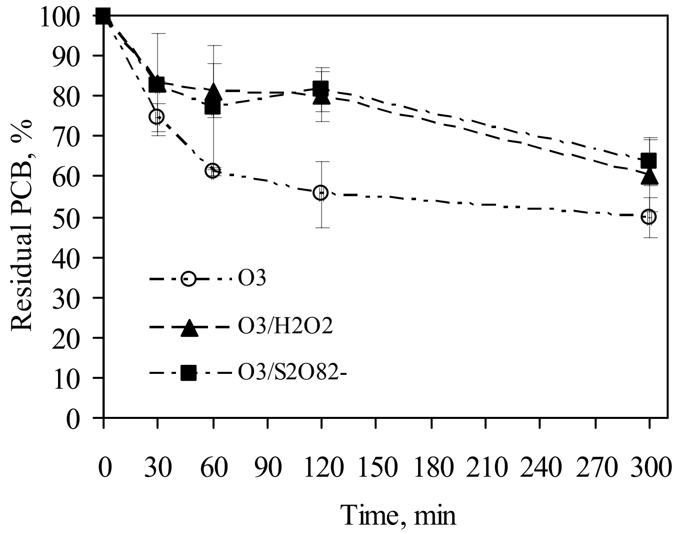

Figure 3. PCB-containing oil residual in soil treated with the systems utilized ozone (soil/H_2O_2 or soil/$S_2O_8^{2-}$ of 1/0.0025, weight ratio).

While joint application of the chemicals did not result in higher PCBs removal than that achieved by non-accompanied ozonation, the PCBs removal efficacy with the persulfate treatment was found to be comparable (Fig. 4). Nevertheless, both treatment processes showed the retardation in the removal of PCBs with prolongation of the treatment time. The soil treatment by non-accompanied hydrogen peroxide with similar dosage to that of persulfate (soil/H_2O_2 or soil/ $S_2O_8^{2-}$ of 1/0.0005) showed reduced efficacy in PCBs removal.

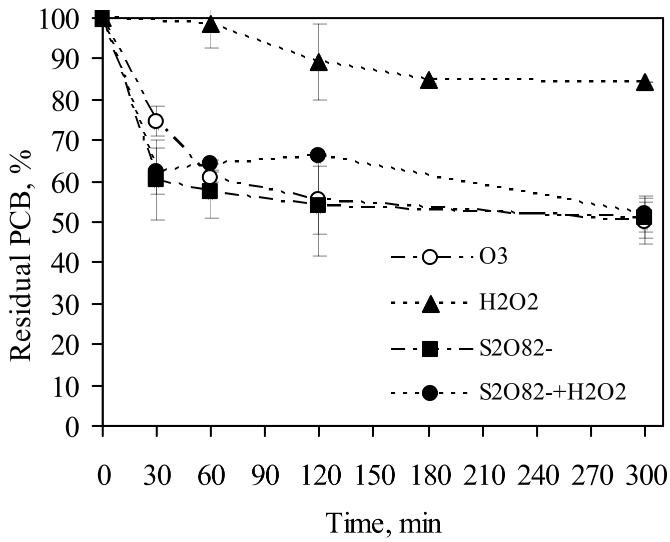

Fig. 4. PCB-containing oil residual in soil treated with ozone, hydrogen peroxide and persulfate (soil/H_2O_2 or soil/$S_2O_8^{2-}$ of 1/0.0005 and soil/H_2O_2/$S_2O_8^{2-}$ of 1/0.0005/0.0005, weight ratio).

The soil pH values changed only slightly from the initial value of 7.3 during the treatment with all the chemicals applied (Fig. 5). It is known that soil buffering capacity usually appeared sufficient to offer resistance to pH changes during the application of moderate dosages of the chemicals. Moreover, such slight variation in the soil pH should not create stress on the microorganisms during the soil treatment.

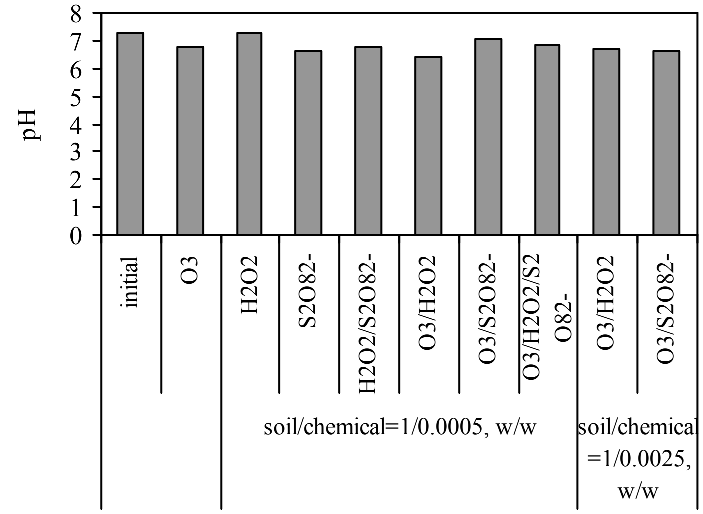

Fig. 5. pH of soil after 300 min of the treatment.

While the DHA in soil slightly decreased after 300 min of the treatment with hydrogen peroxide, and/or persulfate, the application of non-accompanied ozonation did not influence the enzymatic activity of soil indigenous microflora (Fig. 6).

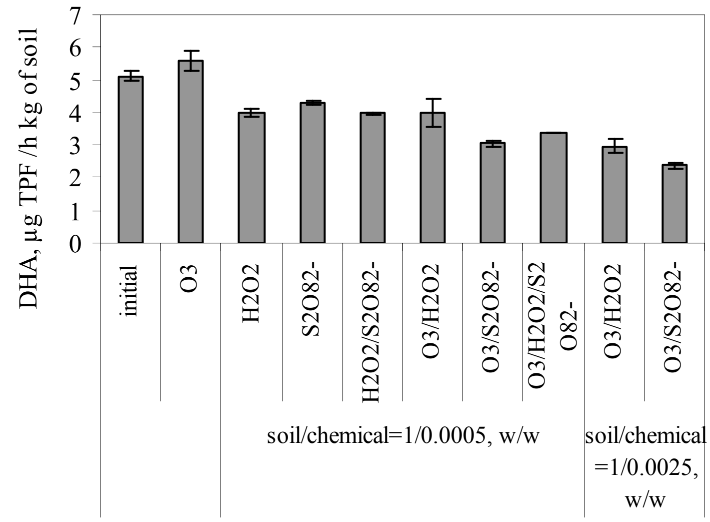

Fig. 6. DHA of indigenous soil microflora after 300 min of the treatment.

In summary, a 300-min treatment of soil with ozone or persulfate without amendments resulted in 50% of PCBs removal, miserable changes in the soil pH and unsubstantial decrease in DHA, allowing using that as the effective treatment step in the soil decontamination.

Acknowledgements

The financial support of the Estonian Science Foundation (Grant 7812) and the graduate school Functional Materials and Technologies (funded by the European Social Fund under the project 1.2.0401.09-0079) for PhD degree student Marika Viisimaa conference participation, is gratefully acknowledged. We would like to thank M.Sc. degree student Olga Sõtševskaja for the experimental assistance.

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Evaluation of the Chemical Composition of Common Spinach (*Spinacea oleracea*) as Influenced by Metallurgical Slag Application

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Abstract
Common spinach, *Spinacea oleracea*, belongs to those vegetables that are very sensitive to acid soils, thus, a necessary lime should be applied. The application of traditional alkaline liming materials such as limestone, dolomite and burnt lime to acid soils for the amelioration of acidity consequently improving crop production is a common practice. Along with these materials, present in Serbia, Ca - containing metallurgical slag from Steel factory - Smederevo (Serbia) can be of great importance.
The aim of this study was to investigate the effects of an application of Ca - containing metallurgical slag from Steel factory from Smederevo, Republic of Serbia (owned by U.S. Steel), on chemical composition of the aboveground biomass of spinach, through vegetative experiments performed in semi-controlled conditions on Pseudogley, a type of soil with very acid reaction.
The effects of metallurgical slag was compared to those of other lime materials (ground limestone and hydrated lime) in combination without and with standard fertilizers (organic and mineral).
All the lime materials, along with metallurgical slag, showed positive effects on elemental composition of spinach. The contents of toxic heavy metals comparing to non-fertilized soils were not significantly increased and were within the allowed concentrations in plant in all the treatments in spite of their higher content in metallurgical slag.
Keywords: Metallurgical slag, lime materials, acid soil, chemical composition, spinach.

Introduction
The main task of every agricultural production, including vegetable, is increasing and maintaining soil fertility. For normal soils maintaining and increasing of productive ability of soils is possible via optimal application of organic and mineral fertilizer. However, for the majority of Serbian soils, characterized by high soil acidity, application of only these fertilizers is not enough to sustain soil productivity. On these soils, that are widely spread in Republic of Serbia, along with regular fertilization, it is necessary to apply Ca-containing fertilizers–calcifiers, for improving their physico-chemical and biological properties.
Common spinach, *Spinacea oleracea*, belongs to those vegetables that are extremely sensitive to soil acidity, thus, a necessary lime should be applied. On acidic soils, spinach will have low germination, yellowing and browning of the leaf tips, the roots will burn and growth of the plant will be slowed (Zvalo and Respondek, 2008).
Application of lime materials and decrease of soil acidity reduce possibility (due to formation of insoluble forms) of higher uptake of toxic elements, which have tendencies of increased accumulation in soil due to anthropogenic pollution.
The application of traditional alkaline liming materials such as limestone, dolomite and burnt lime to acid soils for the amelioration of acidity consequently improving crop production is a common practice (Barber, 1984; Foth and Ellis, 1997). Along with these materials, present in Serbia, Ca - containing metallurgical slag from Steel factory-Smederevo (Serbia) can be of great importance. However, the alkaline nature and the need for sustainable and environmentally acceptable disposal options for metallurgical slag (Lopez et al., 1995) have prompted its use as a liming material on acid agricultural soils. Although metallurgical slag has the largest quantitative share in the overall metallurgical waste, its physicochemical properties offer a high potential for its utilization in agriculture (National Slag Association, 2001).
Regarding the above mentioned, the aim of this research was to investigate the effect of Ca - containing metallurgical slag from Steel factory from Smederevo, Republic of Serbia (owned by U.S. Steel), comparing to the effects of selected commercial lime materials and fertilizers, on chemical composition of the aboveground biomass of spinach, through vegetative experiments performed in semi-controlled conditions on Pseudogley, a type of soil with very acid reaction.

Material and Methods

Greenhouse Experiment

Considering the limited amount of samples of metallurgical slag from Steel factory – Smederevo, at this phase the investigations of its effect on chemical composition of the aboveground biomass of spinach were carried out in pot experiments, under semi-controlled condition in the greenhouse of Institute of Soil Science, Belgrade, from the third decade of February to the begining of April, during 2011. In the experiments the comparisons of the effect of metallurgical slag with other lime materials (ground limestone and hydrated lime) in combination without and with standard fertilizers (organic and mineral) were studied. The ground limestone (calcium carbonate or calcite, $CaCO_3$) contains 60% of carbonate. Hydrated lime (slaked lime, $Ca(OH)_2$) reacts very rapidly and has a TNV (Total Neutralising Value) of 135, thus 740 kg of hydrated lime is equivalent to one ton of ground limestone i.e. the TNV = 135 (Culleton et al., 1999).

The experiment was undertaken with a type of soil from central Serbia region that has very low pH and poor physical and biological properties: *Pseudogley*.

The designed experiments were in three replications: 1. Control – no fertilizer; 2. NPK mineral fertilizer [composite NPK (15:15:15)] + manure – standard fertilization; 3. $CaCO_3$, no standard fertilization; 4. $Ca(OH)_2$, no standard fertilization; 5. Metallurgical slag, no standard fertilization; 6. NPK mineral fertilizer [composite NPK (15:15:15)] + manure + $CaCO_3$; 7. NPK mineral fertilizer [composite NPK (15:15:15)] + manure + $Ca(OH)_2$; 8. NPK mineral fertilizer [composite NPK (15:15:15)] + manure + metallurgical slag.

The experiment was performed in plastic pots with 4 kg of homogenized soils. Common spinach, *Spinacea oleracea* (variety Matador), was chosen as an experimental crop due to its sensitivity to soil acidity. Before planting the amount of fertilizers and slag were measured according to the experiment design and mixed with soil (calculated as for 1 ha): NPK – 15:15:15 = 500 kg ha^{-1}; Manure = 30 t ha^{-1}; $CaCO_3$ = 4 t ha^{-1}; $Ca(OH)_2$ = 2,8 t ha^{-1}; Metallurgical slag = 4 t ha^{-1} (same as the amount of $CaCO_3$, in spite of lower amount of slag). All three lime materials with granulation of 0.2 mm were applied in the experiment.

Slag and Soil Analysis

Before industrial homogenizing and standard grinding the chemical composition of five composite samples of metallurgical slag used from different deposition sites was analyzed. The analyses of chemical characteristics of the study soil were done before the trial was set up.

The following chemical analyses were done: pH in water and 1M KCl was analyzed potentiometrically with glass electrode (Jakovljevic et al., 1985); total N was analyzed on elemental CNS analyzer Vario EL III (Nelson and Sommers, 1996); available P_2O_5 and K_2O were analyzed by Al-method according to Egner-Riehm (Riehm, 1958), where K was determined by flame emission photometry and P by spectrophotometer; Ca and Mg were extracted by ammonium acetate followed by determination on atomic adsorption analyzer SensAA Dual, GBC Scientific Equipment Pty Ltd, Victoria, Australia (Wright and Stuczynski, 1996); determination of effective cation exchange capacity (CEC) and base saturation level was done by the standardized method using barium chloride solution (Sumner and Miller, 1996); microelements were determined with an ICAP 6300 ICP optical emission spectrometer, after the samples were digested with concentrated HNO_3 for extraction of total forms, and by DTPA for extraction of soluble forms of the elements (Soltanpour et al., 1996); the total content of $CaCO_3$ in slag studied was determined using the "rapid titration method" by Piper (van Reeuwijk, 2002).

Plant Analysis

The aboveground biomass of spinach plants was taken and after drying at 105°C the plant biomass was weighed and expressed in g per pot.

For all the plant samples from all the treatments the analyses of aboveground biomass were done. The contents of N, P and K in plant samples were determined by so called "wet" combustion, i.e. they were heated to boiling with the mixture of concentrated acids: H_2SO_4 and $HClO_4$. In the obtained solution, nitrogen was determined by the method of alkaline distillation and titration, phosphorus - by spectrophotometer with molybdate, and potassium – by flame emission photometry (Jakovljevic et al., 1985). In the determination of Ca, Mg, investigated trace biogenic elements (Fe, Zn, Cu) and toxic heavy metals (Cr, Ni, Cd), plant material was converted to a solution by the so-called "dry" combustion, i.e., first by heating at 550ºC (for several hours) and then by treating the obtained ash with hydrochloric acid. These elements were determined by AAS method (Miller, 1998). Soluble Al was determined by dry ashing using ICAP 6300 ICP optical emission spectrometer (Donohue and Aho, 1992).

Statistics
The data shown in Tables are arithmetic means of three replicates of each treatment, namely, of corresponding number of analyzed samples. Standard deviation value and intervals are stated with these data in the Tables. Statistical analyses were performed with SPSS version 16 software, 2007. The effects of treatments on all the variables were tested using Analysis of Variance (ANOVA) method. In certain tables below (3, 4 and 5), NSD indicates no significant difference at the $P=0.05$ level of significance whereas *, ** and *** indicates statistical significant differences at the $P<0.05$, $P<0.01$ and $P<0.001$ levels, respectively; LSD indicates least significant differences.

Results and Discussion
Chemical Properties of Metallurgical Slag
Properties and composition of metallurgical slag from Steel factory – Smederevo are shown in Table 1.

Table 1. Properties and composition of metallurgical slag (means ± standard deviation).

Property	Value
pH in H_2O	12.48±0.04
Total content Ca (%)	26.20±3.48
Total content CaO (%)	36.60±4.83
Total content $CaCO_3$ (%)	65.80±8.64
Available Ca (%) (1M amonacetat)	17.18±1.98
Total content of Mg (%)	0.41±0.04
Available Mg (%) (1M amonacetat)	0.07±0.02
Total content P_2O_5 (%) (HNO_3)	0.64±0.09
Total content P_2O_5 (%) (2% Citrate acid)	0.61±0.10
Total content of Fe (%)	15.34±0.79
Available content of Fe (DTPA – mg kg^{-1})	3.38±0.96
Total content of Mn (%)	1.80±0.15
Available content of Mn (DTPA – mg kg^{-1})	3.12±1.04
Total content of Zn (%)	14.60±5.59
Total content of Cu (%)	228.8±15.4

Results of laboratory investigations showed that this material has very alkaline reaction (pH = 12.50), with the content of Ca in oxide forms (CaO) from 33-45 %, of which about 50 % is easily soluble (in 1 M ammonium acetate). Content of total magnesium is about 0.40 % that was mainly in forms of MgO (0.70%). Total phosphorous contained in the material is about 0.60 % where nearly all the amount was in plant available forms. Content of total iron is expectedly high enough (about 15 %), while the amount of soluble forms is only 0.30 %. The third element (along with Ca and Fe) is Mn, with total amount about 1.8 % , but with low (insignificant) amounts of soluble forms. The studied metallurgical slag contains lower amounts (10-20 mg kg^{-1}) of zinc and a little higher amount of Cu (about 200 mg kg^{-1}).
According to previous studies (Yusiharni et al., 2007), metallurgical slag stone (ground steel slag) contains 22-38 % CaO and 3,5-6,5 % MgO. Oxides of calcium and magnesium are partially free, and partially bound to carbonates and silicate that are easily hydrolyzed. Upon the neutralization rate this slag stone material is classified between burned (oxide) slag and ground slag stone (calcium carbonate).
The availability and alkaline nature of some industrial byproduct qualify them as potential alternatives for lime in agriculture and they include metallurgical slag (Das et al., 2006), although limited studies have been carried out on metallurgical steel slag and derivates (Shen et al., 2004). In

several researches (Rodriguez et al., 1994; Ali and Shahram, 2007), an increase of pH, exchangeable Ca and Mg and decrease of exchangeable Al in acid soils by using different doses of metallurgical slag was reported.

Despite the limiting literature on the utilization of processed metallurgical steel slag as lime in agriculture, the results from research conducted have been very encouraging.

Chemical Properties of Soil

In Table 2 the results of soil chemical characteristics and elemental composition of plowed layer of the studied *Pseudogley* are given.

Table 2. Chemical characteristics of the studied soil (means ± standard deviation).

Property	Pseudogley
pH in H_2O	5.48±0.01
pH in 1M KCl	4.45±0.01
The sum of bases - S (cmol kg^{-1})	11.98±0.95
Potential acidity -Y′	21.66±1.81
Cation exchange capacity - CEC (cmol kg^{-1})	26.06±0.9
Base saturation-V (%)	45.97±2.0
Total N (%)	0.24±0.01
Available P_2O_5 (mg 100g $^{-1}$)	3.73±0.28
Available K_2O (mg $100g^{-1}$)	19.8±1.54
Available Ca (mg $100g^{-1}$)	240±19
Available Mg (mg $100g^{-1}$)	35±3.89
Available Fe (mg kg^{-1})	116±5.9
Available Mn (mg kg^{-1})	66±3
Available Zu (mg kg^{-1})	1.0±0.1
Available Cu (mg kg^{-1})	1.5±0.1
Available Co (mg kg^{-1})	0.21±0.01
Available B (mg kg^{-1})	0.44±0.03

The major factors controlling trace metal concentrations in soil are organic C content, pH, CEC and Fe, Al, Ca, Mg and P concentrations (Chen et al., 1999).

The optimum pH range for growth of most crops in soil is between 5.5 and 7.0, within which most plant nutritives are available (Power and Prasad, 1997). In addition to the aforementioned growth limitations some trace elements may pose a toxicity threat if present at elevated levels as their availability and mobility increases under acidic conditions (Pawlowski, 1997).

The studied Pseudogley had very acid soil reaction, with pH 4.45 in KCl. The soil possessed high potential acidity (Y) and significantly low saturation of CEC (Y =21.7: 11.5; V% = 46:74).

Tested soil had low content of soluble phosphorus and was well supplied with available potassium. Content of soluble calcium is low, while the content of available Mg and microelements are generally within the range of optimal supply.

Experiments in several European countries have demonstrated the ability of metallurgical slag to raise the pH of acid soils, increasing at the same time the Ca and Mg contents of the soils exchange complex. Metallurgical slag use on soils set aside for cereal crops has been studied in previous researches (Coventry et al., 1989), and it has been shown that the slag modified the physical and chemical properties of the soil and lead to an increase in production of between 15 and 40% when 1.6 t ha^{-1} of metallurgical slag was applied to soils with pH of 4-5.

Chemical Composition of Spinach

Results of the content of main and beneficial biogenic macroelements in aboveground biomass of spinach (Table 3) show the significant differences between the treatments, that are due to increased crop yield (their dissolution in plants, especially for some elements: N, K), and due to higher accumulation of some elements and their mobilization from natural soil reserves primarily, as influenced by the additional lime materials. Considering the main goal of this study, the conclusion is that there is a tendency of a little increase of the contents of Ca and P in plants of spinach in the treatment with metallurgical slag (NPK+manure+metallurgical slag).

Table 3. Effect of metallurgical slag and selected lime materials use on the content of biogenic macroelements in spinach (% of dry mass; means ± standard deviation and intervals).

No.	Treatment	N	P	K	Ca	Mg
1	Control – no fertilizer	6.26±0.06 6.20-6.32	1.53±0.02 1.51-1.55	3.06±0.07 2.99-3.12	1.27±0.02 1.25-1.28	0.45±0.03 0.42-0.48
2	NPK + manure	5.97±0.03 5.94-5.99	1.61±0.02 1.59-1.63	3.27±0.02 3.25-3.29	1.22±0.02 1.21-1.24	0.35±0.01 0.34-0.36
3	$CaCO_3$	5.67±0.03 5.64-5.69	1.60±0.02 1.58-1.62	2.86±0.02 2.85-2.88	1.25±0.03 1.23-1.28	0.37±0.01 0.36-0.38
4	$Ca(OH)_2$	6.18±0.02 6.16-6.20	1.54±0.02 1.53-1.56	2.94±0.04 2.90-2.98	1.25±0.03 1.23-1.28	0.37±0.01 0.36-0.37
5	Metallurgical slag	5.64±0.02 5.63-5.66	1.55±0.03 1.52-1.58	2.83±0.02 2.81-2.85	1.24±0.02 1.23-1.26	0.33±0.04 0.30-0.38
6	NPK+manure+$CaCO_3$	5.96±0.02 5.94-5.97	1.66±0.01 1.65-1.67	3.29±0.06 3.22-3.34	1.23±0.01 1.22-1.24	0.31±0.02 0.29-0.33
7	NPK+manure+$Ca(OH)_2$	6.07±0.03 6.03-6.09	1.57±0.02 1.55-1.58	3.08±0.02 3.06-3.10	1.23±0.02 1.22-1.25	0.28±0.01 0.27-0.28
8	NPK+manure+metallurgical slag	6.13±0.02 6.12-6.15	1.61±0.03 1.58-1.64	3.19±0.02 3.18-3.21	1.33±0.01 1.32-1.34	0.27±0.01 0.26-0.27
	P value	***	***	***	***	**
	LSD (0.05)	0.52	0.04	0.07	0.03	0.05
	LSD (0.01)	0.72	0.05	0.09	0.04	0.07

The content of biogenic microelements in aboveground biomass of spinach shows that there are significant differences between different treatments (Table 4). The nature of applied upgrading mediums and their concentration have an impact on heavy metal accumulation, their mobility and storing capacity in plant tissues (Riesen and Feller, 2005). It should be noted that there was not found higher accumulation of iron in spinach plants in the treatments where metallurgical slag was applied in spite of its significant content in this lime material, except a weak tendency of iron increase in these treatments comparing to those where traditional liming materials ($Ca(OH)_2$ and $CaCO_3$) were applied.

The heavy metal concentration in the plant tops is frequently a linear function of total metal concentration in the soil (Chaudri et al., 2001). The content of toxic heavy metals (Cr, Ni and Cd) in aboveground biomass of spinach were within the allowed concentrations (Kloke et al., 1984) in all the treatments (Table 5). Therefore, it should be noted that there was not recorded higher accumulations of even Cr, in mentioned treatment No. 5 – with metallurgical slag, in spite of its higher content in this lime material.

The toxic effects of Al on plant include inhibition of lateral roots and hair roots, disruption of P and Ca nutrition, and inhibition of shoot growth (Fageria et al., 1988). The content of aluminum in aboveground biomass of spinach was generally decreased in all the treatments, especially, under application of lime materials comparing to the unfertilized control (Table 5).

Table 4. Effect of metallurgical slag and selected lime materials use on the content of biogenic microelements in spinach (mg kg^{-1}; means ± standard deviation and intervals)

No.	Treatment	Fe	Zn	Cu
1	Control – no fertilizer	12.62±0.25 12.35-12.85	20.97±0.07 21.00-21.03	0.13±0.01 0.12-0.14
2	NPK + manure	11.63±0.34 11.34-12.00	20.47±0.35 20.09-20.77	0.14±0.01 0.13-0.15
3	$CaCO_3$	11.25±0.17 11.06-11.35	20.02±0.03 20.00-20.05	0.12±0.01 0.11-0.13
4	$Ca(OH)_2$	9.55±0.22 9.31-9.73	19.80±0.24 19.54-20.00	0.11±0.02 0.10-0.13
5	Metallurgical slag	12.57±0.10 12.48-12.67	20.55±0.09 20.45-20.63	0.13±0.01 0.13-0.14
6	NPK+manure+$CaCO_3$	10.82±0.17 10.65-10.99	20.58±0.10 20.49-20.69	0.10±0.01 0.09-0.10
7	NPK+manure+$Ca(OH)_2$	10.26±0.14 10.11-10.38	18.93±0.07 18.87-19.00	0.08±0.01 0.08-0.09
8	NPK+manure+metallurgical slag	12.86±0.11 12.74-12.95	21.06±0.08 20.99-21.14	0.10±0.01 0.09-0.10
	P value	***	***	***
	LSD (0.05)	0.35	0.28	0.016
	LSD (0.01)	0.48	0.39	0.023

Table 5. Effect of metallurgical slag and selected lime materials use on the content of toxic heavy metals (mg kg^{-1}) and soluble aluminum (mg 100g^{-1}) in spinach (means ± standard deviation and intervals)

No.	Treatment	Cr	Ni	Cd	Al
1	Control – no fertilizer	0.04±0.001 0.035-0.037	0.070±0.01 0.06-0.09	0.07±0.007 0.065-0.079	156±36.02 115-181
2	NPK + manure	0.03±0.001 0.032-0.034	0.083±0.006 0.08-0.09	0.07±0.004 0.064-0.071	71±4.16 66-74
3	$CaCO_3$	0.04±0.001 0.036-0.038	0.063±0.006 0.06-0.07	0.06±0.003 0.062-0.068	74±4.73 69-78
4	$Ca(OH)_2$	0.03±0.001 0.03-0.031	0.077±0.006 0.07-0.08	0.06±0.001 0.06-0.062	77±2 75-79
5	Metallurgical slag	0.04±0.002 0.036-0.039	0.011±0.001 0.01-0.012	0.06±0.002 0.06-0.064	78±3.06 75-81
6	NPK+manure+$CaCO_3$	0.03±0.002 0.024-0.027	0.037±0.006 0.03-0.04	0.07±0.003 0.062-0.068	63±3.06 60-66
7	NPK+manure+$Ca(OH)_2$	0.02±0.003 0.022-0.028	0.043±0.006 0.04-0.05	0.06±0.002 0.058-0.061	45±1.53 43-46
8	NPK+manure+metallurgical slag	0.03±0.003 0.024-0.029	0.047±0.015 0.03-0.06	0.06±0.004 0.056-0.063	59±4 55-63
	P value	***	***	**	***
	LSD (0.05)	0.003	0.015	0.006	22.72
	LSD (0.01)	0.0043	0.021	0.009	21.29

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Soil Pollution Study in the Area of Highway E75 :Section Belgrade to Presevo in Republic of Serbia

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Abstract:
The area of study included the E 75 highway through Serbia in the section from Belgrade to Presevo, a distance of about 400 km. Soil samples were taken from each side of the lane at a distance of average 8 km and at 10, 30, 50 and 400 m perpendicular to the direction of the highway. The soil samples were determined by the basic chemical characteristics of soil and content of total Pb, Cu, Zn, Ni, Cr, Cd, As and Hg.
Received results show that about 40% of soil samples has limitations, such as strong acid reaction, i.e., very low available phosphorus content.
The content of total forms of Pb above the MAC (maximum allowable concentration), was found in 5.28%, Cu in 0.25%, Zn in 1.01%, Ni in 8.3%, Cr in 16.6%, As in 1.51%, Hg in 0.75% of the studied samples. The content of total forms of Cd in all the samples tested was below of the MAC.
Based on the performed tests it was concluded that in addition to geochemical there are also anthropogenic impacts of increased concentrations of certain pollutants.
Key words: soil, pollution, highway

Introduction

The highway is the highest traffic class of roads. It is exclusively designed for fast motor traffic, which is operating in physically separated carriageway, usually width of 27.5 meters, with at least two running and one stopping lane.
Observations presented in this paper were performed on the section of the highway E75, which is very frequent throughout the year, so the impact of emissions from motor vehicles on soil and plant is especially emphasized. Since the soil along the highway mainly belongs to agricultural area, examinations were aimed to determine whether there is and what is the level of the pollution of the soil in the examined area.
Soil as an essential natural element represents a very complex system, sensitive to different influences. It responds to small changes and this can cause a degradation of its main characteristics. Therefore, the relations arising from the different spheres of influence on soil also define the whole question of the relationship between the highway and the environment.

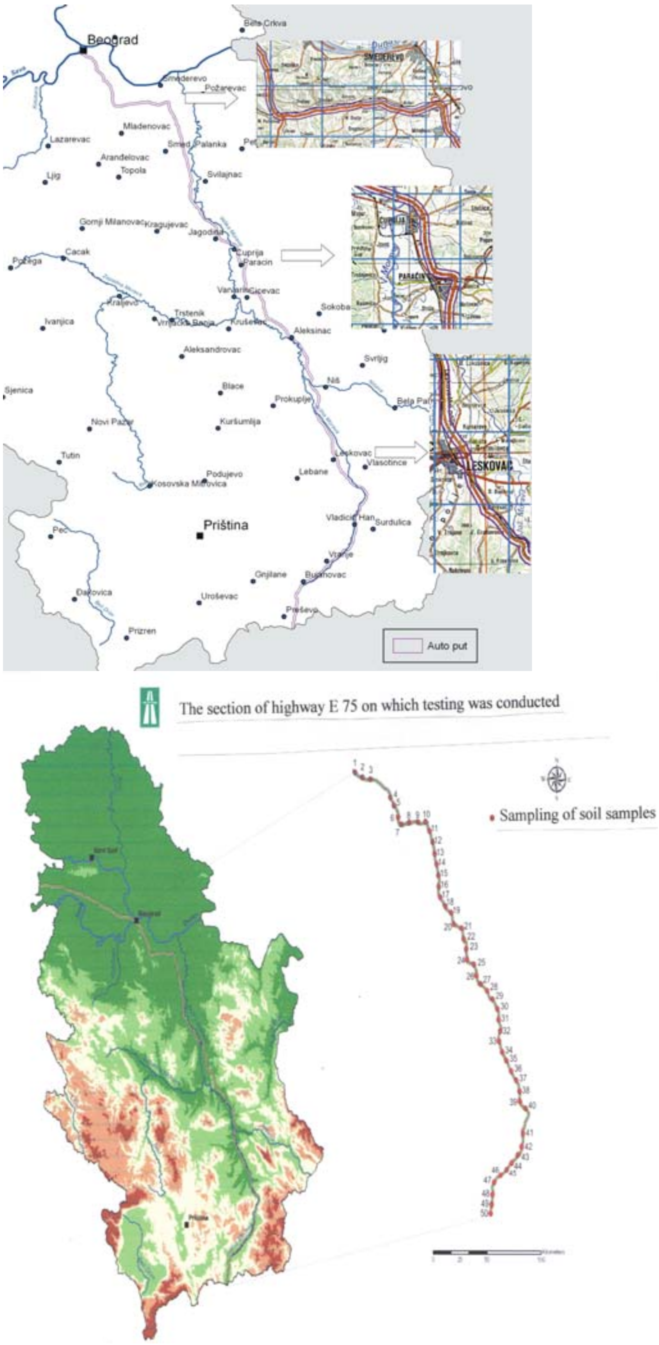

Figure 1.-The route of the highway and sampling spots

Materials and Methods

The area of study included the route of the E 75 in the section from Belgrade to the border with Macedonia-Preševo, (Figure 1.), a distance of about 400 km. Composite soil samples were taken from each side of the lane at a distance of 8 km and at 10, 30, 50 and 400 m perpendicular to the direction of the highway from a depth of 0 do30 cm. Sampling was conducted during August and September 2010.

Composit soils samples were carried to the laboratory, dried, and passed through a 2-mm sieve. Soil pH in water and 1M KCl was analyzed potentiometrically with glass electrode (SRPS ISO 10390:2007- Determination of pH). The equivalent calcium carbonate was determined by the volumetric method (SRPS ISO 10693:2005- Determination of carbonate content - Volumetric method). Soil total C, N and S were analyzed on elemental CNS analyzer Vario EL III, (Nelson, D.W. and Sommers, L.E. ,1996). Available P_2O_5 and K_2O were analyzed by Al-method according

to Egner-Riehm (to Egner-Riehm, 1958), where 0.1M lactate (pH = 3.7), was used as an extract. After the extraction, K was determined by flame emission photometry and P by spectrophotometer after color development with ammonium molybdate and $SnCl_2$. Microelements and heavy metals were determined on ISP emission spectrometer ICAP 6300, after the soils were digested with concentrated HNO_3 for extraction of total forms (Soltanpour et al., 1996).
The concentration of trace elements Hg was determined by AAS method by hydration after the so-called "wet" combustion of samples, i.e. boiled in the mixture of concentrated acids: HNO_3 and H_2O_2 , with filtration and the necessary dilution.
Reference soils NCS ZC 73005, Soil Certificate of Certified Reference Materials approved by China National Analysis Center Beijing China, and reagent blanks were used as the quality assurance and quality control (QA/QC) samples during the analysis.
Statistical analyses were performed with SPSS version 16 software. The effects of treatments are presented in Tables 1 and 2 for all the variables using Analysis of Variance (ANOVA) method.
Cartographic data processing was performed by using ArcView GIS 8.3.

Results and Discussion

Based on the exanimations, (a total of 398 soil samples), the following results were obtained: In the examined area it is represented forty types of soil, with twelve separate zones with different plant cover. Fields are dominating with 43% of examined area, abandoned production areas (neglected land) with of about 23% of areas and meadows with about 20%. The rest of the area is occupied by orchards, vineyards, gardens, vegetable gardens, forests, industrial crops and swamp surface. Based on the results of some basic parameters of fertility (Table 1.), it was noted that about 40% of soil samples has limitations, such as strong acid reaction, i.e., very low available phosphorus content. In the small color samples was found weak and affordable potassium and total nitrogen.

Table 1.- Statistical description of basic hemical properties of investigation soils

Statistical parameters	pH (1MKCl)	$CaCO_3$ (%)	P_2O_5 (mg/100g)	K_2O (mg/100g)	Total N (%)	Total C (%)
Min	3.60	0.00	0.25	4.93	0.03	0.22
Max	7.50	56.52	105.37	39.69	0.79	10.62
Mean	6.02	1.94	16.51	24.66	0.21	2.30
SD	0.93	5.39	16.76	8.60	0.09	1.22
VC	0.86	29.01	281.01	73.97	0.01	1.49
Median	6.00	0.00	11.38	25.23	0.20	2.03
Modus	7.30	0.00	3.58	27.32	0.10	1.50

SD-standard deviation; VC-variation coefficient

The organic fraction in soils has a significant influence on heavy metal transport (Rieuwerts et al. 1998, Wang and Qin 2006; Saeedi et al. 2009).The content of heavy metals in soil and their impact upon ecosystems can be influenced by many natural factors, such as parent material, climate, soil processes, and anthropogenic activities such as industry, agriculture, and transportation (Wei et al. 2007).
Urban roadside soils are the ‘‘recipients’’ of large amounts of heavy metals from a variety of sources including vehicle emissions, coal burning waste and other activities (Jose A. Acosta et al.,2009). Automobile traffic pollutes roadside environments with a range of contaminants. Heavy metals are found in fuels, in the walls of fuel tanks, engines and other vehicle components, in catalytic converters, tires and brake pads, as well as in road surface materials. (Zehetner et.al, 2009).
In Table 2, statistical description of heavy metals is shown.
Averages of Cr, Mn, Ni, Cu, Zn, Cd and Pb are compared with other cities around the world are significantly lower (Birke and Rauch 2000; Manta et al. 2002; Imperato et al. 2003; Ruiz-Cortes et

al. 2005; Ljung et al. 2006; Bretzel and Calderisi 2006), meaning the anthropic activities have a low impact on the soil heavy metal concentrations in the study area.

Content analysis of the total form of the studied elements in the surface layer of the investigated soil samples shows that the samples with 1.51% content of total forms of arsenic above the Maximum tolerable Concentration (MTC), Official Gazette of Republic of Serbia, 23/94. These are samples that are mainly in the zone between 10 and 30 m away from the traffic lanes.The content of total forms of cadmium, cobalt and manganese in all the samples tested below the MTC. In 16.6% of the total content of soil samples chromium is above the MTC. Samples of soil in which the increased content of chromium determined mainly equally represented in all areas of study (10,30,50,400 m from the motorway).

The content of total forms of copper above the MTC was found in 0.25% of the studied samples. Of these, half were located in the vineyards, so the reason for the appearance of increased concentrations of this element may be excessive use of plant protection products based on copper, which are used on these surfaces. Total forms of nickel above the MTC were registered in 8.3% of all samples and are evenly spaced along the area of research. Extreme content of this element (over 200 mg kg^{-1}) was registered in 0.8% of the samples and to the zone at 10 m distance from the motorway route. The content of total forms of lead above the MTC was registered in 28.5% of the samples, except that in one sample at a distance of 10m from the highway route registered an extremely high concentration of this element of 215.45 mg kg^{-1}. Total zinc in the form of 1.01% of all samples exceeding MTC s and the samples are mainly located in the zone to 10 meters from the motorway. The content of total mercury above the MTC was determined in 0.75% of samples in the zone of 10-50 m away from the traffic lanes.

Table 2. Statistical description of heavy metals end As in the study area

	Statistical parameters	**As**	**Cd**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**	**Hg**
	(mg kg^{-1})								
Surface layer (0-30 cm)	Total No of samples	398	398	398	398	398	398	398	398
	Min	0.69	0.27	17.39	4.64	4.83	0.000	23.97	0.00
	Max	61.45	2.54	202.71	223.82	438.07	1108.16	591.10	4.84
	Mean	7.69	0.91	71.56	25.25	47.83	74.56	77.85	0.13
	SD	6.85	0.38	33.91	19.53	43.30	81.34	55.18	0.39
	VC	39.88	0.14	12.83	1108.16	283.95	1501.86	3934.06	2398.0
	Mediana	6.02	0.91	12.51	67.71	22.11	37.72	32.23	66.05
	Modus	4.92	0.85	13.01	43.85	17.72	37.67	27.53	71.05
Limits	Lower	/						0-50	/
	Usual	0-10	0-1	1-25	<50	1-25	<50	50-100	>0.1
	Higher	10-25	2-3	25-50	50-100	25-50	50-100	100-300	1-2
	MTC*	25	3	100	100	100	100	300	2
	Extreme	>100	>5		>200	>200	>150		

*Official Gazette of Republic of Serbia, 23/94

Numerous studies on roadside soil pollution have focused on total emission loads of heavy metals into open grassland and agricultural areas (Wheeler and Rolfe 1979; Harrison et al.1981; Ward 1990; Fergusson 1990; Viard et al. 2004; Donaldson and Bennett 2004; Hjortenkrans et al. 2006; Nabulo et al.2006). Generally, total heavy metal contents in roadside soils were found strongly dependent on traffic density and showed an exponential-like decrease with distance from the road, reaching background levels within tens to hundreds of meters.

The natural soil concentration of heavy metals depends primarily on the parent material composition (De Temmerman et al. 2003).

Recently, roadside soils have been an increasingly important sampling medium for assessing anthropogenic metal concentrations. A variety of heavy metals have been measured in roadside soils and reported by many researchers (Turer and Maynard 2001,2003; Wang et al. 2005; Manta et

al. 2002; Tang et al. 2005; Zhang et al. 2006; Xue-Song Wang 2008). The most frequently reported heavy metals of concern have been lead, zinc and copper, to a lesser extent, Cr. These heavy metals in roadside soils are principally derived from vehicle emissions, wear and tear on automobile parts
The most frequently reported heavy metals of concern have been lead, zinc and copper, to a lesser extent, Cr. These heavy metals in roadside soils are principally derived from vehicle emissions, wear and tear on automobile parts (Xue-Song Wang andYong Qin ,2007).

It can be concluded that the addition of anthropogenic pollution (excessive use of plant protection products and fertilizers, as well as the impact of air pollution from motor vehicles originating in the valley of the Morava dominant geochemical pollution (based on the available literary sources). The geological parent materials are river sediments and loess, and the geochemical background concentrations (in topsoils) range from 18 to 23mg kg^{-1} for Pb, 0.14 to 0.20 mg kg^{-1} for Cd, 8.7 to 17.5 mg kg^{-1} for Cu, 36 to69 mg kg^{-1} for Zn, 18 to 26 mg kg^{-1} for Ni, and 60 to 76 mg kg^{-1} for Cr (Geochemical Atlas of Europe, www.gtk.fi/publ/foregsatlas). Namely, Ni and Cr, are found in increased quantities in the ultrabasic rocks that have formed land. The origin of increased contents of Pb and As is so closely associated only with these rocks, but the causes of pollution and should be linked to anthropogenic influence.

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Improvement of the Hydrodynamic and Physico-Chemical Properties of the Sandy Soils by the Mud of the Dam of Foum El Gherza (Biskra-Algeria)

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Abstract
The objective of the study is the improvement of the physical, chemical and hydrodynamic properties of the sandy soils and the valorization of the mud. The experiment is made out in pots of vegetation with increasing amounts of the mud and in the presence of a barley culture.
The results show a remarkable effect of the mud on the sand amended compared to the control. The addition of the mud to sandy soil increased the holding capacity and the useful reserve and decreased the infiltration. The improvement of the hydrous properties resulting from a reduction in the macroporosity and increase in microporosity as well as the improvement of the fertility of the soil have a direct consequence on the development of the plant. Indeed, the growth of barley (height of stem and tiller number) and dry matter yield are clearly improved according to the amounts of the mud. The EC of the soil increases slightly with the increase in the amounts but it is not significant except with the treatment 100% mud. Through the statistical results, the treatment 15% represents the best amount.
Keywords: sand, mud, barley

Introduction
Siltation in Algeria has reduced dam capacity and become a big problem for the optimal mobilization of water resources. Not only the usable capacity is gradually reduced as the sediment progressively settles in the reservoir but also the removal of the mud is a delicate and difficult operation (REMINI and KETTAB, 1998). The dam of Foum El Gherza of Biskra is one of these dams threatened by this dangerous phenomenon which involved a loss of more than 50% of its initial capacity.
On the other hand agriculture uses enormous quantities of water for the irrigation in particular for the sandy soils. This type of soils is mainly characterized by its poverty, its very low holding capacity and its excessive permeability that promotes a loss of important quantities of irrigation water. The majority of the soils of the Sahara need clay amendment for the improvement for their fertility and of their resistance to erosion (DAOUD and HALITIM, 1994)
Our work in this study is to use the mud of the dam as an amendment for sandy soils whose objective is the improvement of the quality of these soils and the valorization of the sediments of the dam and consequently optimum exploitation of water.
Thus we can arrive at a saving in water of irrigation of the sandy soils through the improvement of the hydrous and hydrodynamic properties of this type of soils namely the permeability, the holding capacity and the useful reserve as well as the improvement of the chemical properties.

Material
1. The mud: the origin of the mud is the dam Foum El-Gherza (Biskra) taken after last unsilting.
2. The sand: the sand used comes from the soil of the area of Ain Ben Naoui in the west of Biskra.
3. The plant: the plant used is a local variety of barley which is called (Tichedrett)
4. The pots: the pots are in plastic perforated in bottom, a 15 cm height. The higher part is 15 cm and the lower base is 9 cm in diameter.

Table 1: Physicochemical characteristics of the sand and mud.

characteristic	sand	mud
Particles size %		
Clay	0	44.82
Fine silt	0.9	10.35
Coarse silt	27.25	41.4
Fine sand	70.65	2.07
Coarse sand	1.2	1.36
EC 1/5(ds/m)	0,83	1,15
pH	7,14	7,67
Organic Carbon (%)	0,117	0,896
Organic matter (%)	0,201	1,54
Holding capacity CR (%)	1,74	32,92
PF 4.2 (%)	0.73	21.68
Permeability (cm/s)	$3,2 \times 10^{-2}$	$2,3 \times 10^{-4}$
Total limestone (%)	27.38	49.22

Experimental protocol

The experiment comprises 7 treatments and 3 repetitions, the treatments are mud-sand mixtures The percentages of the mud in the treatments are: 0 %(pure sand), 5%, 10%, 15%, 20%, 25% and 100 %(pure mud). The device blocks is used for the experiment.

Results and discussions

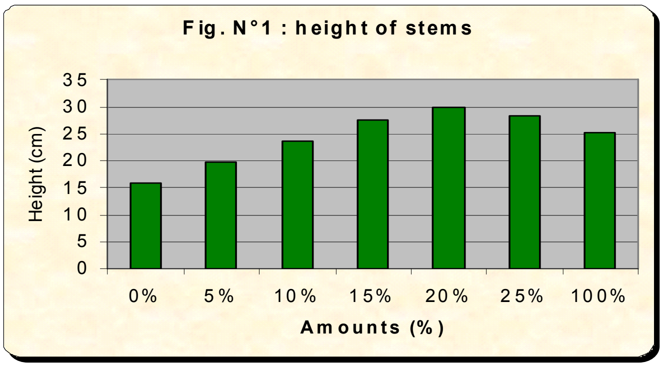
Effect of the mud on the growth of the plant

The height of stems:

We noticed a progressive increase height of the stems according to the amounts until the 20% then it decreases in the treatments 25% and 100% (fig. 1). The highest height is in the treatment 20% (approximately 30,04 cm) and the weakest is that of the treatment 0% (approximately 15,95 cm). Thus after a while the effect of the amount of the mud becomes obvious through the improvement of the physicochemical and hydrous properties of sand. The difference between the treatments is significant. The homogeneous groups according to the Newman-Keuls test are summarized in table 2

Table 2: Height of the stems in cm

Treatments	Average	Homogeneous groups
20%	30.04	A
25%	28.41	A
15%	27.52	A
100%	24.09	A B
10%	23.66	A B
5%	19.75	B C
0%	15.95	C



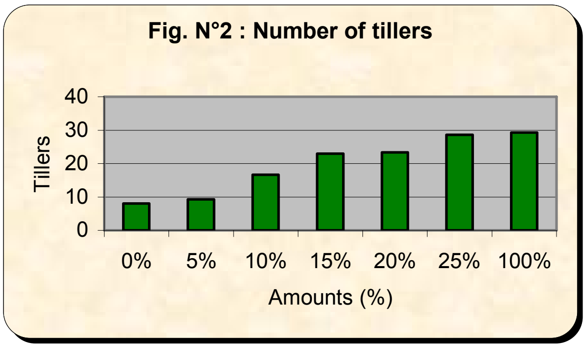
Number of tillers

The number of tillers increases according to the amounts of the mud (fig. 2). This increase seems to be the result of the total fertility and the improvement of the characteristics of the medium

especially the hydrous properties. Because during tillering and stem elongation the requirements of water increase quickly (DUBOST, 1994).
The statistical analysis shows a significant effect of the treatments (tab 3).

Table 3: Numbers of tillers

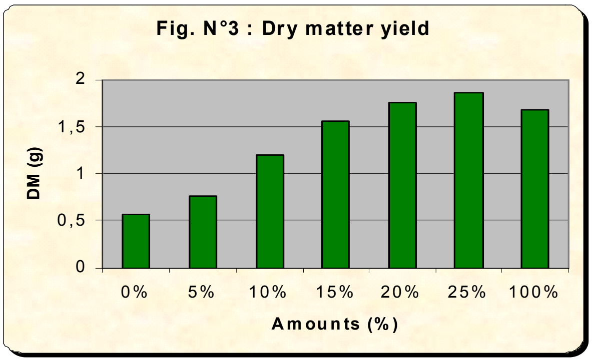
Treatment	Average	Homogeneous groups
100%	29.33	A
25%	28.67	A
20%	23.33	A
15%	23.00	A
10%	16.67	B
5%	9.33	C
0%	8.00	C



Dry matter yield
The yield of dry matter ranged from 0.6 to 1.8 g, this variation is generally proportional with the amount of the mud. The yield is weak for the treatment 0%, a gradual increase in yield until the treatment 25% then it decreases for the treatment 100% (fig. 3). The yield is thus clearly improved under the effect of the mud. The analysis of the variance shows a significant effect of the treatments (tab 4).

Table 4: Dry matter yield (g)

Treatment	Average	Homogeneous groups
25%	1.86	A
20%	1.75	A
100%	1.68	A
15%	1.56	A
10%	1.20	A B
5%	0.76	B C
0%	0.56	C

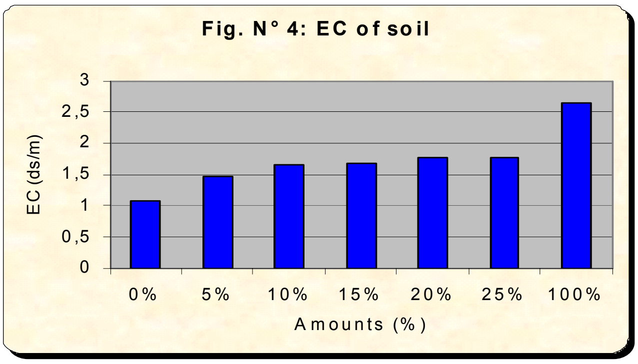


Electrical conductivity (EC)
The EC of the soils is proportional with the increase in the amount (fig. 4). The lowest is recorded in treatment 0% (1.07 ds/m) and highest in treatment 100% (2,64 ds/m).We can say that there is a slight increase in salinity with the increase in the amounts of the mud except for treatment 100%.

This is confirmed by the statistical analysis where treatment 100% formed group and other treatments another group (tab 5).

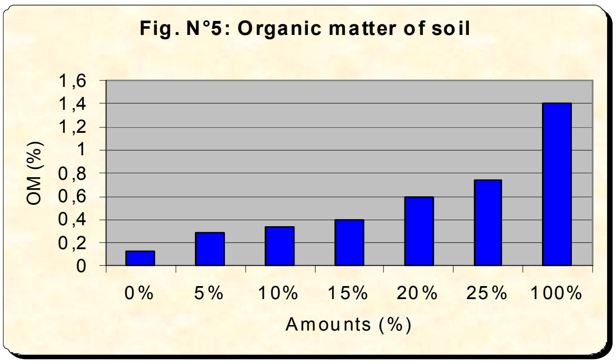
Table 5 : EC of the soils (ds/m)

Treatment	Average	Homogeneous groups
100%	2.64	A
20%	1.77	B
25%	1.76	B
15%	1.67	B
10%	1.65	B
5%	1.47	B
0%	1.07	B



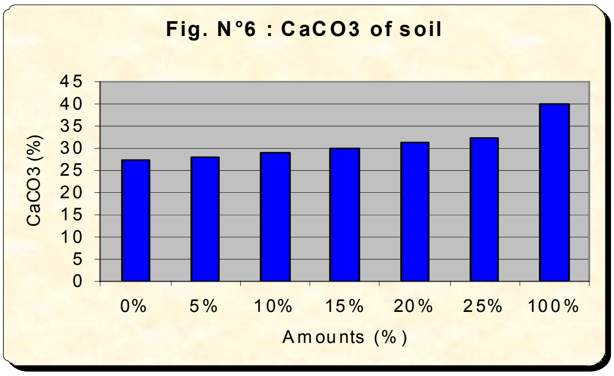
4. The organic matter (OM) of the soil

It was noticed that the organic matter increases with the increase in the amount of the mud in the treatments (fig. 5). It is weak for the treatment 0% (0,13%), increasing for the following treatments until the treatment 100% (1,47%). Thus we can say that the addition of the mud can contribute to the enrichment of the sandy soil by OM what has an effect on the development of the plant.



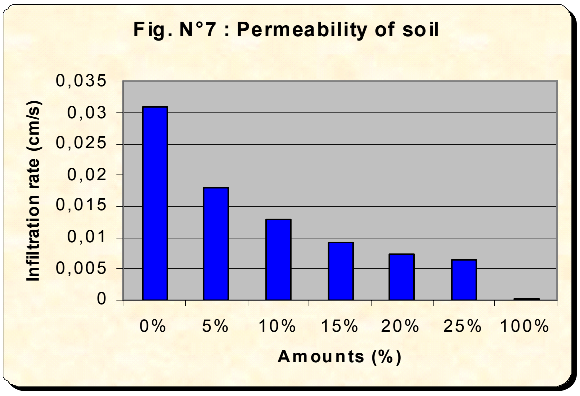
5. The limestone

The limestone rate increases according to the amounts of the mud until the treatment 100%, that resulted from the increasing enrichment of sand by the limestone contained in the mud (fig. 6)



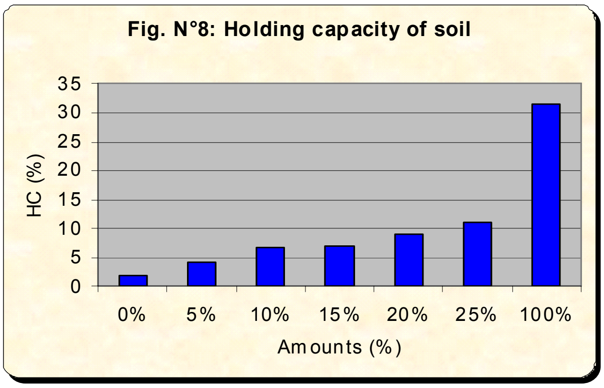
Evolution of the permeability

The permeability depends greatly on the texture (CTGREF, 1979). For sand the permeability can reach several tens of cm/h according to the size of the grains and the proportion of fine element (BOULAINE, 1974). The addition of the mud to sand could decrease the permeability of the mixture. The significant reduction is observed starting from the treatment 15% where the class of permeability becomes moderately permeable (9,2 $.10^{-3}$ cm/s). Finally for the treatment 100%, the permeability is lower (low permeable: 2 X 10^{-4} cm/s). The mud has enriched the sand in fine particles by decreasing consequently its infiltration rate (fig. 7).



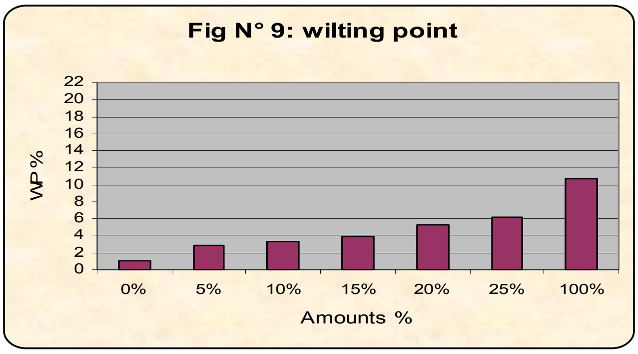
Evolution of the holding capacity HC

The holding capacity increases with increasing amounts of the mud. According to TESSIER (1994), the soils containing fine constituents are those which retain water most strongly. The results show that more the mud content is greater the water retention is higher (fig. 8).



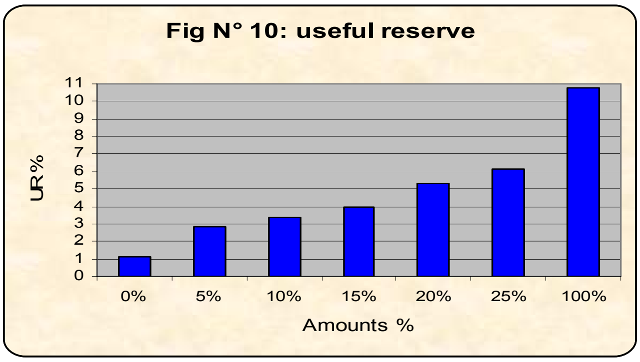
Evolution of the wilting point

The wilting point also increases with the increase in the amounts of the mud. The results show that more the mud content is greater the water retention at wilting point is stronger. Because, more the percentage of fine elements of the soil increases, more its wilting point rises (SOLTNER, 2005) (fig. 9).



Evolution of the useful reserve UR

The useful reserve increases with the increase in the amounts of the mud. The results show that more the mud content is greater the reserve useful water is stronger. Because the useful reserve of a soil is higher when its texture is finer (CTGREF, 1979) (fig. 10).



Conclusion

The contribution of the mud in our experiment could give satisfactory results on the soil and the plant. The effect of the mud is clear on plant growth and dry matter yield. The mud contributed to the improvement of soil physical properties by decreasing the macroporosity and increasing the microporosity what has a consequence on the reduction in the permeability and the increase in HC and UR This effect is very positive because the useful reserve of the sandy soils is weak and the plants will be subjected to the hydrous stress (DUBOST, 1994). The improvement of the hydrous properties contributed certainly to the development of the plant. Moreover, the rate of the organic matter knew an increase in the soil with the increase in the amount. The mixture becomes increasingly fertile according to the amounts. Concerning salinity, the EC of the soil increased slightly with the increase in the amounts but it is not significant except with the treatment 100%. Finally through the statistical results, we noticed that the amount 15% is the best amount from point of view techno-economic. HALILAT (1998), found that 12% of clay is sufficient for the improvement of the properties of sand.

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Investigation of land degradation in semi-arid regions of Iran

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Abstract
This paper investigated main factors of land and ecological degradation in Simindasht catchment. The study area is located in the Iran Central Plateau (35° 30′ and 35° 37′ N, 52° 27′ and 52° 30′ E) in the Northern part of Iran Central Plateau, which belongs to the continental semi-arid climate. Mean annual precipitation is 253 mm, mean annual potential evaporation is 891 mm, and the mean annual temperature is 6.7°C. The average annual wind speed is 4.2 m s^{-1}. In this region animal unit combinative are sheep 32.5%, goat 20% and cow 47.1% those 9 months of year graze in range. Dominant species in three plant types are Artemisia aucheri, Ephedra distachya and Stipa arabica. The study indicates that over grazing, water erosion and Scio-economics problems are main causes of land degradation in research area.
Keywords: Land degradation, semi-arid, Iran.

Introduction
Land degradation and desertification are raising problems in arid, semi-arid and dry sub-humid regions. Climate change exacerbated with socio-economic pressures acting on the land may induce a reduction of resource potential and thus affect directly the livelihood of rural populations. In this paper we investigated effective factor on land degradation in arid regions of Iran.

Materials and methods
Study area
The study area is about 2800 ha and located in the Simindasht catchment (° 30′ and 35° 37′ N, 52° 27′ and 52° 30′ E) in the northern part of Kavir Plain, which belongs to the continental arid climate in the temperate zone. Mean annual precipitation is 253 mm, mean annual potential evaporation is 891 mm, and the mean annual temperature is 6.7°C. The average annual wind speed is 4.2 m s^{-1}.
The studied factors
The studied factors were containing geology, geomorphology, soil and surface cover, hydrometeorology, hydrology, hydrogeology, soil erosion, Scio-economic, Vegetation covers, Land use and management. In this study, geomorphologic studies are conducted to define unit, type and faces of each working unit. The most important part of this method is preparing geomorphology map to determine type and faces which leads to more detailed working units based on slope and faces. Soil condition was determined by field sampling and laboratory analysis.

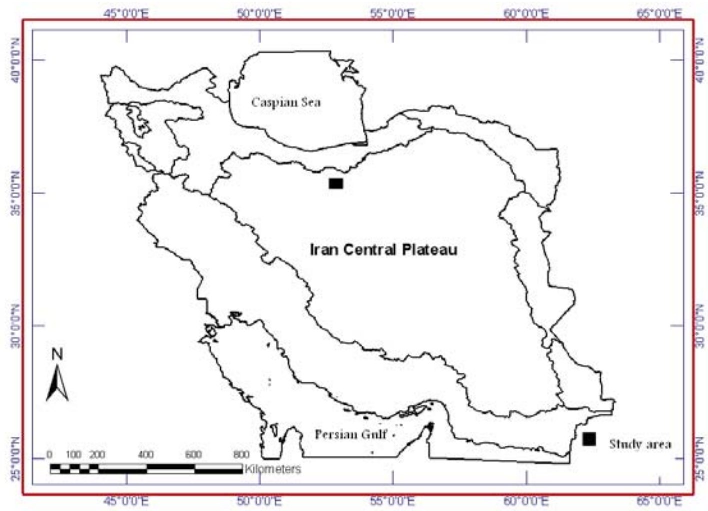

Fig.1. Location of the study area

Result

Regarding to the studies we found that most of the study region is covered by slopes over 70 percent. It means that topography plays main role in soil erosion, vegetation and land degradation among natural factors. Stakeholders as other main factor which is influence and reinforce natural factors to increase soil erosion. Soil erosion in three facies, bare land with limited vegetation, destroyed croplands and floodway was very high. In this region animal unit combinative are cows 47.1%, sheep 35.2% goat 20% those 9 months of year graze in range. Dominant species in three plant types are Artemisia aucheri, Ephedra distachya and Stipa arabica. Mean annual precipitation is 253 mm, mean annual potential evaporation is 891 mm, and the mean annual temperature is 6.7°C.

Conclusion

Developing any method river basin management in arid regions is a difficult and consuming task After evaluation of the effective factors on land degradation, studies show that Simindasht catchment incoming an emergency condition and leading to land and ecological degradation and over grazing, drought in recent years, soil erosion and Scio-economics problems are main causes of ecological degradation in this region. For prevent move to the land degradation in the study area must help to people for reduce any pressure on range and fragile lands in slopes and total of arid and semi-arid lands.

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Natural recovery assessment of physical and chemical properties of forest soil disturbed by ground-base skidding in Iranian Caspian forest

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Abstract:
Skidding machinery traffic can have a long-term detrimental impact on soil physical properties such as soil bulk density and soil strength. Therefore this research was conducted to examine the recovery of physical and chemical properties in compacted soil during twenty-year period in Asalam forest northern Iran. For this purpose three parcels of first and second districts of Nave Asalam were chosen. The treatments were three chronological series (1year, 10 and 20 years), two slope classes (>20% and <20%) and two traffic levels (high and low). In order to assess soil bulk density and soil strength a sample plot of 12×5 m2 dimensions were considered. In each sample plot, sampling was carried out at skid trails and control. Experiment of soil bulk density was carried out in laboratory and soil strength was measured by penetrometer. Also temporal trend on recovery of some soil chemical properties (organic matter, P, K and Mg) was quantified. The results showed that longitudinal slope and traffic intensity were very important factors in soil recovery process in skid trail. So that most soil disturbance occured at >20% slope and high traffic level. The recovery trend of organic matter, P, K and Mg varied depending on traffic intensity and skid trial slope. In general, on steep slope treatments with heavy traffic the rate of recovery was significantly lower than that of at other treatments. The results revealed that organic matter has not totally been recovered over the 20 years. The result also showed that 20 years after skidding soil bulk density and soil strength were in the process of recovery, but have significant difference compared to control.
Keywords: Natural recovery, Forest soil, Soil physical and chemical properties.

1-Introduction
Forest harvesting and mechanical site preparation have the potential to cause detrimental levels of soil and site disturbances, particularly soil compaction and organic matter removal (Tan et al., 2005; Makineci et al., 2007; Ballard, 2000). The use of heavy machinery to perform forestry activities such as logging has increased world wide during the last decades. However, these machines may seriously influence the soil ecosystem as they induce rutting, churning of the upper soil layers, and soil compaction (Ampoorter et al., 2011). Soil compaction often accompanied by rutting, is a physical process that may appear as a result of inappropriate use of this heavy forest machinery (Ampoorter et al., 2010). The amount of soil compaction is affected by the weight of machinery and load, number of machinery passes, resistance and hardness of forest floor, soil structure, soil texture and soil moisture content (Naghdi et al., 2007; Agherkakli et al., 2010; Servadio, 2010).
Persistence of soil compaction and recovery of soil physical properties is likely to vary degree of soil compaction, depth of soil layer compaction, soil type, vegetation and climate (Rab, 2004).
Hope (2007) in his study on trend of disturbance and recovery of soil chemical properties in Canadian forest concluded that most changes that were aparent in the first year, disapperead in tenth year and the effect of traffic on soil chemical properties were significant. But the nutrients of soil surface due to decrease in residual cover was significantly less than initial condition and this was attributed to the increase in disintegration of soil organic matter. Maceddo and et al.(2008)carried out a research on the recovery time of soil chemical properties of Brasilian forest that were disturbed due to traffic of harvesting machinery. Their results showed that the recovery of soil nitrogen and carbon after 13 years were 25 and 35%, respectively. Banning and et al. (2008) assessed amount of soil organic carbon, nitrogen and and organic matter in western forest of Australia. They concluded that nitrogen recovered faster than other tested properties in the 26 period. There was no significant difference in recovery process in other properties. The rates of

recovery so far reported were different and depending on method of skidding, type of skidder, soil texture and site (Ziegler et al., 2006; Servadio, 2010; Tan et al., 2005; Rab, 2004; Ampoorter et al., 2010). The objectives of this research were to:
- Quantify the changes in soil physical and chemical properties 1, 10 and 20 years after logging on skid trails in order to determine the degree of recovery.
-To assess the effects of traffic and slope on soil physical and chemical properties.

2- Materials and Methods

This research was carried out in first and second district of Nav-Asalem forest in northern Iran. Compartments 115, 126 and 220 were selected for this study. This area is located between 37° 39′ N and 48° 49′ E. The parent material is granite and basalt in all three compartments; soil texture is clay loam. The average annual rainfall is 1486.75 mm and mean annual temperature is 15.66°C. The skidder type used in this study was 450 C Timber Jack skidder, model 6BTA 5.9 with 177 hp and 10257 weight. Sampling for soil physical and chemical properties measurement was carried out 1, 10 and 20 years after harvesting in compartment 220, 126 and115, respectively. A skid trail was selected in each compartment for the experiments. In each skid trail two slope classes (>20% and <20%) and two traffic levels (high and low) were chosen; sample plots of 5×12 m dimensions were considered. Plots were replicated three times in randomized complete block design; samples were taken along 4 randomized lines across the wheel track perpendicular to the direction of travel with 2.4 m buffer zone. Three of four lines were selected randomly to measure soil physical and chemical properties. Also, in each sample plot, sampling was carried out at control area. Collected samples were put in bags, labeled and brought to the laboratory; bulk density and particle density (picnometric method) were measured (Klute, 1986). In order to assess soil chemical properties, after samples were prepared the potassium absorbtion capability was carried out using 1M ammonium acetate at PH 7.0. method, phosphorus absorbtion capability was carried out by Olsson method and organic matter percentage was measured by method of burning moistur.

A two way analysis of variance (AVOVA) was carried out on the data after normality of data was tested by using of Kolmograv-Smirnov test and means were analyzed by Duncan's multiple range tests utilizing the SPSS.

3- Results

The results of two way analysis of variance of the effects of slope, traffic and year on bulk density are shown in Table 1. The results showed that bulk density was affected by mentioned factors; also interaction between year, slope and traffic wasn't significant.

Table 1. Analysis of variance (p value) of the effects of year, slope and traffic on soil bulk density

Source	df	F	p
Year	2	25.337**	0.0001
Slope	1	46.206**	0.0001
Traffic	1	11.192**	0.003
Year×Slope	2	0.682 ns	0.516
Year×Traffic	2	0.830 ns	0.449
Slope×Traffic	1	1.867 ns	0.186
Year×Slope×Traffic	2	0.035 ns	0.966
Error	22		
Total	35		

Means are compared against each other after ANOVA using Duncan's test (α= 0.01)

**. Marked p-value are significant (α= 0.01), Ns represents non significant.

The results of soil bulk density of skid trails compared to the control area are shown in Table 2. The results showed that bulk density decreased after 20 years. Bulk density increased significantly with traffic intensity and slope in all 3 treatments of year. Furthermore, maximum bulk density increase of 71.14% occurred with more than 20% slope, high traffic level and 1 year skid trail and minimum bulk density increase was 40.67% with less than 20% slope, low traffic level and 20 years skid trail.

Table 2. Percentage of increasing bulk density of skid trails compared to control area

Skid trails age	increasing bulk density of skid trails compared to control area			
	More than 20% slope		less than 20% slope	
	High traffic	Low traffic	High traffic	Low traffic
1 year	71.14	70.3	66.67	63.31
10 years	67.64	58.62	65.64	58.29
20 years	42.01	41.24	40.96	40.67

The results of soil strength of skid trails compared to the control area are shown in Table 3. The results showed that soil strength decreased after 20 years. The maximum soil strength occurred with high traffic level and more than 20% slope. Also, the results of mean comparison test of soil strength and control area showed that there was significant differences between soil strength of 1, 10 and 20 years of treatments with control area (Table 4).

Table 3. Percentage of increasing soil strength of skid trails compared to control area

Skid trails age	Increasing soil porosity of skid trails compared to control area (%)			
	More than 20% slope		less than 20% slope	
	High traffic	Low traffic	High traffic	Low traffic
1 year	64.72	44.44	40.31	26.39
10 years	36.11	36.11	33.33	23.61
20 years	29.17	15.28	13.89	11.11

Table 4. Compare means of strength from different years of logging*

	Different years after logging			
	Control area	1 year	10 years	20 years
Soil strength (kpa)	608.64±15.77[d]	985.14±31.48[a]	898.79±11.62[b]	797.36±19.34[c]

* Data are mean ± standard error
Significant differences between means within a row are marked with different letters

The results of analysis of variance of organic matter and phosphorus against traffic treatments, year and longitudinal slope of skid trails showed that there was significant differences between amount of organic matter and phosphate with slope changes, traffic and year. But there was no significant differences between the interaction effect of theses three factors (Table 5).

Table 5. Analysis of variance of organic matter and phosphorus against traffic treatments, year and slope of skid trails

Sig	F	Mean Square	df	Type III Sum of Squares	Source	
0.000 **	1024.720	337.954	2	675.909	levels of traffic	**Organic Material**
0.000 **	49.761	16.411	1	16.411	slope	
0.000 **	74.463	24.558	1	24.558	years	
0/862 ns	.149	.049	2	.099	traffic * slope	
0.000 **	40.918	13.495	2	26.990	traffic* years	
0/539 ns	.384	.127	1	.127	slope * years	
0/131 ns	2.134	.704	2	1.407	traffic* slope* years	
		.330	42	13.852	Error	
			54	5677.430	Total	

Sig	F	Mean Square	df	Type III Sum of Squares	Source	
0.000 **	812.975	4639.120	2	9278.241	levels of traffic	**phosphorous**
0.000 **	61.069	348.481	1	348.481	slope	
0.000 **	30.901	176.333	1	176.333	years	
0.192 ns	1.715	9.787	2	19.574	traffic * slope	
0.021 *	4.240	24.194	2	48.389	traffic* years	
0/178 ns	1.876	10.704	1	10.704	slope * years	
0/096 ns	2.475	14.120	2	28.241	traffic* slope* years	
		5.706	42	239.667	Error	
			54	56834.000	Total	

**. Marked p-value are significant (α= 0.01), Ns represents non significant.

Analysis of variance of amount of potassium and magnesium at traffic, year and longitudinal slope of skid trail treatments are shown in Table 6.

Table 6. Analysis of variance of amount of potassium and magnesium at traffic, year and slope of skid trails

Sig	F	Mean Square	df	Type III Sum of Squares	Source	
0.000 **	4098.394	241577.565	2	483155.130	levels of traffic	Potassium
0.014 **	6.537	385.333	1	385.333	slope	
0.000 **	208.467	12288.000	1	12288.000	years	
0.017 **	4.514	266.083	2	532.167	traffic * slope	
0.000 **	40.171	2367.861	2	4735.722	traffic* years	
0/346 ns	.907	53.481	1	53.481	slope * years	
0/361 ns	1.044	61.565	2	123.130	traffic* slope* years	
		58.944	42	2475.667	Error	
			54	4151059.000	Total	
Sig	**F**	**Mean Square**	**df**	**Type III Sum of Squares**	**Source**	
0.000 **	370.386	404.764	2	809.528	levels of traffic	Mg
0/565 ns	.336	.368	1	.368	slope	
0.000 **	61.939	67.687	1	67.687	years	
0/238 ns	1.488	1.626	2	3.252	traffic * slope	
0.001 **	8.988	9.822	2	19.644	traffic* years	
0.015 **	6.501	7.105	1	7.105	slope * years	
0/047 *	3.282	3.587	2	7.174	traffic* slope* years	
		1.093	42	45.898	Error	
			54	13351.180	Total	

The results showed that there was significant differences in the amount of potassium at traffic and year treatments (α= 0.01). There was also significant differences in longitudinal slope and interaction effect of traffic and slope treatments ((α= 0.05), but there was no significant differencs between interaction effect of these three factors and effect of slope and year. There was significant differences in the amount of mangessium in traffic and year treatments (α= 0.01), but there was no significant differences in longitudinal slope and interaction effect of traffic and slope and interaction effect of these three factors.

4- Discussion

The results of this study showed that bulk density generally increased with an increase in traffic at two levels of slope. Although the bulk density increment was measured with an increase in traffic frequency, the increment varied between two slope classes. A considerably higher value of bulk density was recorded in >20% slope at high level of traffic in comparison with <20% slope. The significant increase in soil bulk density in >20% slope could be due to movement of machinery on the slope which cause a high stress, another reason could be that the average speed of machines was lower compared to <20% slope. When the skidder passes more slowly on steep slope, the top soil is obviously vibrated and gets more disturbances compared to gentle slope trail. These results are in accordance with results of Najafi et al., 2009; Agherkakli et al., 2010; Naghdi et al., 2010; Naghdi et al., 2007. Also, depending on the compaction of the soil, considerable differences were found between skid trails and control area (Demir et al., 2007; Makineci et al, 2007; 1986; Croke et al., 2001). This indicated that recovery of bulk density need more than 20 years and is a time consuming process. During 20 years, soil strength was recovered but similarly it need more time to complete recovery (Jansson & Johansson, 1998).

With regards to the obtained results increasing traffic frequency in the studied skid trails significantly decreases amount of assessed elements. Also after 10 years harvesting these elements significantly decreased. Assessing changes in organic matter and phosphorus in skid trails showed that all three factors traffic frequency, longitudinal slope and year had significant effect on decreasing organic matter and phosphorus. With regards to the research by Rab (1999) which showed that 30% decrease and lack of organic matter was due to harvesting operation which causes soil disturbance and decrease in soil fertility.In this research lack of organic matter was twice more than the amount that will affect soil fertility and tree growth. The results showed that traffic frequency and age of skid trails decreases potassium and magnesium and longitudinal slope has no significant effect on them. Merino and et al. (1998) also came to conclusion that disturbing soil layers and decreasing amount of soil due to erosion decreases organic matter in surface layers by 65% and also decreases CEC, potassium and magnesium.

The results of this study showed that 20 years after skidding, soil bulk density and soil strength were in the process of recovery, but have significant difference compared to control area. Rab (2004) found detectable change in porosity 10 years after logging while Ziegler et al (2006) stated the recovery time could be lingered from a few years up to half a century. Ampoorter et al (2010) concluded that 30-40 years were not sufficient to allow complete recovery. Other literatures showed that it can take at least 20-30 years before recovery is complete, depending on soil type (Rab, 2004; Croke et al., 2001).

It is too early to make any definitive judgment about how long it will take for soils to fully recover from compaction based on measurements only 20 years after logging and it isn't definitely known but to reduce the detrimental effects of ground skidding on soil physical properties, forest manager should minimize compaction during skidding.

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Effect of Four Types of Organic Fertilizer on Soil Properties and Sugar Beet - Wheat Yield

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Abstract
Effects of several ratios of four types of organic fertilizer on the growth and chemical composition of wheat-sugar beet as well as some soil properties were studied under field condition at Miandoab in 2007-8. This experiment was conducted as split plot design with twelve treatments and three replications. The organic fertilizers were applied from four sources: manure, green fertilizer, apple and grape waste. Four rate of the recommended fertilizer (2.5, 5, 10 tons/ha) were applied. The results showed that dry matter and grain yield increased with increasing manure rates. The maximum dry matter and grain yield were obtained by 10 t/ha for manure in first year and 5 t/ha for manure, respectively).Application of organic fertilizers on sugar content percentage were not significant. Soil available water increased with increasing organic fertilizer levels, whereas bulk density of soil decreased. Maximum available water contents were 10.6% and 31% increase by 5 t/ha manure. Minimum bulk density was obtained by 10 t/ha for apple waste (1.29 g/cm3).
Keywords: manure, apple waste, green fertilizer, wheat, sugar beet.

Introduction
Organic materials with different characteristics, even in small amounts are applied to positive effect on physical and chemical properties of soil. In arid and semi arid regions of the world, including Iran, not only back, but decomposition of organic matter is low it is also rapid because of severe micro-organism activity. Amount of organic matter in soils more than 60 percent of planted less than one percent and a significant portion of them are less than half a percent(Chemi1995). In this regard the use of organic fertilizers is one of the most important ways to maintain balance and soil organic carbon food supply is safe for humans and livestock (Walen et al., 2001). Organic matter is the principal indigenous source for soil available nitrogen (N), insofar that it contains as much as 65% of the total soil phosphorus (P), and provides significant amounts of sulfur (S) and other nutrients essential for plant growth (Bauer and Black 1994). Adequate nutrients, good structure and abundant biological life are important factors of a productive soil. There is a consensus that soil organic matter has a significant role to play in the sustainability of farming systems (Swift and Woomer 1993) and that it is an important indicator of soil quality and productivity (Larson and Pierce 1994). Under tropical and subtropical climatic conditions, high cultivation frequency and a low input of organic matter the organic matter contents in the farmland soils of Taiwan are generally low, and it is common for the soil organic matter content to be lower than 20 g kg^{-1} (Huang 1994). Therefore, in recent years the application of organic fertilizers has received great attention from researchers investigating the sustainability and productivity of agricultural soils.
Animal fertilizers can cause positive effects in addition to biological and improved physical and chemical properties of soil due to the fact that slowly released and provide the plant are less pollution in the environment. Effect of organic matter on soil physical properties, including increased permeability of soil, soil Bulk density, increased available water contents, increasing microbial activity and soil nutrients is increased (Hornick1988). Increasing organic matter in agricultural soils in addition to improved physicochemical properties increases the solubility of elements phosphorus and micronutrients, particularly iron, zinc, manganese and copper on (Abdel - Saber and Abo - EL - Seoud 1996; Awad and Griesh1992). Manure application to soil as a result has created a positive balance of nitrogen, potassium, and calcium in the soil (Lupwagi and Hapue 1999). Some researchers believe that soil fertility could be raised only by increasing organic materials. Adding organic fertilizer phosphorus availability is increased by different mechanisms (Gaure et al., 1990 ; Sharma et al. 1991). Important products of wheat and sugar beet crops in the rotation are Western Azerbaijan Province. Therefore, the use of organic fertilizers in this period may seem to improve the soil physical and chemical. The aim of this study is to compare the effects of different amounts and sources of organic fertilizers on soil physicochemical properties and sugar yield in sugar beet - wheat.

Materials and Methods

This experiment was carried out at Agricultural Research Station on miandoab. In this experiment, rotation of wheat and sugar beet were planted. Different sources include manure and green manure, and two-product processing factories (apple waste, grape waste). This experiment was carried out in the form of a split base design randomized complete block design with three replications at 81 and 82 years. Main plots type of manure used is from various sources and plots with three levels of (2.5, 5 and 10T/ha of organic matter). To evaluate properties of soil and water where the experiment, complex soil samples were taken from each replicate and physical and chemical properties were measured (Table1,2) This includes 12 treatments per block and a manure control (without application of organic fertilizers) and generally the 39 plot. Each sub-plot was 36 m^2 at the first year of sugar beet and wheat was planted in the second year. Operations, planting and harvesting was performed in all treatments equally. Calculated at the time of harvest yield and effect of treatments, each treatment was performed using Excel and Mstatc software**.** Were sent each year after harvesting, soil samples to determine some physical and chemical properties of soil to the laboratory.

Table 1. Results of soil analysis

Cu	Mn	Zn	Fe	avaK	avaP	pH	S	Si	C	OC	TNV	EC	depth
mg/kg							%			%	%	ds/m	cm
1.34	3.08	0.58	3.42	440	10.5	7.9	15	56	29	1.21	11.8	1.52	0-30

Table 2. Results of irrigated water analysis

Class	SAR	mg/l							PH	EC
		Na^+	Mg^{2+}	SO_4^{2+}	SO_4^{2-}	Cl^-	HCO_3^-	CO_3^{2-}		ds/m
C_2S_1	2.7	1/9	3/2	1/5	1/2	1/2	4/4	-	8/2	0,548

Results and Discussion

Sugar beet: the first year of the statistical analysis showed that levels of main factors (sources of manure) yield no significant difference relative to each factor and the highest yield to manure rate was 70.09 ton/ha. A level of secondary factor (different quantities of manure) on yield was significant at 1% and maximum is related to application of 10 tons of manure per hectare. The interaction between main plot and sub 1% probability level and the highest yield was significantly related to treatment is 10 tons of manure per hectare. Statistical analysis of parameters related to percent sugar, N, sugar extraction rate showed no significant difference. The highest grade of sugar related to the application of green manure 10 ton per hectare-scale 16.9 percent.

Wheat: statistical analysis in the second year showed that levels of main factor (source of manure) yield no significant difference relative to each other and the highest yield was related to manure factor of 4246 kg per hectare. Levels of secondary factor (different amounts of manure) at the 5 percent yield were significant and the highest value is related to the application of 5 tons of fertilizer per hectare. The interaction between main plot and sub-5 percent probability level was significant and the highest yield is related to the treatment of 5 tons per hectare of manure.

Soil: The study results related to changes of soil bulk density significantly observed. Least up to 1/29 g/cm^3 to 10 tons per hectare consumption of treated apple waste and the highest was obtained up to 1.4 g/cm^3 in the control (no manure application),which has shown decreased about 8 percent. Assessment of water use in the highest amount was related to the treatment of 5 tons of manure per hectare compared with the controls showed increased about 50 percent.

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The Nitrogen Use Efficiencies of Some Different Nitrogen Fertilizers in Irrigated Wheat

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Abstract

In order to study the nitrogen use efficiency of different nitrogen fertilizer sources in irrigated wheat, a randomized complete block experiment with three replications was carried out in 2004-2005 period. Treatments consisted of T1 (Control), T2 (150 kg/ha N from urea source in 3 split applications), T3 (150 kg/ha N from urea source in two split applications without base application), T4 (50 kg/ha N from complete macro fertilizer as base application+100 kg/ha N from urea in two split in the spring), T5 (50 kg/ha N from SCU source+100 kg/ha N from urea in two split applications in the spring). The results showed that effect of treatments were completely significant on grain yield (α=0.01) so that complete macro fertilizer as application (T5) produced the maximum grain yield (58.8 percent more than the control). The results of nitrogen use efficiency estimation show that nitrogen apparent recovery percents were higher in T4 and T5 as compared with the other treatments. The application of SCU as a base fertilizer in T4 also improved the nitrogen apparent recovery fraction. The effects of treatments on grain protein content was significant (α=0.01) whereby T4 produced the highest protein.

Keywords: NUE, Urea, SCU, Wheat.

Introduction

Nitrogen is key in achieving optimal functioning in cereals. Wheat (Triticum aestivum L.) usually requires a lot of nitrogen. Nitrogen adsorption stage of germination begins and be its maximum at the flowering stage. Soil nitrogen dynamics and mobility, which makes it time consuming for success in seed production and protein is very important. Therefore, considering the economic and environmental factors may be the least amount of loss, the efficiency will be maximum. nitrogen efficiency depends on several factors that include time-consuming, the number of split application, fertilizer consumption, rainfall And other climate-related variables(Khademi, 1999; Malakouti, 2000; Malakouti et al, 2004).Prevent leaching losses, it is better to use nitrogen as a few parts, otherwise the use of fertilizers with low solubility such as sulfur-coated urea is necessary(Lotfolahy et al, 2004). Due to heavy rainfall in winter, autumn nitrogen fertilizer used in wheat are used to consuming a small amount of nitrogen available and most are rooted out. With careful management of fertilizer, nitrogen fertilizer consumption will be lower (Fassen et al, 1990). Nitrogen use efficiency is greatly influenced by the rate, source, time and method of fertilizer. Excessive nitrogen fertilizer in wheat will be causing an increased risk of lodging.. Also, a large amount of nitrogen in the root zone in the early stages of growth, increased crown growth and prevents the growth of roots. The nitrogen is not true once consumed. Because of the loss of nitrogen will be washed and reduces N efficiency. (Johnstone and Fowler, 1991; Malakouti et al, 2004).

Materials and Methods

This study was conducted at Agricultural Research Station on miandoab in a soil Fine silty mixed active mesic ,Typic Haploxerepts in 2005. The experiment included five treatments in a randomized complete block design with three replications. Experimental treatments were first treated: Control (the use of all nutrients based on soil test, but no nitrogen);Second treatment: nitrogen based on soil test in three split application of urea (150 kg per hectare);Third treatment: nitrogen based on soil test in the two split application of urea as a basal dressing without consumption (150 kg per hectare); Fourth treatment: nitrogen application in three split,1/3 from the SCU to the base, 1/3 The first dressing of urea,1/3 second dressing of urea(150 kg per hectare). Five treatments: 150 kg per ha in three split application of nitrogen (1/3 of complete fertilizer source based macros +1/3 dressing of urea+ 1/3 second dressing of urea).

To evaluate properties of soil where the experiment, complex soil samples were taken from each replicate and physical and chemical properties were measured (Table 1).Each plot size 30 m^2, a width of 4 m and length 7.5 m plots were considered. Golden wheat variety was planted from Zarin. Phosphorus and zinc fertilizers based on soil test was used to determine and equally in all plots. Wheat Yield was calculated from the area of 15 square meters. Biological yield, seed weight, number of grains per panicle, number of tillers and plant height at maturity was measured in each plot. Straw and grain samples were taken after harvest and nitrogen and protein rate were determined. Statistical analysis using MSTATC and drawing diagrams was performed using EXCEL software.

Table 1 - Results of soil analysis test

Cu	Mn	Zn	Fe	avaK	avaP	NO_3	pH	S	Si	C	OC	TNV	EC	depth
mg/kg								%			%	%	ds/m	cm
0/98	14/35	0/49	5/85	520	12/4	17/1	8/1	15	56	29	1/18	11/5	1/08	0-30

Results and Discussion

Effects of treatments on yield and its components

Results of statistical analysis are given in Table 2. Effects of treatments on grain yield was significant (α=0.01). The highest yield was obtained in T5 treatment. And 59% increased compared to control. Macro fertilizer significantly increased grain yield than urea (α=0.05).Of nitrogen and grain protein, there was significant difference between treatments at the one percent level (α=0.05). T4 treatment was the highest grain protein.

Table 2 - Mean effect of treatments on yield, yield components and grain protein

Yield index	Seed protein %	Seed nitrogen %	number of grains per panicle	Weight of 1000 grain gr	Biological yield (kg/ha)	straw (kg/ha)	grain (kg/ha)	treat
A28/2	b8/23	b1/36	aBC53	A29/7	A12112	A8690	c3422	T1
A34/1	ab9/93	1/65 b	aB55	A40/9	A14159	A9409	ab4749	T2
A32/1	a11/09	a1/84	bC45	A36/5	A14250	A9702	b4548	T3
A331/7	a11/21	a1/85	C45	A41/6	A16153	A11084	ab5069	T4
A32/2	a10/59	a1/78	A63	A31/6	A16372	A10937	a5435	T5
8/64	7/23	7/3	11/95	12/86	12/73	16/01	8/18	C%
5/192	-	-	11/7	8/628	3502	3004	-	(0.05)%LSD
-	1/96	0/33	-	-	-	-	0/40	(0.01)%LSD

The results obtained from this project, with results presented by many researchers including Malakouti (2004); Lotf et al (2004) was consistent.

Nitrogen fertilizers on the efficacy of treatments

The results estimate the efficiency of nitrogen fertilizers are given in Table 3. Percent recovery of nitrogen in the fifth treatment (complete fertilizer macro) was highest. Percentage recovery of fertilizer nitrogen in the treatment of complete macro level was 39 percent higher compared to other treatments. Fan and colleagues (2004), agronomic efficiency of nitrogen in sulfur-coated urea, and 33 reported a sulfur-coated urea consumption showed a significant rise in the efficiency of crop. Physiological efficiency of nitrogen fertilizer treatment was the most complete macro. The optimum yield is a result of increased N uptake efficiency.

Table 3 - Mean percent recovery efficiency of nitrogen and its various treatments on wheat

NHI	UTE	UPE	NPE	NAE	NUE	NARE	treat
%			mg/kg			%	
0/69	-	-	-	-	-	-	T_1
0/63	76	44	58	8/8	32	13	T_2
0/68	54	56	49	7/5	30	28	T_3
0/73	54	62	76	11/0	34	31	T_4
0/71	56	65	92	13/4	36	39	T_5

Conclusion and recommendation

Agronomic efficiency of fertilizer treatments showed a significant increase in complete macro. The use of this fertilizer experiment in the same conditions as the basis for irrigated wheat crop is recommended. N uptake efficiency in wheat crops in West Azarbaijan province is low. Probably because of the low organic matter soils, leaching increased, the percentage of available soil nitrogen is low. Therefore, to avoid excessive irrigation and basic principles of the process is strongly recommended.

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Effects of different land use types on some soil attributes in a calcareous-Mediterranean region in northwest of Iran

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Abstract

In order to monitoring impact of different land use types on the combination of morphological, clay mineralogical and physicochemical characterizes, forty-two soil samples (0-30 cm) were described and analyzed. Soil samples were collected from three neighboring land use include cropland, grassland, and forestland. The soils were characterized by high pH (mean of 7.1 to 7.5) and calcium carbonate equivalent (mean of 35 to 97 g kg^{-1}) in the three land use types. The weakening in soil structure, hardening of consistency, and lighting of soil color was occurred for the cropland under comparable condition with grassland and forest. Changes in land use types was produced a remarkable modify in the XRD patterns of clay minerals contain illite and smectite which can attribute to a process involving the depletion of potassium. Through continuous cultivation, sand content was increased by 2 to 35% while silt and clay content was decreased by 2 to 22% and 2 to 18%, respectively, compared to those of the adjoining grassland and forest mainly as result of the difference of dynamic alterational and erosional process in the different land use. Long-term cultivation result in a negative and degradative aspect on soil heath as is manifested by the increasing in soil pH, electrical conductivity (EC), sodium absorption ration (SAR), and exchangeable sodium percentage (ESP) and the decreasing in soil organic C (SOC), and fertilitical attributes.

Keywords: Land use, Cultivation, Soil attributes Soil quality

Introduction

Recent assessment suggests that changes in land use and management can appear a marked effect in soil attributes as well as soil quality. The changes in soil properties and processes, in turn, can affect pattern of plant growth and environment (Ahuja, 2003). Indeed, land use changes and soil management practices influence the soil attributes related soil processes such as oxidation, mineralization, and leaching, etc., and consequently modifying soil quality (Hontoria et al., 1999; Wang et al., 2001). Monitoring soil over the medium to long term is the only way (Cotching and Kidd, 2010) to estimate the risk of these soil threats regarding to the combination of different soil properties. Overall, it is suggested that changes in land use can highlight a crucial threat for the soil system. Soil erosion, soil contamination, decline in organic matter and biodiversity, soil compaction, salinization, floods and landslides, and sealing are the major threats faced by soils (De la Rosa and Sobral, 2008) following changes in land use. In this context, the conversion of forests and pastures into cropland can have particular impact on soil characterizes (Zucca et al., 2010) due to two factors: (i) the intrinsic factors such as climate, topography, and vegetation, and (ii) the extrinsic factors such as fertilization, cultivation, over grazing, and management (Başaran et al., 2008). The specific objective of this study were (i) to assess the spatial variability of soil physicochemical and clay mineralogical properties in the three land use types and (ii) to evaluate the impact of different land use types on soil quality inferred through monitoring the combination of morphological, clay mineralogical, and physicochemical attributes.

Material and Methods

Environmental Setting

This work was undertaken at Piranshar area (36° 30´ to 36° 50´ N latitude and 45° 5´ to 45° 25´ E latitude), Western-Azarbaijan province, north-west of Iran. The studied region is characterized by a natural beauty agroecosystem including vast and fertile plains, luxuriant forests and pastures. A Mediterranean type of climate was exist in Piranshar area following the variation in climatic parameters such as mean annual precipitation (650 mm), mean annual temperature (12.5 °C), and mean annual reference crop evapotanspiration (1750 mm). This area that is part of Iranian plateau formed in the late period of Quaternary (10000 BP). The land use types assessed included a cultivated land, grassland, and a native forestland (as a combination forest trees and pasture plants).

Soil Physical and Chemical Analysis

Standard methods (Black, 1996; Sparks, 1996) were used for determination of soil texture, soil organic carbon (SOC), Calcium carbonate equivalent (CCE), soil pH (0.01 *M* $CaCl_2$ suspension), electrical conductivity [(EC), saturation extract], cation exchange capacity (CEC), total N, and available phosphorus, and exchangeable and soluble cations (1*M* NH_4OAc at pH 7). The statistical analyses were conducted using SPSS software.
Clay minerals were determined, semi- quantitatively, by X-ray diffraction (XRD) technique (Mehra and Jackson, 1960; Biscaye, 1965).

Results and discussion

Clay Mineralogy Characteristics

XRD analyses of clay fraction suggest that the examined soils are predominantly composed of illite, smectite, chlorite, and kaolinite. The semi- quantitative estimate of clay minerals is exhibited in Table1. Changes in land use types and soil type did not cause noticeable modification in the XRD pattern of chlorite and kaolinite regarding to the quantity and the intensity or in the position of peaks. This trend is not surprising, especially, in view of the fact that chlorite and kaolinite are very stable against weathering process in calcareous and alkaline soil (Rezapour et al., 2009) like the region investigated. Variability of illite and smectite were strongly evident following changes in land use and soil type. Variation of illite was in the rank of cultivated soil ≈ grassland > forestland whereas of smectite was in the rank forestland> grassland ≈ cultivated soil. Indeed, two opposite patterns in illite and smectite distribution were highlighted in the forest land. It is suggested that these two clay minerals are largely related together through genetic pathways following water-plant activity-soil processes interaction in the forest land ecosystem. In this context, smectitization process as result of expanse of illite layer (peak of 10 Å)-to smectite (peak of 17-18 Å) through a disordered stacking sequence (interstratified illite/smectite phase) in a K removal environment can be an acceptable reason for trends of illite and smectite.

Table 1. Semi-quantitative percentage of clay minerals for the three land use types studied[a]

Clay mineral	Cambisols			Vertisols		
	Cultivated soil	Grassland	Forest land	Cultivated soil	Grassland	Forest land
Illite	+++	+++	++ to +++	+++	+++	++
Smectite + mixed layered mierals	++	++	++	++	++	++++
Chlorite +Kaolinite	+++	+++	+++	+++	+++	+++

[a] ++ (10-25%); +++ (25-40%); ++++ (40-60%)

Soil physiochemical characteristics

There was marked differences on the morphophysical behavior of soils among the three land use types in both Cambisols and Vertisols (Table 2). Particle-size distribution among land use types indicated some changes in both the studied soil types. However, there was no statistically significant difference in percent distribution of sand, silt, and clay among the three land use types. The cultivated soils were noticeably lower in silt and clay contents and higher in sand fraction compared to those of the adjoining grassland and forest. By the mean, silt and clay contents were in the order of forest> grassland> cropland whereas sand content was in the order of cropland> grassland> forest. Through cultivation, sand content was increased by 4% to 35% while silt and clay content were decreased by 2% to 22% and 2% to 18%, respectively, compared to those of the adjoining grassland and forest. Present of greater silt and clay contents in soils from the grassland and forest could be attributed to: (i) accelerated alteration induced by natural and suitable condition in the grassland and forest ecosystems, for instance, increasing of weathering processes in the grassland and forest could be highlighted through increasing of the secondary clay silicates (smectite) compared with the cropland (as was discussed later) and (ii) well-covered vegetation in the grassland and mainly forest protects the soil against erosion.

Table 2. Selected morphophysical properties for the three land use types studied

Variable	Cambisols			Vertisols		
	Cultivated soil	Grassland	Forest land	Cultivated soil	Grassland	Forest land
Structure[a]	f2abk	m1gr	m1gr	f2abk	m2gr	m3gr
Color (moist)	10YR 5/6	10YR 4/3	10YR 4/3	10YR 5/4	10YR 4/3	10YR 3/3
Consistence[b] (moist)	vfi	fri	fri	fi	fri	vfri
Sand (%)[c]	38.2±14.99[a]	34.52±18.2[a]	29.52±12.81[a]	27.4±16.72[a]	24.86±14.19[a]	21.0±12.42[a]
Silt (%)	31.0±9.16[a]	33.97±8.89[a]	36.5±8.94[a]	33.46±6.7[a]	34.42±10.56[a]	35.6±6.11[a]
Clay (%)	30.8±7.79[a]	31.53±10.52[a]	33.97±9.72[a]	39.14±11.33[a]	40.72±10.55[a]	43.4±9.86[a]
Texture	Clay loam	Clay loam	Clay loam	Clay	Clay	Clay

Mean (± S.D.) values of selected soil chemical and fertilitical attributes are summarized in Table 3. The mean soil pH of the three land use types showed that soil from the forest land had the minimum pH followed by the cropland and grassland in both Cambisols and Vertisols. While the variability of pH (mean) appear to be uniformly in the cultivated soil and grassland, continuous cultivation led to a rise of 0.30 unit in Cambisols and 0.46 unit in Vertisols compared to the adjacent soils under forest. This pattern may be explained by tillage practices such as (i) the mixing of surface soil with subsurface soil containing carbonates (Kettler et al., 2000) and (ii) the irrigation practices containing a noticeable content salts and bicarbonate (data not shown). Long-term cultivation significantly changed the EC and SAR of the soil compared to the adjacent soils under grass land and forest. On an average, the soil from cropland had 1.78 (Cambisols) to 4.38 (Vertisols) and 2.0 (Cambisols) to 5.5 (Vertisols) times higher EC than soils from grassland and forest, respectively. Similarly, SAR contents of the cropland were 10% (Cambisols) to 45% (Vertisols) and 12% (Cambisols) to 51% (Vertisols) greater than those of the grassland and forest, respectively, indicating that the general distribution SAR was in matching with distribution pattern of EC. In view of the fact that the applied irrigation water had a remarkable concentration of salts (data not shown), increasing pattern of EC and SAR was not surprising in the cultivated soils. In spite of soil quality affected negatively by increasing soil salinity in the cultivated soils, the EC values were in the acceptable range (0-1.5 dS m^{-1}) for “general plant growth and microbial activity” (Smith and Doran, 1996).

Similarly, spatial distribution SOC and total N were in the order forest> grassland> cropland for both Cambisols and Vertisols. Impact of different land use types on OC (mean) indicated that soil from the cropland had 12% (Vertisols) to 41% (Cambisols) and 15% (Vertisols) to 18% (Cambisols) low OC and toal N, respectively, than the adjacent soils under the grassland. These differences were so wider as compared to the cropland and forest. Significantly, OC content and total N (mean) of cropland were 2.4 (Vertisols) to 3.8 (Cambisols) and 1.82 (Vertisols) to 2.5 (Cambisols) times lower, respectively, than that of forest soil (Table 3), showing that degrading effects of cultivation on soil quality is into a crucial category. Overall, the combination of fewer plant residues return and biomass after harvest, continuous cropping and frequent burning, faster decomposition rates of organic matter, and greater erosion can be subject to declining SOC and total N and destroying soil quality in the studied region following long-term cultivation. The organic matter content of the Vertisols was generally much higher than those of the Cambisols in the three land use types. This trend may be explained by the higher clay percentage in soils containing Vertisols, making clay-humus complexes that protect the organic matter from oxidation and degradation. This assessment was more evident through occurrence a recorded close correlation between SOC and clay content (*r = 0.52, P≤0.05*).

Table 3. Mean ± standard deviation values of chemical and fertilitical properties for the three land use type's studied[a]

Variable	Cambisols			Vertisols		
	Cultivated soil	Grassland	Forest land	Cultivated soil	Grassland	Forest land
pH	7.4±0.29[a]	7.4±0.28[a]	7.1±0.28[a]	7.54±0.05[b]	7.48±0.03[b]	7.08±0.23[a]
EC (dS m^{-1})	0.775±0.18[b]	0.435±0.10[a]	0.385±0.11[a]	1.51±0.62[b]	0.342±0.05[a]	0.272±0.09[a]
SAR (mmol L^{-1})	2.92±0.36[a]	2.73±0.53[a]	2.63±0.06[a]	3.33±1.10[b]	2.30±0.48[a]	2.2±0.20[a]
CCE (g kg^{-1})	43.33±26.22[b]	42.20±36.5[b]	35.02±22.81[a]	96.80±104.13[b]	96.66±99.67[b]	63.90±72.67[a]
OC (g kg^{-1})	7.33±3.44[a]	10.33±6.31[a]	27.8±4.03[b]	11.40±1.52[a]	12.80±2.28[a]	27.60±2.97[b]
Total N (g kg^{-1})	1.1±0.17[a]	1.04±0.26[a]	2.8±0.20[b]	1.13±0.01[a]	1.3±0.24[a]	2.43±0.59[b]
Available P (g kg^{-1})	24±3.61[b]	10.0±2.65[a]	39.67±2.08[c]	11.0±1.0[a]	13.0±1.0[a]	29.33±2.08[b]
Available K (g kg^{-})	345.0±5.0[a]	450.0±10.0[b]	482.0±18.93[c]	340.0±10.0[a]	410.0±26.46[b]	426.67±5.77[b]
Ca ($cmol_c$ kg^{-1})	19.0±1.0[a]	19.5±0.5[ab]	20.67±0.58[ab]	22.0±2.0[a]	22.33±0.58[a]	23.0±1.0[a]
Mg ($cmol_c$ kg^{-1})	6.2±0.10[a]	6.1±0.15[a]	6.4±0.10[ab]	6.73±0.21[a]	7.7±0.26[b]	7.77±0.25[b]
Exchangeable K ($cmol_c$ kg^{-1})	0.75±0.03[a]	0.87±0.01[b]	0.88±0.02[b]	0.83±0.05[a]	1.07±0.07[ab]	1.18±0.03[b]
Na ($cmol_c$ kg^{-1})	0.91±0.58[a]	0.90±0.53[a]	0.88±0.02[a]	1.47±0.03[b]	1.13±1.10[a]	1.07±0.06[a]
ESP (%)	3.52±0.52[a]	3.43±0.59[a]	3.0±0. 2[a]	4.40±1.05[b]	3.06±0.13[a]	3.0±0.2[a]
CEC ($cmol_c$ kg^{-1})	26.83±5.15[a]	27.5±7.56[a]	29.80±4.55[a]	31.40±8.56[a]	32.40±7.13[a]	35.20±6.61[ab]

Soil under continuous cultivation had both negative and positive changes than the adjacent soils under forest and grassland, respectively, regarding to available phosphorous content (Table 3). The mean soil P contents were found in the order forest> cropland> grassland for both Cambisols and Vertisols. By the average, P content of cropland was 2.4 times higher and 1.65 time lower compared to those of the adjoining grassland and forest, respectively, in the Cambisols. For the Vertisols, cultivation led to phosphorous pattern as 1.2 times higher and 2.3 times lower than the adjacent soil contain grassland and forest, respectively. Significant increase of P content (*P≤0.05*) in the forest land than that of the cultivated field, may be associated with SOC and erosion. As discussed before, the forest land is contain high level of OC than those of the cropland and grassland that can release soluble phosphorous compounds when organic residues and humus decompose as proposed by other works (Kamprath, 1999; Yu et al., 2005). Organic matter can also improve available P by blocking or masking of phosphorus fixation site. By contrast, the combination of tillage activities along with very low SOC input during harvest that leaves the soil bare and unprotected from the ravages of erosion (Brady and Weil, 1999) can contribute to the significant differences between cultivated soils and natural ecosystems like forest regarding to available P.

Long-term cultivation was specified a significant decline (*P≤0.05*) in available K compared to those of the adjoining grassland and forest (Table 3) and the order was as forest> grassland > cropland for both Cambisols and Vertisols. Through the mean, soils under cultivation manifested a drop of 21% (Vertisols) to 30% (Cambisols) and 26% (Vertisols) to 40% (Cambisols) than the adjacent soil contain grassland and forest, respectively. This means that depletion of available K was low remarkably in the Vertisols area than the soils under Cambisols area, mainly due to variation in clay content, nature and types of clay minerals, CEC, and organic matter. It seems that the greater clay content, nature and smectite content, and corresponding large surface area and CEC manifested higher available K in the Vertisols (Srinivasarao et al., 2007). Accumulation of significant more available K in the forest may be explained by a process involving the biocycling of K. Trees involving the forest region scavenge K from deeper within the soil, incorporate it into their biomass and return it to the soil surface in litter, making an enrichment aspect of K following litter decomposition (Graham and O'Geen, 2010).

Intensive cropping was specified a depletion face in exchangeable Ca, Mg and K compared to those of the adjoining grassland and forest and the order was as forest> grassland > cropland for both Cambisols and Vertisols (Table 3). Accumulation of remarkably more exchangeable cations (Ca, Mg and K) in the forest can be associated with a process known as the "nutrient pumps or nutrient uplift". In the forest land, deep-rooted trees often act as nutrient pumps, taking exchangeable cations form deep subsoil horizons into their root systems, translocating it to their leaves, and re-entering it to the soil surface with litter fall and decomposition, causing much higher exchangeable cations levels in the natural forests.

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Land Use Change and Soil and Water Degradation in South Hodna, Algeria

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Abstract
The Southern of Hodna is an arid region of Algeria with variable rainfall, which averages about 170 mm/yr. The study area has a pastoral vocation. This zone is under various pressures: natural (aggressive climate, wind erosion) and anthropogenic (overgrazing, intensive agriculture, overexploitation of the water resources). The human activities have a great influence on of land use change. Our approach is based on mapping of sanding in this area and the quantitative and qualitative study of water resources.
The results reveal that the most serious consequence is the extension of sanding, the contamination of the groundwater with nitrate and notable fall of the piezometric surface of the groundwater which constitutes the only source for the irrigation and human consumption. For this, a rational management of this environment as part of a sustainable development plan is needed to safeguard the potential of this region.

Keywords: Land use change, soil degradation, water degradation, south Hodna, Algeria.

Introduction
In Algeria, the steppe has a strong tendency to degradation and this situation generates a reduction of the biological potential and the rupture of ecological and socio-economic balances (Aidoud et al., 2006; Nedjraoui et Bedrani, 2008). The Southern of Hodna is an arid region of Algeria with variable rainfall, which averages about 170 mm/yr. The study area is under various pressures (Boyadjiev, 1975; Sebhi, 1986; Mimoune, 1996; Abdesselam et al., 2007 ; Abdesselam et al., 2008), natural (aggressive climate, wind erosion) and anthropogenic (overgrazing, intensive agriculture, overexploitation of the water resources). For a few decades, the human activities have a great influence on of land use change. The fast evolution of the land use requires to make a report and to establish an assessment of the evolution of this ecosystem.

Study area
The study area is located at South of Hodna at 35°25' and 35°12' North of latitude and with 4°13' and 4°44' Easts of longitude. It is limited to North by Chott El Hodna (fig. 1), in the West by Maitar wadi, the East by Mellah wadi and the South by Meharga Mountain. It consists of sand dunes, recent alluvial deposits and isolated rocky hills.

Materials and methods
Methodology is based, on the one hand, on missions in field, sampling and analyses of groundwater, and on the other hand, on bibliographical data available. The cartography of the dynamics of the stranding was carried out by the use of three satellite images Landsat muti-dates.

Results and discussion
The results reveal that the most serious consequence is the extension of sanding, the contamination of the groundwater with nitrate and notable fall of the piezometric level of the groundwater which constitutes the only source for the irrigation and human consumption.

Total dynamics of sanding:
In comparison with the total surface of study area (103300 ha), the percentage of the zone affected by the sanding was passed from 4.57% in 1972 to 7.72% in 1987 to reach 10.86% into 2001 (figure 2).

Overexploitation of water resources:
Water points (Wells and Boreholes) is considerably increased since the Sixty ten (fig. 3). Notable fall of the piezometric surface of the groundwater was registered. In the south of Hodna, the falls of the level in the western agricultural zone (Maarif, Khoubana, Boussaada and Houamed) can reach 35 m what is enormous ; in East in the M'Cif zone, they are less significant, the falls of the level are lower than 10 m.

Water pollution

The increasing nitrate concentration in groundwater has become a matter of worldwide concern. In the study area, the phreatic groundwater contamination is old (fig. 4). However, the pollution of the deep aquifer increased compared of the archive data and the recent analyses. This indicates an alarming situation and a deterioration of the quality of deep aquifer this one represents the only source for the human consummation and the irrigation.

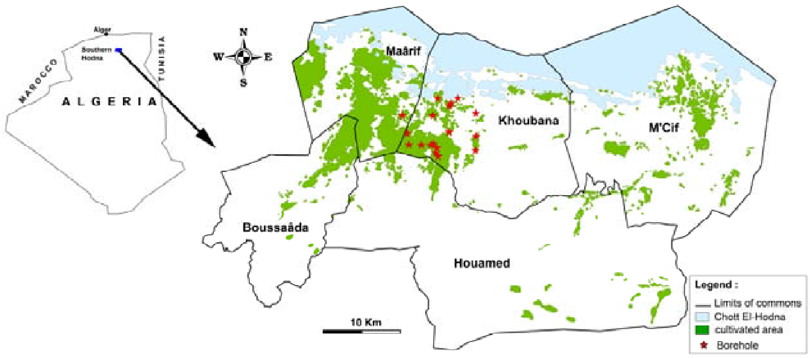
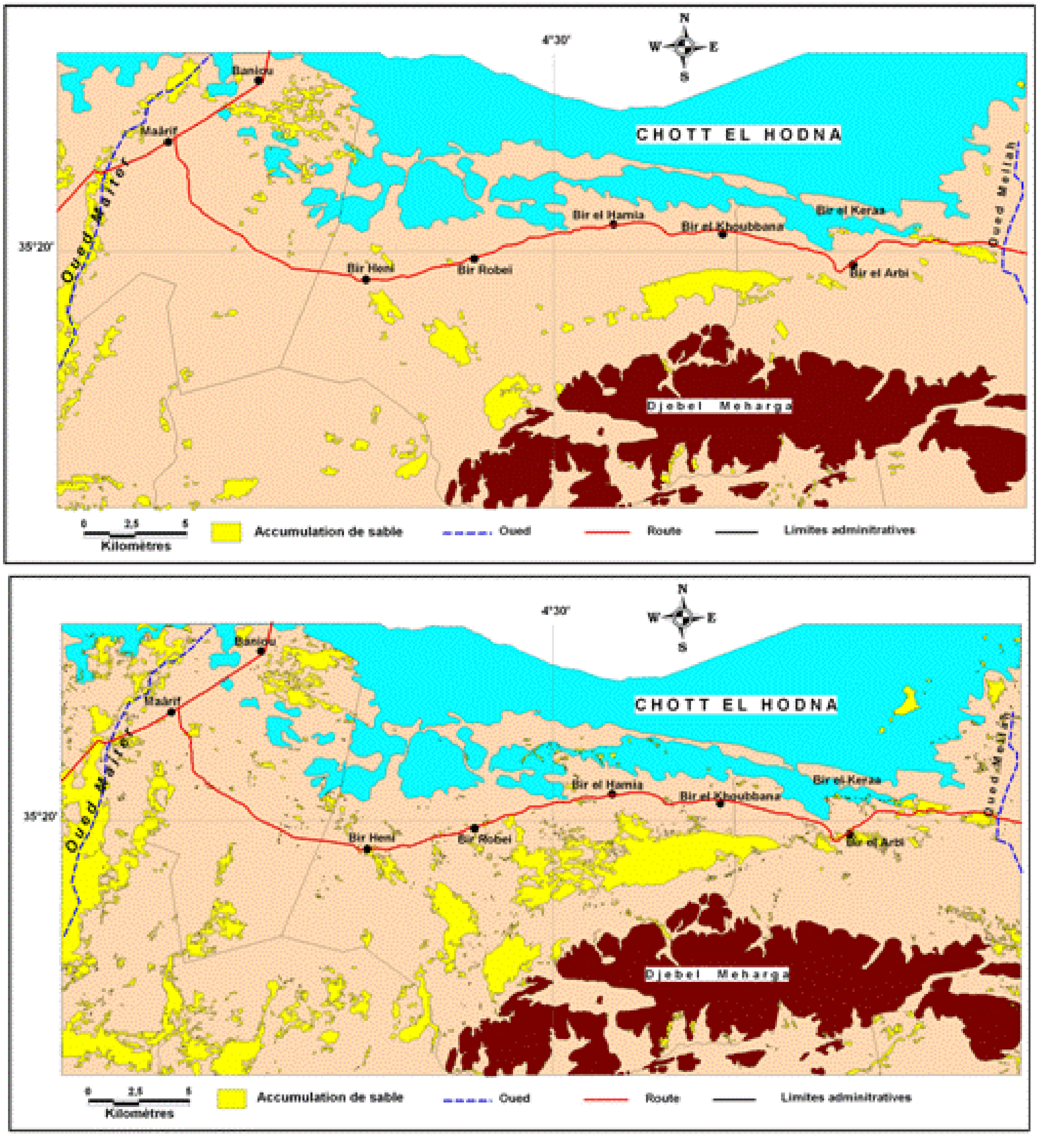


Fig. 1. Localisation of study area and boreholes.



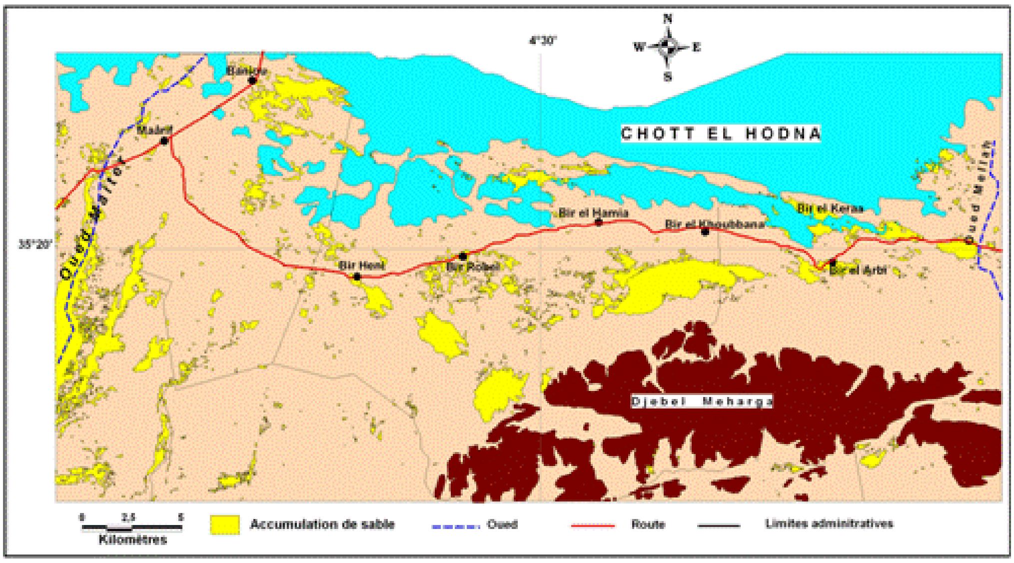


Fig.2: Evolution of sanding process.

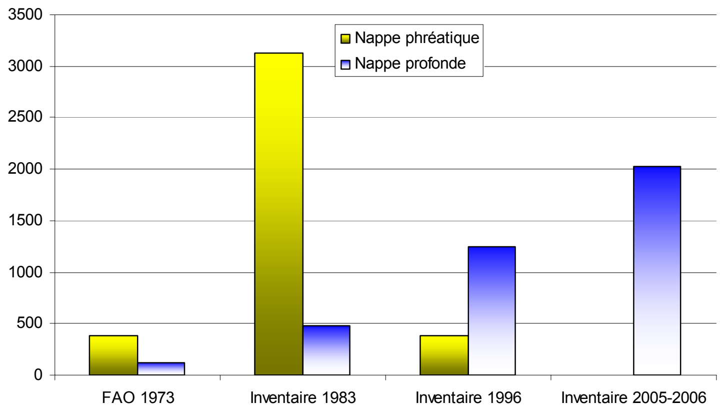


Fig. 3 : Synthesis of the water points count in aquifer system of Hodna.

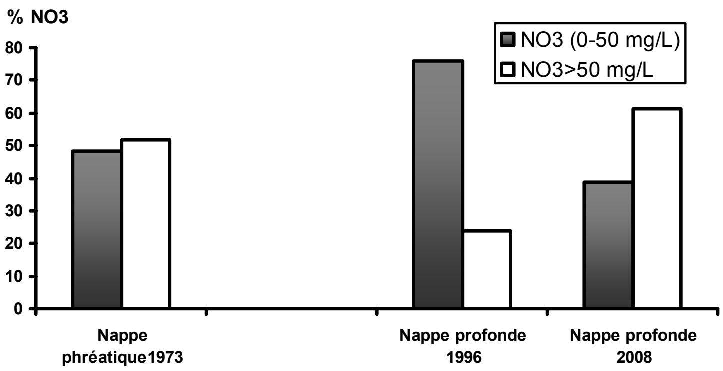


Fig. 4: Contamination of groundwater by nitrates. Recent analysis and archive data.

Conclusion

This study is relates to the degradation of soil and water resources in southern Hodna. This steppe, marked by severe physical conditions, underwent a significant evolution as regards to land use and overexploitation of groundwater.

Irrigated agriculture has developed with the reduction of grassland. The deep aquifer present very worrying nitrate concentrations, this contamination can cause serious problems to the agricultural development and the public health. The southern area of Hodna is very sensitive to the desertification, the process of sanding became extensive since several years; thus errors of management can degrade and constrain more the development of this region.

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An Overview of Real Life Applications of Remediation Technologies

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Abstract
In response to a growing need to address environmental contamination, many remediation technologies have been developed to treat soil and groundwater contaminated by various pollutants, including *in-situ* and *ex-situ* methods. The treatment processes can be, and usually are, combined into process trains for the more effective removal of contaminants and hazardous materials present at contaminated sites. Site conditions, contaminant types, contaminant source, source control measures, and the potential impact of the possible remedial measure determine the choice of a remediation strategy and technology. The objective of this study is to summarize real life applications of the technologies used for soil and groundwater remediation and to emphasize the applicability of these technologies.
Keywords: Remediation Technologies, Soil and Groundwater Remediation, Applicability.

1. Introduction

Complex chemical pollutants enter the environment directly as a result of accidents, spills during transportation, leakage from waste disposal or storage sites and/or from industrial facilities. Sites where pollutants such as total petroleum hydrocarbons (TPHs), polychloro biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), heavy metals, and pesticides may be found include battery disposal area, burn pits, chemical manufacturing plants and disposal areas, contaminated marine sediments, disposal wells and leach fields, electroplating/metal finishing shops, fire fighting training areas, hangars/aircraft maintenance areas, landfills and burial pits, leaking collection and system sanitary lines, leaking storage tanks, radiologic/mixed waste disposal areas, oxidation ponds/lagoons, paint stripping and spray booth areas, pesticide/herbicide mixing areas, solvent degreasing areas, surface impoundments, vehicle maintenance areas and/or wood preserving sites (DOD, 1994).

Many remediation technologies have been developed to treat soil and groundwater contaminated by various pollutants, including *in-situ* and *ex-situ* methods. *In-situ* processes involve placement of amendments directly into contaminated media while *ex-situ* processes transfer the media for treatment at or near ground surface. The *in-situ* or *ex-situ* remediation technologies used for soil and groundwater remediation technologies consist of biological, physical, chemical and thermal treatments, and air emissions/off-gas treatment.

Site conditions, contaminant types, contaminant source, source control measures, and the potential impact of the possible remedial measure determine the choice of a remediation strategy and technology. Site soil conditions frequently limit the selection of a treatment process. The soil variability, in turn, will result in variability in the distribution of groundwater and contaminants and in the ease with which they can be transported within, and removed from, the soil at a particular site (DOD, 1994).

Since most remediation technologies are site-specific, the selection of appropriate technologies is often difficult. However, it is extremely important for a successful remediation of a contaminated site. Therefore, the successful treatment of a contaminated site depends on proper selection, design, and adjustment of the remediation technology's operations based on the properties of the contaminants and soil and on the performance of the system (Khan et al., 2004). The treatment processes usually are combined into process trains for the more effective removal of contaminants and hazardous materials present at contaminated sites.

Purpose of application, important details and results of different technologies for soil and groundwater remediation is presented by Member Agencies of the Federal Remediation Technologies Roundtable (FRTR), U.S. Department of Defence Environmental (DOD) and U.S. Environmental Protection Agency (USEPA).

The objective of this study is to summarize real life applications of the technologies used for soil and groundwater remediation and to emphasize the applicability of these technologies.

2. Contaminant Types

Information on classes and concentrations of chemical contaminants, how they are distributed through the site, and in what media they appear is essential to begin the pre-selection of treatment technologies. The contaminants have been separated into five contaminant groups as follows (DOD, 1994):

1. Volatile organic compounds (VOCs); benzene, toluene, ethylbenzene and xylene (BTEX) or gas phase contaminants.
2. Semivolatile organic compounds (SVOCs); PAHs, PCBs, pentachlorophenol (PCP) or pesticides.
3. Fuels; benzene, fluorine, phenol or pyrene which are nonhalogenated.
4. Inorganics; radioactive elements, metals or arsenic.
5. Explosives; trinitrotoluene (TNT) or nitro-glycerine.

3. Technologies for Soil and Groundwater Remediation

Among the various technologies, *in-situ* technologies generally used for soil remediation are biodegradation, bioventing, soil flushing, soil vapour extraction, solidification/stabilization, thermal desorption and/or vitrification. *Ex-situ* technologies often used for soil remediation are composting, controlled solid phase biological treatment, landfarming, chemical reduction/oxidation, base catalyzed decomposition dehalogenation, glycolate dehalogenation, soil washing, soil vapour extraction, solidification/stabilization, solvent extraction, thermal desorption, hot gas decontamination, incineration, pyrolysis, vitrification, excavation and off-site disposal and/or natural attenuation (DOD, 1994).

In-situ technologies generally used for groundwater remediation are co-metabolic processes, nitrate enhancement, oxygen enhancement with air sparging, oxygen enhancement with hydrogen peroxide, air sparging, pump-and-treat technology, dual phase extraction, free product recovery, passive/reactive treatment walls, slurry walls and/or vacuum vapour extraction. *Ex-situ* technologies often used for groundwater remediation are bioreactors, air sparging, filtration/biofiltration, ion exchange, liquid phase carbon adsorption, precipitation, ultraviolet-oxidation treatment, natural attenuation, membrane separation and/or vapour phase carbon adsorption (DOD, 1994).

4. Real Life Applications of Remediation Technologies

A brief summary of real life applications of soil and groundwater remediation technologies is presented in Table 1 (FRTR, 1998; FRTR, 2007; Ryan, 2010).

When real life applications given by FRTR (2000) are examined in detail, it can be seen that stabilization technologies were often proposed for remediating sites contaminated by metals or other inorganic species. Generally inorganic contaminants such as metals are immobilized, whereas organic constituents are not. Field applications presented that phosphate-induced metal stabilization (PIMS™) using Apatite II™ for lead (FRTR, 2007), polysiloxane for hexavalent chromium, oxides of lead, mercury, cadmium and chromium (FRTR, 2000) and phosphate bonded ceramics for oxides of cadmium, chromium, lead, mercury and nickel (FRTR, 2000) were used for solidification/stabilization. For solidification/stabilization and vitrification, long-term monitoring was often necessary to ensure that the contaminants were actually immobilized, consequently, increasing the total cost. The costs of soil remediation with solidification/stabilization were reported to be \$22/yd^3 for lead (FRTR, 2007) and \$573/ft^3 for oxides of lead, mercury, cadmium and chromium (FRTR, 2000). According to field applications (FRTR, 2000), other technologies applied for remediating soil sites contaminated by metals or other inorganic species were phytoremediation, chemical reduction/oxidation and/or thermal desorption, and, those applied for remediating contaminated groundwater were bioremediation and/or permeable reactive barrier.

According to field applications examined (FRTR, 1998; FRTR, 2000; FRTR, 2007; Ryan, 2010), soil vapor extraction was effective at reducing VOCs and SVOCs in the vadose zone. This technology had a short treatment time (a few months to 2 years) and was cost-effective. Other technologies used in field applications for the removal of organic compounds were found to be thermal desorption, pump and treat with air stripping and/or bioventing for soil remediation, and, bioremediation, dual-phase extraction, *in-situ* chemical oxidation with Fenton's Reagent, pump-and-treat systems and/or permeable reactive barrier were used for groundwater remediation. As can be seen in Table 1, some of these technologies were used together with soil vapour extraction for the removal of DCE, TCE, PCE and VC.

Field applications (FRTR, 1998; FRTR, 2001; Ryan, 2010) also showed that pump-and-treat systems were frequently used for groundwater contaminated with a variety of dissolved materials including dissolved metals, fuels, VOCs and SVOCs like DCE, TCE or PCE. This technology is simple to design and operate, equipment is easily available, and implementation is quick. But, it is a disadvantage that pump-and-treat systems need a long time (e.g. 5-10 years) to meet the cleanup goals. If it is combined with other remediation technologies such as vacuum extraction, air sparging and/or air stripping, treatment efficiency is found to be higher. Two case studies (Table 1) demonstrated that the combination of pump-and-treat systems with air stripping and/or air sparging enabled a decrease in contaminant concentrations within a much shorter time (e.g. 1-3 years). FRTR (1998) was reported that the costs of groundwater remediation with pump-and-treat systems and air stripping were $0.53, $10, $47, $464/1,000 gals for chlorinated solvents. FRTR (1998) was also reported that the costs of groundwater remediation were $76/1,000 gals for pump-and-treat systems combined with air stripping and permeable reactive barrier systems for the removal of chlorinated solvents and $374/1,000 gals for pump-and-treat systems combined with *in-situ* bioremediation for the removal of PCP and PAHs.

Field applications presented that *ex-situ* bioremediation slurry phase was used for soil contaminated with explosives such as TNT, dinitrotoluen (DNT), trinitrobenzene (TNB), RDX and HMX (FRTR, 2000). It was found that more than 99% of explosives were removed from soil in one-year and resulting in a cost of $290-350/yd^3 for soil remediation. Nonetheless, according to field applications examined (FRTR, 2000), *in-situ* bioremediation was used for groundwater contaminated with TCE, DCE, PCE, BTEX, fuel hydrocarbons or metals. The costs of groundwater remediation with *in-situ* bioremediation were $5.8/m^3 for carbon tetrachloride (CCl_4) and nitrate (FRTR, 2000). Other field studies showed that the cost was $4,340/gal fuel for the removal of fuel hydrocarbons and BTEX (FRTR, 2000), for comparison purposes similar costs for pump-and-treat were reported to be $6,120/gal fuel. As a real life application in Turkey it was reported that the less contaminated soil due to the leakage of crude oil, was cleaned up with a bioremediation method at the technically arranged site. According to the incident in April 2005, approximately 20 thousand barrels of crude oil leached from the pipeline of the Petroleum Pipeline Corporation (BOTAŞ) in Şanlıurfa. The highly polluted soil, on the other hand, was transported together with other oily wastes to İZAYDAŞ incineration plant for termal treatment (Özkaraova Güngör, 2008).

According to the reported by FRTR (1998), FRTR (2000), FRTR (2001), Khan et al. (2004) and Ryan (2010), thermal desorption was found efficient in removing contaminants that were difficult to treat. Low temperature thermal desorption was usually used to treat VOCs and various fuels, for example, pesticides like aldrin, dieldrin, dikloro difenol trikloroethan (DDT), dichloro diphenyldichloro ethylene (DDE) and dikloro difenil dikloretan (DDD) at 350 °F (soil temperature) (FRTR, 1998), BTEX, TPHs, VOCs and metals at 450-500 °F (FRTR, 1998), and VOCs like TCE and TCA at 250 °F (FRTR, 2000). However, high temperature thermal desorption was mainly used for PAHs, PCBs and pesticides, for example, PAHs at 700-750 °F (FRTR, 1998), PCBs and VOCs at 700-750 °F (FRTR, 1998) and BTEX, dichlorobenzene, napthalene and methylnaphthalene at 825 °F (FRTR, 1998). The costs of soil remediation with thermal desorption were reported to be $117/ton for heavy metals (FRTR, 2004), $125/yd^3 for pesticides-contaminated soil (FRTR, 1998) and $147/yd^3 for VOCs and SVOCs-contaminated soil (FRTR, 2001).

Experiences in real field applications also showed that some technologies had disadvantages. For example, phytoremediation was limited to soils less than one meter from the surface and groundwater less than 3 m from the surface. On the other hand, the cost of remediation of soil contaminated with phytoremediation was estimated to be $60,000-100,000 (Khan et al., 2004) and $10,600/acre (Table 1) (FRTR, 2007). In comparison, excavating and landfilling the same soil volume would cost from $400,000-1,700,000 (Khan et al., 2004). Air sparging was not appropriate for silt and clay sediment, and was ineffective in the case of nonstrippable and non-biodegradable contaminants for groundwater remediation.

Table 1. A brief review of recent soil and groundwater remediation case studies ([1]FRTR, 1998; [2]FRTR, 2007; [3]Ryan, 2010)

Site	Contaminant	Technology	Highlights
[1]Coal Creek Superfund Site, Chehalis, Washington	**Soil:** Polychlorinated biphenyls, lead, copper, barium, mercury, cadmium and zinc.	On-Site Incineration	Period 1994 Incineration system consisting a rotary kiln and a secondary combustion chamber (2,100 °F) The incinerator processed 9,715 tons soil. Total cost $8,100,000.
[1]JMT Facility RCRA Site, Brockport, New York	**Groundwater:** Chlorinated solvents; TCE (70,000 µg/L), 1,2-DCE (23,000 µg/L) Cleanup goals; TCE (5 µg/L), 1,2-DCE (5 µg/L)	Pump and Treat with Air Stripping	Period 1997-1998 The extraction well is located in 1 aquifer. 50.1 million gallons groundwater treated. Concentrations of contaminants decreased by more than 80%. Total costs for pump and treat were $2,163,000 ($47/1,000 gallon).
[2]Palmerton Zinc Pile Superfund Site, Pennsylvania	**Surface soil:** Cadmium (Cd) (364-1,300 ppm), Lead (Pb) (1,200-6,475 ppm), Zinc (Zn) (13,000-35,000 ppm) **Sediment:** Cd (250 ppm), Pb (3,600 ppm), Zn (27,000 ppm) **Groundwater:** Cd (1-1,670 ppm), Pb (1-1,630 ppm), Zn (40-2,122,000 ppm)	Phytoremediation	Period 1991- 2006 1,200 acres of the Blue Mountain area, 220 acres of the cinder bank, and 40 acres of Stoney Ridge have been revegetated. After 10 years, the initial 850 acres of revegetated land on Blue Mountain has retained more than 70% of its vegetative cover. The estimated cost for revegetating the initial 850 acres of Blue Mountain was $9,000,000 ($10,600/acre).
[2]Swift Cleaners, Jacksonville, Florida	**Soil and Groundwater:** 1,1-dichloroethene (DCE) cis-1,2-DCE tetrachloroethene (PCE); (max. in soil; 40 mg/kg) (max. in groundwater; 10,000 g/L) trans-1,2-DCE trichloroethene (TCE) vinyl chloride (VC)	Soil Vapor Extraction, *In Situ* Chemical Oxidation	Period 2001- 2006 The SVE system consists of five 12-ft vapor extraction wells and flow rate of 27 ft^3/minute. The SVE system has removed a total of 140.7 lb. The test area covered 2,500 ft^2 and consisted of three injections of Fenton's chemistry-based Oxy-Cat™ to treat groundwater. After second injections, PCE were reduced to below 200 g/L. PCE and TCE had decreased in all three superficial aquifers. 22,500 ft^3 of soil and 37,500 ft^3 of groundwater had been treated. Cost for site characterization totalled $164,000.
[2]East Helena, Montana	**Groundwater:** Arsenic (As) (20 mg/L)	Zero-Valent Iron Permeable Reactive Barrier	Period 2005-2007 Treating arsenic contaminated groundwater plume that is 450 ft wide and extends 2,100 ft downgradient. The ZVI PRB includes a 30 ft long trench that is 46 ft deep and 6 ft wide. The system was constructed 600 ft downgradient from the process ponds. After treatment, arsenic below 0.010 mg/L. $325,000 to construct.

Table 1 (continued). A brief review of recent soil and groundwater remediation case studies ([1]FRTR, 1998; [2]FRTR, 2007; [3]Ryan, 2010)

Site	Contaminant	Technology	Highlights
[2]F.E. Warren Air Force Base, Wyoming	**Groundwater:** Trichloroethene (TCE) (300 mg/L) Cleanup goal; TCE (5 µg/L)	Electrically Induced Redox Barrier (e-Barrier)	Period 2002-2004 The e-barrier consisted of 17 individual electrode panels. The effective cross-sectional area was 17 m^2. Each panel contained three Ti-mmo electrodes, four layers of Geotextile™, and six layers of Triplanar Geonet™. Power was supplied by a 30V DC 200 amp single-phase rectifier. Treated groundwater 63,000 gal. After treatment, TCE (300 µg/L). Total cost $419/$ft^2$/year.
[3]The Eastland Woolen Mill Superfund Site, Corinna, Maine	**Soil:** 1,2,4-Trichlorobenzene (6,000,000 mg/kg) 1,2-Dichlorobenzene (2,000,000 mg/kg) 1,3-Dichlorobenzene (37,000 mg/kg) 1,4-Dichlorobenzene (1,000,000 mg/kg) Chlorobenzene (530,000 mg/kg)	*In Situ* Chemical Oxidation	Period 2005-2007 The chosen oxidant, iron-catalyzed sodium persulfate (ICP). ISCO reduced 1,2,4-Trichlorobenzene by 87%, 1,2-Dichlorobenzene by 67%, 1,3-Dichlorobenzene by 67%, 1,4-Dichlorobenzene by 66%, Chlorobenzene by 77%.
[3]The Gold Coast Oil Superfund Site, Miami, Dade Country, Florida	**Groundwater:** PCE (100,000 µg/L; avg. 176 µg/L) TCE (48,000 µg/L; avg. 88 µg/L)	Pump and Treat, Air Sparging	Period 1990-1994 A TCE/PCE plume estimated at 0.87 acres and at 2,834,700 gal. Excavation of 683 tons of contaminated soils. Operated 21 wells and two air strippers. The porous limestone facilitated groundwater extraction. After 1 year of P-T, PCE (8 µg/L), TCE (9 µg/L). After 6 year of P-T, PCE (0.5 µg/L), TCE (1.0 µg/L). $694,325 for pump and treat.
[3]The Stamina Mills Site, North Smithfield, Providence Country, Rhode Island	**Soil:** TCE (430,000 µg/kg; limit 195 µg/kg) **Groundwater:** TCE (850,000 µg/L; limit 5 µg/L)	Pump and Treat, Soil Vapor Extraction, Multi-Phase Extraction, Groundwater Extraction, Excavation	Period 1998-2005 Excavation and offsite disposal of 24,400 tons of material. The SVE/MPE system removed 1,600 lbs of TCE. The GWE/MPE-GW system extracted a total of 1,830 lbs of contaminants. At off-site wells, below 5 µg/L. At some onsite wells, 140-20,000 µg/L.
[3]The Central Wood Preserving Site, East Feliciana Parish, Louisiana	**Soil:** Arsenic (20-6,913 mg/kg) Benzo(a)anthracene (0.059-56,200 mg/kg)	Excavation, Low Temperature Thermal Desorption	Period 1995-2004 9,142 tons of creosote-contaminated soil was treated onsite with LTTD. Post-remedy arsenic (3.2-6.3 mg/kg), benzo(a)anthracene (0.08-210 mg/kg) After excavation areas were backfilled with 15,846 cy of clean clay, organic-rich topsoil was distributed.
[3]The Southern Maryland Wood Treating Superfund Site, Hollywood, Maryland	**Soil:** PAH (10-1,000 ppm) **Groundwater:** VOCs (355-2,990 ppb) Base-neutral and acid extractable compounds (BNAs) (0.065-270 ppm) PAHs (4-31 ppm)	Sheet Pile, Low Temperature Thermal Desorption	Period 1995-2005 Soil within the sheet pile wall, two thermal desorption units with vapor recovery systems were installed. 270,600 tons contaminated soil and sediment were treated. After treat, benzo(a)pyrene below 0.1 ppm at surface soil, below 1 ppm at subsurface soil, and low MW PAH below 3.2 ppm, high MW PAH below 9.6 ppm at sediment. Total project cost was $60,700,000.

Additionally, field demonstrations showed that passive/reactive treatments walls were often used for groundwater contaminated with VOCs, SVOCs and/or inorganics; but were ineffective in treating other fuel hydrocarbons. Similarly, remediation times for *in-situ* soil flushing were usually found to be long due to the slowness of diffusion processes in the liquid phase. According to field studies, the application of on-site incineration technologies was not economical, compared with off-site technologies, due to the small amount of waste treated. Soil, sludge and liquid were treated with on-site incineration technology and its costs were reported to be $230-3,200/ton ranges (soil-sludge) and $9/gal (liquid) (FRTR, 1998).

5. Conclusions

[1] No single technology is appropriate for all contaminant types and the variety of site-specific conditions that exist at different contaminated sites. Site conditions, contaminant types, contaminant source, source control measures, and the potential impact of the possible remedial measure determine the choice of a remediation strategy and technology.

[2] Often more than one remediation technology is needed to effectively address most contaminated site problems. Treatment processes can be, and usually are, combined into process trains for the more effective removal of contaminants and hazardous materials present at contaminated sites.

[3] Consequently, several technologies that can provide both efficient and cost-effective remediation should normally be reviewed and explored as possible candidates in a remedy selection process.

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Soil degradation of Northern Tjan-Shan mountains and foothill plains

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Abstract
Northern Tjan-Shan soils are intensively used in agriculture as irrigated and dry-farming lands (foothill plains) and as pastures (mountains). The degree of soil cover degradation under the influence of anthropogenous factors depends not only on the kind and intensity of influence, but also on the general bioclimatic and litologo-geomorphological conditions of soils formation. Distinctions in response of mountain and foothill soils on the same anthropogenous influences considerably differ in various landscapes of Northern Tjan-Shan vertical zonality. Anthropogenous influence stability of foothill soils from sierozems to chernozems used as dry-farming lands decreases subject of absolute height lowing and climate aridity strengthening. At using in irrigated agriculture foothill soils of vertical desert-steppe and sierozem zones (sierozems, light-chestnat soils) are characterized by the minimal degree of degradation in comparison with soils with initially high level of natural fertility - dark-chestnat, chernozems, meadow soils. Among the soils of mountain territories using as pastures, soils of steppe zone (leached, typical and common chernozems) are characterised by the greatest anthropogenous influences stability. It is connected with the optimum conditions of moistening defined by the hydrothermal coefficient, close to 1. Stability of soils of the landscape zones located above (forest-meadow, meadow and meadow-steppe) and more low (desert-steppe; sierozem) decreases proportionally to a deviation of size of hydrothermal coefficient from 1-1,5. The researches carried out have allowed to reveal territories with the greatest degree of soil degradation and also to estimate the character of soil transformation at various factors of anthropogenous influence.
Keywords: Soil cover degradation, anthropogenous influences stability, vertical zonality.

Influence of Salinity and Sodicity on Physics Properties of Clays Minerals

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Abstract
Salinity and sodicity constitute a major constraint to the development of arid regions. The work reported attempt to show the impact of these parameters on the behavior of clays representing the solid phase that is the most important and most reactive soil. The physical properties considered are water retention, hydraulic conductivity and dispersion. The techniques used are laser particle size, the ultra-filtration device (pF), the device Prost (1984) for hydraulic conductivity, the sedimentation for the index of dispersion. The salts used for testing are NaCl and CaCl2, 2H2O. The salts concentrations and SAR tested vary respectively 2me / l to 40 me/l and 0 to 100.
The results show that:
-Salinity and sodicity have opposite effects on the functional properties considered. All minerals tested are sensitive to these parameters but the smectites are more reactive that illite and interstratified.
-In the presence of a salt concentration, the effect of SAR is low, m 4me/l for the smectite when it comes to the hydraulic conductivity, dispersion index and particle size. Conversely in the absence of salt concentration (less than 2me) the effect of SAR becomes very clear and this from 5.
-The mechanisms involved are swelling and dispersion of clays which result of a microstructural reorganization of the clay fraction.

Keywords: Salinty, sodicity, clays, physics properties.

Influence of Arbuscular Mycorrhizal Inoculation and Chelating Agent on Pb Phytoremediation

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Abstract
Lead (Pb) contamination of soils is a widespread problem. Among biological technologies, the use of metal accumulating plants to clean up polluted soils, as a natural, alternative, in situ, cheap and environmental friendly method is an innovative technique known as phytoremediation. Synthetic chelators such as ethylendiamin tetraacetic acid (EDTA) and mycorrhizal inoculation may be useful for improving of phytoremediation efficiency. A greenhouse experiment was performed to study influence of inoculation with arbuscular mycorrhizal (AM) fungus (*Glomus mosseae*) and addition of EDTA on phytoremediation of Pb by sunflower plant. The experiment was a completely randomized design in a factorial arrangement with factors: lead at five levels (10, 50, 100, 200, 400 mg kg^{-1} as $Pb(NO3)_2$, mycorrhizal treatments at two levels (inoculation with *Glomus mosseae* and control) and EDTA at two levels. Three replications were considered for each treatment. Shoot and root dry matters were increased in mycorrhizal treatments, but it was decreased in co-application treatments of EDTA and Pb. Result showed that the Pb concentration of shoots were significantly higher than Pb concentration of roots. Addition of EDTA decreased root colonization per cent. Inoculation with *G. mosseae* or addition of chelating agent significantly increased Pb uptake of root and its translocation into shoot. According to the results achieved herein, it assumed that both mycorrhizal inoculation and EDTA addition are effective in phytoextraction of Pb by sunflower.
Keywords: phytoremediation, lead (Pb), EDTA, arbuscular mycorrhiza

Introduction:
Heavy metals belong to type of toxic substances that have negative impact on human health and agriculture. The most common heavy metals are Cd, Cr, Cu, Hg, Pb, and Zn having their atomic number greater than 20 and with metallic properties. Phytoremediation, the use of green plants to decontaminate the metals from the soil, is a promising technique with advantages of being in situ, cost effective and environmentally sustainable (Haque et al., 2008). Ethylenediamine tetraacetic acid (EDTA) is the most effective chelating agent to rapidly increase the availability of metals in the soil for plant uptake (Lou et al., 2005), Neugschwandtner et al., (2008) reported that the EDTA as synthetic chelators, increase the risk of water pollution by uncontrolled metal solubilization and leaching and its application EDTA may also induce plant stress resulting from higher metal uptake. The use of arbuscular mycorrhizal (AM) fungi was proposed in remediation strategy to increase plant growth by improving the mineral nutrition and enhancing the plant tolerance to stress (Wang et al., 2007). Furthermore, Wang et al., (2007) reported that AM Fungi can colonize plant roots in metal contaminated soils. The plants used in phytoremediation scheme should naturally have large biomass production and accumulate high concentration of metals in the above ground portions. Sunflower appear to be good candidate for phytoremediation purpose (Audet and Charest 2006), due to its fast growing, large biomass, ease in harvesting, tolerance and accumulation of heavy metals in shoots. The objectives of present study were to examine the effect of microbial inoculation with AM fungi, and EDTA on the plant growth, the uptake index and Pb translocation in sunflower grown on contaminated soil

Material and Methods
The experiment was conducted in the greenhouse of College of Agriculture of Shiraz University, Shiraz, Iran. A completely randomized design with a factorial arrangement was used. A composite soil sample of a non-contaminated area was collected from 0–30 cm soil surface in Badjgah Agricultural Experiment Station of Shiraz University, Shiraz, Iran. The samples were air-dried and passed through a 2 mm sieve. Some physical and chemical properties at studied soil are presented in table 1.

Table 1. Physical and chemical characteristics of soil used in pot experiment

Characteristics		Characteristics	
Soil texture	Sandy clay loam	CEC ($cmol_+ kg^{-1}$)	24
pH (1:1)	7.96	DTPA-extractable of Pb (mg kg^{-1})	n.d
EC(dS m^{-1})	0.33	DTPA-extractable of Fe (mg kg^{-1})	2.66
CCE (%)	40	DTPA-extractable of Cu (mg kg^{-1})	1.38
Organic Matter (%)	0.93	DTPA-extractable of Mn (mg kg^{-1})	8.6
NaOAc- extractable P (mg kg^{-1})	9	DTPA-extractable of Zn (mg kg^{-1})	0.97

A greenhouse pot experiment was conducted to investigate the effect of the Arbuscular Mycorrhizal Fungi (AM) and EDTA on lead uptake by sunflower (*Heliantus anuus L.*). treatment consisted of two levels of arbuscular mycorrhizal Fungi (AM), $-AM_0$ (without inoculation of AM fungus), +AM (inoculation of *Glomus mosseae*), two levels of EDTA (0 and 5 g pot^{-1}) and five levels of Pb (0, 50, 100, 200 and 400 mg pb kg^{-1} as $Pb(NO_3)_2$) Plastic pots were filled with 5 kg of the studied soil samples. Pb levels were added before planting. The microbial inoculum of the arbuscular mycorrhizal fungus, G. mosseae, was spread as a thin layer below the soil surface, before planting. EDTA (as Na_2-EDTA salt) were applied to the soil surface 2 weeks before the plants were harvested. Six seeds of sunflower were planted in each pot. Soil moisture was maintained near the field capacity during the experiment. The plants were thinned to 3 uniform plants after emergence. Plants were harvested 8 weeks after emergence. Shoot and root were then separated and dried at 65 ˚C for 48 h for dry mass determination. Shoots and roots were dry ashed, dissolved in HCl, pb concentration were measured by atomic absorption spectrophotometer. Neugschwandtner et al., (2008) indicated that translocation factor (TLF) demonstrating heavy metal phytoextraction efficiency was calculated based on the ability of the root to transport element to shoot. Translocation factor can evaluates the capacity of a plant to transfer metals from root to shoot were measured as follows (Chen et al., 2006; Jankong and Visoottiviseth, (2008).

$$TLF= \frac{\text{Shoot Pb concentration}}{\text{Root Pb concentration}}$$

Solhi et al., (2005) reported that uptake index (UI) is a relative criterion having the capability of ranking the treatments based on their respective metal removal. The larger metal UI, the higher potential of metal removal. UI, which is obtained by multiplying of shoot dry biomass coefficient by shoot metal concentration, was recommended. Huang *et al*., (1997) found that Dry biomass coefficient is a ratio of shoot dry biomass of a specific treatment to the maximum value of dry biomass among all treatments.
Means were compared by least significant difference (LSD) at the 5% level of significance.
using a SAS 9.1 statistical package

Results and discussions
The analysis of the variance by ANOVA indicated that the effect of Pb, AM and EDTA on shoot and root dry weight of Sunflower were significant. Addition of Pb levels and application of EDTA, decreased shoot dry weight (table 2). Which was due to the toxic effects of Pb and EDTA on plants. On the other hand inoculation with AM increased root and shoot dry matter yield (Fig1). Usman et al., (2009) reported that microbial inoculation increased the sunflower biomass, but using EDTA significantly decreased it. Simultaneous usage of Pb and EDTA had a considerable decrease on the roots and shoots dry weights (table2). Azhar et al., (2006) expressed that the lengths of shoots and roots of sunflower decreased with increasing Pb level and simultaneous application of EDTA. Meers et al., (2004) concluded that the addition of EDTA before or right after germanization would make plant growth impossible, Which is due to EDTA toxicity or indirectly dependent on the solubility increase of some macro and micro elements, causing the disruption of plant growth. Evangelo et al., (2007) mentioned that although chelators like EDTA caused the removal of heavy metals from contaminated soil, they limited the microorganism's activity and decreased the plant biomass significantly.

Table 2- Effects of Pb levels, EDTA and *Glomus mosseae* on shoot and root dry weights of sunflower

	-AM			+AM		
Pb level	EDTA(g pot^{-1})			EDTA (g pot^{-1})		
(mg/kg)	0	5	Mean	0	5	Mean
	Shoot dry weight					
10	9.33bc*	8.16de	**8.75ABC**	10.04a	9.12c	**9.58A**
50	9.55b	7.26h	**8.4ABC**	10a	7.99ef	**8.99AB**
100	9.3bc	7.38gh	**8.34BC**	9.63ab	7.7fg	**8.67ABC**
200	8.5 d	6.69i	**7.62CD**	9.49bc	7.09hi	**8.29BC**
400	7.03hi	5.66k	**6.34E**	7.82ef	6.18j	**7DE**
Mean	**8.75A**	**7.03B**	**7.89B**	**9.39A**	**7.62B**	**8.5A**
	Root dry weight					
10	0.8e	0.44ghij	**0.62ABCD**	0.92cd	0.5fgh	**0.71ABCD**
50	0.79e	0.45ghi	**0.62ABCD**	0.9d	0.55f	**0.72ABC**
100	0.7e	0.42hij	**0.56BCD**	1c	0.53fg	**0.76ABC**
200	0.55f	0.35g	**0.45CD**	1.26b	0.45ghi	**0.85AB**
400	0.53fg	0.24k	**0.38D**	1.42a	0.4ij	**0.91A**
Mean	**0.67B**	**0.38D**	**0.52B**	**1.1A**	**0.48C**	**0.79A**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level P<0.05.

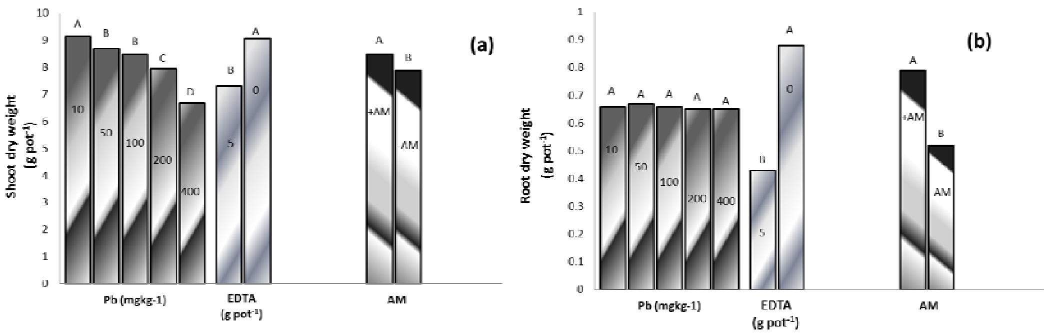

Figure 1- Influence of Pb, EDTA and M on shoot (a) and root (b) dry weight of sunflower plant**.**

Application of Pb, EDTA and AM increased mean Pb concentration in roots and shoots of sunflower (fig 2). EDTA addition and Am inoculation increased mean concentration of Pb by 80.7 and 30.18% respectively (Fig 2) Usman et al., (2009) reported that EDTA application increased the concentration of Zn, Cu, Pb and Cd in roots and shoots of maze, and sunflower. Lou et al., (2005) believed that the increased Pb uptake following EDTA addition was due to an increase in Pb mobility. They pointed out the rate of Pb accumulation in plants is dependent on the complex of this metal with synthetic chelator used. Wang et al, (2007) indicated that AM inoculation had a positive effect on plant growth and heavy metal uptake. According to the amount of Pb concentration in shoots and roots, it could be concluded that the amount of Pb in shoots was higher than roots. Simultaneous usage of EDTA and Pb caused an increase in the concentration of Pb, especially at 200 and 400 mg Pb kg^{-1}. Tandy et al., (2006) maintained that the concentration and uptake of Pb increased as Pb levels increased addition of Pb levels and inoculation with AM, increased concentration of Pb in plants. increase in AM activity at high Pb levels or the clarification of AM role in high Pb levels was due to the high tolerance of this fungus species to high Pb levels. This is due to the fact that this fungus was taken from contaminated soil around Angouran Pb and Zn mine.

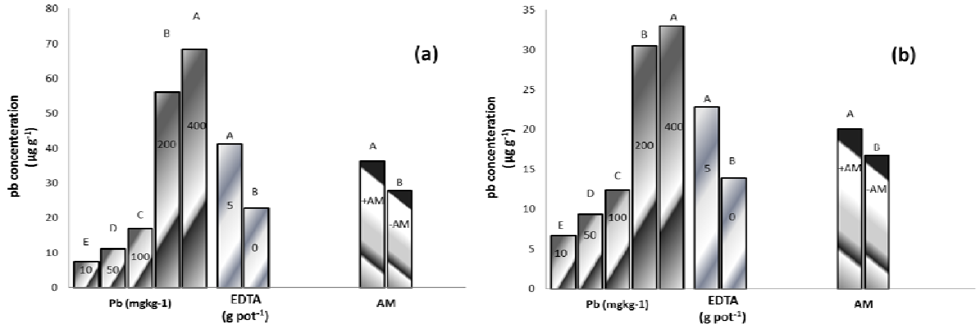

Figure 2. .Influence of Pb, EDTA and AM on the concentration of Pb in shoot (a) and root (b)

Díaz et al., (1996) reported that fungi taken from contaminated soil were highly tolerated to soils contaminated with high concentration of heavy metals. Both AM and EDTA treatments cause the translocation of Pb and its accumulation in shoots. Hung et al., (1997) reported that EDTA increased the desorption of Pb, and caused Pb diffusion to the xylem resulting in the translocation of Pb from roots to shoots. It appears that the increase in Pb concentration due to AM inoculation was due to the positive effects of AM on plant growth.

The rate of root colonization increased 19.5 folds in AM- inoculated Plants. This rate also increased by 14.29% when Pb levels were increased. However, the addition of EDTA decreased the colonization by 10.53%. According to the results, the rate of root colonization increased by increasing Pb levels, which is due to the AM tolerance to high Pb levels. Zho et al., (2001) expressed that the AM species taken from contaminated sites showed greater tolerance to toxicity compared to species taken from non-contaminated areas. The negative influence of EDTA on root colonization was atributed its toxic influence on soil microorganisms.

The least translocation factor, TLF, was observed at 10 mg Pb kg^{-1} level without AM and EDTA. The maximum TLF occurred at 400 mg Pb kg^{-1} accompanied with AM and EDTA. TLF increased by 75.89, 12.23 and 10.71% by increasing the Pb levels and incorporating EDTA and AM, respectively. Solhi (2005) indicated that generally speaking Pb uptake by roots was done inactively but capillary roots could uptake Pb and store it in cell walls to some extent. The results showed that TLF value was greater than one under all circumstances. Therefore, sunflower is a hyper accumulator for Pb extraction. McGrath and Zhao (2003) believed that only plants with TLF were longer than 1 can be considered hyper accumulators. Adesodum et al., (2010) showed that TLF was longer than 1 in sunflowers concerning Zn and Pb indicating that these metals moved more easily in this plant. EDTA and AM increased the TLF was positive which showed their high potential in phytoremediation. EDTA application increased the solubility and bioavailability of Pb. Since the chelating agents have the ability to extract metals from soil matrix, they could increase the uptake of plant tissue. The result revealed that in AM- inoculated Plants the TLF increased dominstrating metals the positive influence of AM on phytoremediation. Usman et al., (2009) concluded that both *Glomus mosseae* fungus and EDTA increased TLF.

EDTA, Pb, and AM effects on UI were significant. Increasing Pb levels increased the UI by 6.47 folds, whereas the EDTA and AM increased it 38.36 and 49.69%, respectively (Fig4). Solhi (2005) reported UI in measuring the potential of phytoremediation; as UI increased, the capability of plants in phytoremediation increased. Although both usage of EDTA and AM inoculation increased the UI, AM inoculation proved more efficient and so it seems that in our study the preference must be given to AM utilization.

Table 3- Effects of Pb levels, EDTA and *Glomus mosseae* on TLF.

Pb level (mg/kg)	-AM EDTA(g pot^{-1}) 0	-AM EDTA(g pot^{-1}) 1	-AM Mean	+AM EDTA (g pot^{-1}) 0	+AM EDTA (g pot^{-1}) 1	+AM Mean
10	1.07i*	1.14fghi	**1.11F**	1.1hi	1.2fgh	**1.14EF**
50	1.11ghi	1.19fg	**1.15EF**	1.2fgh	1.22f	**1.2DEF**
100	1.21f	1.42de	**1.31DE**	1.4e	1.4e	**1.37D**
200	1.49d	1.87c	**1.67C**	1.85c	1.9c	**1.88B**
400	1.39e	2.1b	**1.74BC**	2.13b	2.25a	**2.2A**
Mean	**1.25B**	**1.54A**	**1.4B**	**1.52AB**	**1.58A**	**1.56A**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level P<0.05.

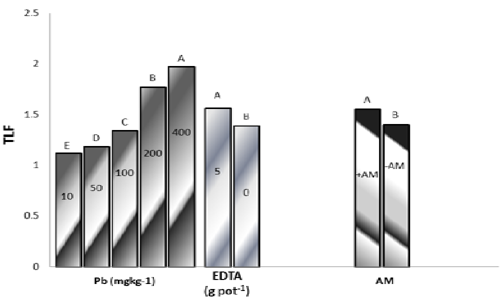

Figure 3. treatments affects on Translocation Factor

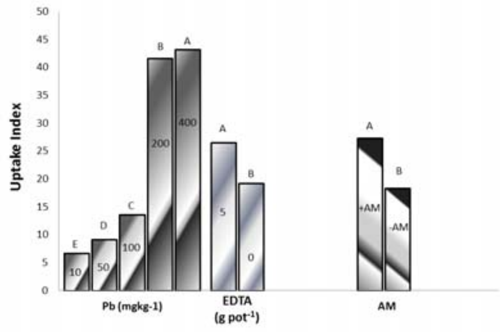

Figure 4. Treatments effects on Uptake index

Table 4- Effects of Pb levels, EDTA and *Glomus mosseae* on Uptake Index.

Pb level (mg/kg)	-AM EDTA(g pot^{-1}) 0	-AM EDTA(g pot^{-1}) 1	-AM Mean	+AM EDTA (g pot^{-1}) 0	+AM EDTA (g pot^{-1}) 1	+AM Mean
10	4.87k*	7.44j	**6.16C**	7.21j	7.15j	**7.18C**
50	6.58j	9.83hi	**8.21C**	10.75gh	9.48hi	**10.11C**
100	8.16ij	15.9e	**12.03C**	14.84e	15.36e	**15.1C**
200	11.65fg	53.3bc	**32.49B**	54.31b	47.09d	**50.7A**
400	13.09f	52.06c	**32.57B**	60.1a	47.48d	**53.79A**
Mean	**8.87B**	**27.71A**	**18.29B**	**29.44A**	**25.31A**	**27.38A**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level P<0.05.

Aknowledgment

The authors thank Shiraz University for providing research facilities.

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Influence of *Glomus mosseae* and EDTA on Growth and Ni Uptake of Sunflower in Ni- Contaminated Soil

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Abstract
Phytoremediation of nickel (Ni) in polluted soils seems a promising strategy for the environmental clean-up. Applications of chelating agents to plant growth media and inoculation of plant roots with arbuscular mycorrhizal fungi (AMF) have been employed to improve the extraction of heavy metals from polluted soils via phytoremediation. A greenhouse study was carried out to examine the influence of *Glomus mosseae* and addition of ethylenediamine tetraacetic acid (EDTA) as synthetic chelator on phytoremediation of Ni by sunflower (*Helianthus Annuus L.*) in a calcareous soil. The experiment was a completely randomized design in a factorial arrangement with three factors: nickel at five levels (5, 25, 50, 100, 200 mg kg^{-1} as $Ni(NO_3)_2$), mycorrhizal treatments at two levels (inoculation with *Glomus mosseae* and control) and EDTA treatments at two levels (1g kg^{-1} and control) with three replications. The result revealed that, the shoot and root dry weights increased in mycorrhizal plants, but decreased in co-application treatments of Ni and EDTA. Results showed that mycorrhizal treatments and addition of EDTA increased Ni uptake in plant shoots and roots. The amounts of Ni taken up by roots were higher than shoots in all treatments. With increasing Ni levels, Ni extraction and uptake efficiencies increased, but translocation efficiency of Ni decreased. Our results suggest Ni phytostabilization was the major mechanism involved in the present study.
Keywords: Nickel (Ni), EDTA, Arbuscular mycorrhiza, phytostabilization

Introduction
This metal (Ni) can be easily taken up by plants and tend to bioaccumulate in different organs (Liphadzi and. Kirkham, 2006). It can ultimately enter the human body by food and contaminated water or breathing in air containing toxic levels of Ni (Jarup, 2003). Scientists have developed phytoremediation approaches that defined as the process of utilizing plants to absorb, accumulate and detoxify contaminants in soil through physical, chemical and biological processes (Karami and Shamsuddin, 2010). The importance of interactions between metals, rhizosphere microbes and plants is due to the biotechnological potential of microorganisms for metal removal directly from contaminated soils or the feasible transfer of accumulated metals to higher plants (Ma et al., 2009). Audet and Charest (2008) reported that the use of arbusular mycorrhiza (AM) fungi was proposed in remediation strategy to alleviate plant stresses and decreased bioavailability of metal. Ethylenediamine tetraacetic acid (EDTA) as synthetic chelator that is one of the common chelators which use in phytoremediation. EDTA can enhance mobility of chelated metal complexes in the soil solution increases the metal available to the plant, it also increases the risk of inadvertently spreading the contamination. This concern has led to a developing consensus that familiar chelating agents such as EDTA may not be suitable for field work (Saifullah et al., 2009). Helianthus annuus (sunflowers) are one of the target species that continue to hold excellent promise for phytoextraction. They grow rapidly, produce significant biomass and are able to hyperaccumulate heavy metals, including cadmium (Chen and Cutright, 2001). The objective of this work is to investigate the effect of inoculation by *Glomuss mosseae* and EDTA on growth and Ni uptake of sunflower in Ni- contaminated soil.

Material and Methods
Soil characteristics

A greenhouse experiment was performed in college of agriculture of Shiraz university, Shiraz, Iran. A completely randomized design with a factorial arrangement was used. A composite soil sample of a non-contaminated area was collected from 0–30 cm soil horizon in Bajgah agricultural experiment station of Shiraz university, Shiraz, Iran. The samples were air-dried and passed through 2 mm sieve and prepared for further analysis which present in (Table 1).

Table 1- Physical and chemical characteristics of soil used in pot experiment.

Characteristics		Characteristics	
Soil texture	Sandy clay loam	CEC ($cmol_+kg^{-1}$)	24
pH (1:1)	7.96	DTPA-extractable of Ni (mg kg^{-1})	n.d
EC(dS m^{-1})	0.33	DTPA-extractable of Fe (mg kg^{-1})	2.66
CCE (%)	40	DTPA-extractable of Cu (mg kg^{-1})	1.38
Organic Matter (%)	0.93	DTPA-extractable of Mn (mg kg^{-1})	8.6
NaOAc- extractable P (mg kg^{-1})	9	DTPA-extractable of Zn (mg kg^{-1})	0.97

n d: not detected

This experiment was conducted to study the effect of the arbuscular mycorrhizal fungi (AMF) and EDTA on lead uptake by Sunflower (*Heliantus anuus L.*). Factors were included 1) arbuscular mycorrhizal fungi (AMF) with two levels -AM_0 (without inoculation of AM fungus), +AM (inoculation of *Glomus mosseae*), 2) EDTA with two levels (0 , 5 g pot^{-1}) Ni with five levels (5, 25, 50, 100 and 200 mg Ni kg^{-1}). Plastic pots were filled with 5 kg of the selected soil samples. Five levels of Ni (as $Ni(NO_3)_2$) were added to samples. The microbial inoculum of the arbuscular mycorrhizal fungus, *G. mosseae*, was spread as a thin layer below the soil surface, before planting. EDTA (as Na_2-EDTA salt) was applied to the soil surface two weeks before the plants were harvested. Treatments were replicated three times. 6 seeds of sunflower were planted in each pot. In all pots the moisture was maintained near the field capacity by deionized water during the experiment. The plants were thinned to three plants after germination. Eight weeks after germination the plants were harvested.

Plant analysis

After two months of planting sunflower plants were harvested. Then Shoot and root were separated and dried at 65 ˚C for 48 h for biomass determination. Ni concentration of shoot and root were determined by dry ash method with HCl, using atomic absorption. Three aspects of plant Ni efficiency were assessed (Wang *et al.*, 2007). Phytoextraction, uptake and translocation efficiencies of Ni measured as follows

$$\text{phytoextraction efficiency} = \frac{\text{amount of Ni in the shoot}}{\text{root dry weight}}$$

$$\text{Uptake efficiency} = \frac{\text{amount of Ni in the plant}}{\text{root dry weighr}}$$

$$\text{Translocation efficiency} = \frac{\text{amount of Ni in the shoot}}{\text{amount of Ni in the root}}$$

Differences between treatments were determined by analysis of variance (ANOVA) using a SAS 9.1 statistical system. Means of treatments were compared using least significant difference (LSD) at the 5% level of significance.

Results and discussion

Shoot and root dry weights

The effects of main factors and their interactions on shoot and root dry weights were significant, except interaction between AM and EDTA. (Table 2 and Fig 1). The result showed that with application of Ni and EDTA shoot and root dry weights were decreased but in mycorrhizal treatments these factors increased significantly. The results revealed that the presence of Ni in soil and application of EDTA as a synthetic chelator reduced the biomass, which was due to the toxic effect of Ni and EDTA. EDTA indirectly increased metals availability and increasing uptake of these metals by

Table 2- Effects of Ni levels, EDTA and *Glomus mosseae* on shoot and root dry weights of sunflower

	-AM			+AM		
Ni level	EDTA(g kg^{-1})			EDTA (g kg^{-1})		
(mg/kg)	0	1	Mean	0	1	Mean
			Shoot dry weight			
5	9.92a*	8.85b	**9.39A**	9.88a	8.45c	**9.16A**
25	9.9a	8.15d	**9.02A**	9.77a	8.32cd	**9.05A**
50	7.4f	6.51i	**6.95BC**	7.83e	7.13j	**7.48B**
100	6.53i	5.87j	**6.2DE**	6.85h	6.51i	**6.68CD**
200	5.22h	4.61l	**4.92EF**	5.81j	5.31k	**5.56EF**
Mean	**7.79AB**	**6.8B**	**7.3B**	**8.03A**	**7.14AB**	**7.58A**
			Root dry weight			
5	0.86c	0.76d	**0.81BC**	1.07b	0.76de	**0.91AB**
25	0.89c	0.63ghi	**0.76CD**	1.18a	0.75df	**0.97A**
50	0.7defg	0.63gh	**0.67DE**	0.74def	0.67efgh	**0.71CDE**
100	0.64gh	0.54jk	**0.59EF**	0.67fgh	0.61hij	**0.64DEF**
200	0.55ijk	0.48k	**0.51F**	0.65gh	0.51k	**0.58EF**
Mean	**0.73B**	**0.61C**	**0.67B**	**0.86A**	**0.66BC**	**0.76A**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level P<0.05.

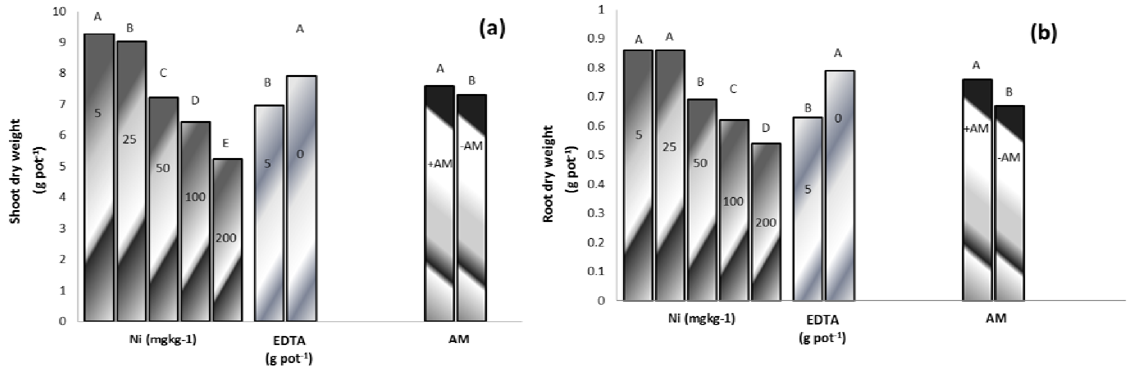

Figure 1. Effects of Ni levels, EDTA and *Glomus mosseae* on shoot and root dry weights of sunflower plant**.**

Plant so it caused toxicity. On the other hand using AM increased the biomass and toxicity tolerance of the afflicted plants. Chen and Zhao (2007) reported that AM Fungi and yeast were widely recognized as plant growth promoters. Ahmad et al., (2011) was observed that root and shoot fresh weights, and root length decreased consistently with increase in Ni concentration. The result indicated, that the simultaneous usage of Ni and EDTA or in Am-plants with application of Ni decreased shoot and root dry weights. Ker and Charest (2010) reported that the effect of AM and soil Ni treatments and their interaction were significant on biomass which was higher in AM than non-AM plants at 0 and100 Ni.

Ni uptake

The result showed that the effect of Ni levels, AM and EDTA were significant on the shoot and root uptake of Ni, however EDTA had not significant effect on root Ni uptake (Fig1). The amount of Ni uptake in shoot and root of plants inoculated with AM significantly increased as the levels of Ni increased. The result also showed that the simultaneous usage of EDTA and Ni levels caused an increase in the shoot uptake of Ni especially at 100 and 200 mg Ni kg^{-1} (Table 3). Ker and Charest (2010) expressed that the AM treatment significantly increased the Ni extracted percentage in roots and whole plants.

Table 3. Effects of Ni levels, EDTA and *Glomus mosseae* on Nvi shoot and root uptake (µg pot^{-1})

Ni level	-AM			+AM		
	EDTA(g kg^{-1})			EDTA (g kg^{-1})		
(mg/kg)	0	1	Mean	0	1	Mean
				Shoot uptake		
5	62.14j*	69.99ij	**66.07H**	87.55h	73.99i	**80.77H**
25	91.6h	89.13h	**90.37FG**	109.92g	94.86h	**102.39EF**
50	94.38h	132.07f	**113.22E**	139.45ef	134.62f	**137.03D**
100	161.67d	157.4d	**159.54C**	173.43c	197.46b	**185.44B**
200	144.72e	196.93b	**170.82BC**	181.06c	236.48a	**208.77A**
Mean	**110.91B**	**129.11AB**	**120B**	**138.28AB**	**147.48A**	**142.88A**
				Root uptake		
5	9.69j	15.46i	**12.58F**	20.73h	16.39i	**18.56E**
25	27.56fg	25.92g	**26.74D**	42.52e	31.41f	**36.96C**
50	31.5f	45.55d	**38.53C**	45.03d	53.19c	**49.11B**
100	39.23e	44.16d	**41.69C**	53.33c	54.35c	**53.84B**
200	54.17c	53.08c	**53.62B**	70.78a	61.58b	**66.18A**
Mean	**32.43B**	**36.83AB**	**34.63B**	**46.48A**	**43.38AB**	**44.93A**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level $P<0.05$.

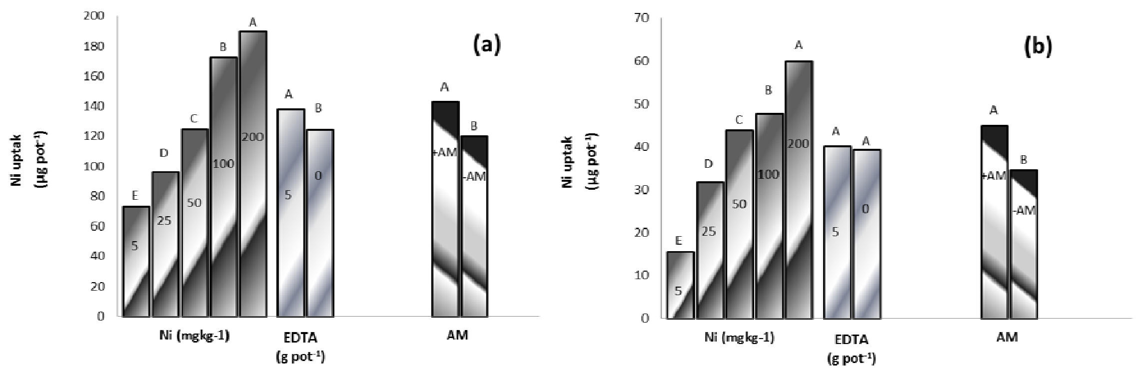

Figure 2. Effects of Ni levels, EDTA and *Glomus mosseae* Ni uptake in (a) shoot and (b) root of sunflower phytoextraction, uptake and translocation efficiencies of Ni

The effect of main factors on uptake, phytoextraction and translocation efficiencies of Ni was significant. Also their interactions were significant except EDTA and AM on uptake and phytoextraction efficiency (Table 4). Taking a close look at the result it can be said that phytoextraction efficiency was higher than uptake efficiency consequently uptake of Ni in shoot was higher than in root, so translocation of Ni from root to shoot was slower than accumulation of Ni in root. The result revealed that maximum Ni translocation efficiency was measured in plants at 5 mg Ni kg^{-1}. The minimum translocation efficiency of Ni at the level of 200 mg Ni kg^{-1} was observed in plant inoculated with AM. Our results suggest Ni phytostabilization was the major mechanism involved in the present study.

Table 4. Effects of Ni levels, EDTA and *Glomus mosseae* on phytoextraction, uptake and translocation efficiencies of Ni

	-AM			+AM		
Ni level	EDTA(g kg^{-1})			EDTA (g kg^{-1})		
(mg/kg)	0	1	Mean	0	1	Mean
			Phytoextraction efficiency			
5	72.46k*	91.69jk	**82.07F**	81.81jk	97.42jk	**89.61F**
25	102.17ij	152.01h	**127.09EF**	92.66jk	125.98hi	**109.32F**
50	134.25h	207.38g	**170.81DE**	186.83g	199.04g	**192.94D**
100	250.35f	288.06d	**269.2C**	258.85ef	320.78c	**289.42BC**
200	263.14def	409.92b	**336.53AB**	279.16de	460.84a	**370A**
Mean	**164.47A**	**229.81A**	**197.14B**	**179.86A**	**240.81A**	**210.34A**
			Uptake efficiency			
5	83.74l	11.94k	**97.84E**	11.17kl	118.99jk	**110.08DE**
25	132.92j	192.95i	**162.93D**	128.49jk	167.68i	**148.09DE**
50	179.04i	278.93j	**228.92C**	247.14h	277.65g	**262.4C**
100	311.02f	368.84d	**339.93B**	338.46ef	408.93c	**373.7B**
200	361.64de	520.51b	**241.07A**	388.06cd	580.82a	**484.44A**
Mean	**213.67A**	**294.64A**	**245.15B**	**240.67A**	**310.81A**	**275.74A**
			Translocation efficiency			
5	6.42a	4.52b	**5.47A**	4.23bc	4.51b	**4.37B**
25	3.32efgh	3.71cdef	**3.51CD**	2.58i	3.02ghi	**2.8E**
50	2.99ghi	3.89hi	**2.94DE**	3.03fghi	2.53i	**2.81E**
100	4.12bcd	3.56defg	**4.84BC**	3.25efgh	3.64cdef	**3.44CDE**
200	2.67hi	3.7cdef	**3.19CDE**	2.56i	3.84cde	**3.2CDE**
Mean	**3.9A**	**3.68AB**	**3.79A**	**3.14B**	**3.51AB**	**3.33B**

*Means followed by the same letters at each column and row are not significantly different according to LSD test at the level P<0.05.

Aknowledgment

The authors thank Shiraz University for providing research facilities.

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Phytoremediation of cadmium using plant- growth Promoting microorganisms and *Hyoscyamus* (*Hyoscyamus niger L*)

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Abstract
Cadmium (Cd) is one of the non-essential and phytotoxic heavy metals. Phytoremediation as a means of cleaning up polluted soils has gained popularity during the last decade due to its convenience and low costs of installation and maintenance. Plant growth promoting rhizobacteria (PGPR) and arbuscular mycorrhizal fungi (AMF) are known to improve plant growth and health by improving mineral nutrition, or increasing resistance or tolerance to biotic and abiotic stresses. Inoculation of plants increased the uptake of heavy metals without showing any symptoms of heavy metal toxicity as compared to the controls. The solubility of metals such as Cd is reduced due to the formation of insoluble hydroxides. Cadmium bioavailability depends on soil pH, redox potential, and rhizosphere chemistry. Immobilization can be achieved by complexing the contaminants or by increasing the soil pH by liming. Uptake of bioavailable metals are improved in AMF and PGPR plants due to modification of the root/rhizosphere systems. In this study, the effects of plant growth promoting microorganisms on cadmium uptake content and some other plant (*Hyoscyamus)* physiological characteristics under cadmium toxicant were investigated. This experiment was arranged in a completely randomized design and factorial with three replications under the greenhouse condition. Therefore, a two-factorial pot experiment was conducted with *Hyoscyamus* and (1) four contaminated soils with different concentrations of cadmium (0. 10, 30 & 100 mg kg^{-1} soil) and (2) three strains of the AMF (*G. mosseae*, *G. facsciculatum* and *G. intraradices*) and three strains of the PGPR (*P. aeruginosa*, *P. fluorescence* and *P.putida*) involutus. All treatments had three replicates and were harvested after 6 month growth in a greenhouse. The results showed that inoculation with AMF and PGPR increased the phytoavailability of Cd, stem biomass and metal concentrations in the stems ($P \leq 0.05$). AMF and PGPR significantly increased Cd translocation from soil to the plant shoots. Phytoremediation of heavy metal–contaminated soils can be enhanced by inoculation with growth-promoting microorganisms.
Keywords: AMF, cadmium, Heavy metal, PGPR, Phyremediation

Introduction
The presence of heavy metals in the environment is one of major concern because of their toxicity to many forms. Numerous industrial processes produce aqueous effluents that contain heavy metal contaminants. Since the majority of heavy metals donot degrade into harmless end products, their concentrations must be reduced to acceptable levels prior to discharge of industrial effluents. Otherwise,they could pose threats to public health or affect the aesthetic quality of potable water According to the World Health Organization (WHO), the metals of most immediate concern are aluminum, chromium, manganese, iron, cobalt, nickel, copper, zinc, cadmium, mercury and lead (Shuman, 1985). The physical and chemical characteristics of soil determine the speciation and mobility of heavy metals (Kabata-Pendias and Pendias, 1992).
Phytoremediation as a means of cleaning up polluted soils has gained popularity during the last decade due to its convenience and low costs of installation and maintenance. Bacteria mainly Plant Growth Promoting Rhizobacteria (PGPR) and fungi mainly Arbuscular Mycorrhizal Fungi (AMF) associated with hyperaccumulating or non-hyperaccumulating plants were analyzed on the basis of a bioprocess engineering approach (concentration and amount of metals extracted by plants, translocation and bioconcentration factor, and plant biomass). Plant-AMF symbiosis may alter the growth of the plant host and may play an important role by increasing the host-plant stress-tolerance. High metal concentrations in soil are toxic to bacteria and fungi. Poor or absent mycorrhizal inoculum were found in some of mine spoils, wich could explain the lack of mycorrhizal colonization. However, mycorrhizal rather than non-host plants could colonize polluted mining sites (Shetty et al., 1994), suggesting that heavy metal tolerance or other beneficial effects were conferred by mycorrhizal symbiosis .
Rhizosphere microorganisms, which are closely associated with roots, have been termed plant growth promoting rhizobacteria (PGPR) (Glick, 1995). PGPR include a diverse group of free-living soil bacteria that can improve host plant growth and development in heavy metal contaminated

soils by mitigating toxic effects of heavy metals on the plants (Belimov et al., 2004). It has been known for some time that many soil bacteria are able to degrade toxic organic compounds (Chakrabarty, 1981). *Pseudomonas* spp. are the most predominant group of soil microorganisms that biodegrade complex organic compounds, a process that typically requires the concerted efforts of several different enzymes.

The genes that code for the enzymes of these biodegradative pathways are often located on large (50 kb to 200 kb) plasmids (Ghosal et al., 1985; Cork and Krueger, 1991).

Materials and methods

Microbial inoculums including PGPR and AMF were prepared from Soil Science Department Microbial Bank. PGPR strains belonged to *Pseudomonas* species (*P. putida, P. fluorescence and P. aeruginosa)*. AMF inoculums contained three most abundant species including *Glomus* sp. (G. *mosseae*, G. *intraradices* and G. *faciculatum*). Plants Seeds of *Hyoscyamus* were surface sterilized with 0.5% NaClO solution and subsequently washed several times with distilled water. They were selected for uniformity before sowing. Soil was collected at 0–20 cm depth from West Azerbaijan Province, Iran. The soil had the following properties: soil pH (soil: water ratio, 1: 2.5) 8.1, organic matter 2.69%, total Fe 29505 mg kg^{-1}, total Zn 62 mg kg^{-1}, total Pb 21.42 mg kg^{-1}, total Cu 14.11 mg kg^{-1}, total Cd 1.47 mg kg^{-1}. Then the soil was sterilized by autoclaving at 121°C for 2 h and air dried. This study was designed as a two-factor experiment: (a) Cd levels and (b) inoculation treatments. Four Cd levels (0, 10, 30, 100 mg kg^{-1}) were applied in an analytical grade $Cd(NO_3)_2$ salt mixed thoroughly with the soil in every 40 days. Mycorrhizal treatments (M) received 25 g of mycorrhizal inoculums, bacterial treatments (B) received 15 ml of bacterial inoculums while the control treatment (C) received an equivalent sterilized same mycorrhizal and bacterial inoculums to provide a similar condition. Thus, there were 12 treatments in total with three replicates giving a total of 36 pots in a randomized blocks design. Five months after sowing, shoots were harvested separately. Shoots were first rinsed with tap water and then with deionized water. Shoots were weighed after oven drying at 75 °C for 72 h and then ground to < 0.25 mm in a stainless mill. Cd concentrations in dried and ground plant material were determined by atomic absorption spectrometry (Shimadzu 6300 AA) after wet-digestion with a mixture of concentrated HNO_3, $HClO_4$ and H_2SO_4 (40:4:1, v/v, guaranteed reagent) mixed acid. The Cd translocation ability was computed as the ability of the plant to transport the Cd to the shoot (percentage of total Cd in the plant present in the shoot tissue):

Translocation efficiency = Shoot Cd uptake/ Root Cd uptake (1)

Data were analyzed using analysis of variance. Comparisons between means were carried out using the Duncan's multiple rang test using the SAS systems. A significance level of 95% was applied.

Results and Discussion

Normalized Cd in shoot: In general, shoot concentrations tended to increase with increasing Cd addition levels. Compared with the non-inoculated controls, shoot Cd concentrations in mycorrhizal and bacterial plants were higher at all Cd levels (Fig. 1).

Studies dealing with the effect of AM fungi on heavy metal uptake by host plants have provided conflicting results (Meharg and Cairney 2000). Some reports indicate higher concentrations of trace elements in plants owing to AMF (Kilham and Firestone 1983), whereas others have found a reduced plant concentration of Zn and Cd in plants (Heggo et al., 1990). Some studies report that AMF do not limit uptake of heavy metals by their host plants, moreover, they can increase such an uptake, which was the case of zinc in *Pinus sylvestris* inoculated with *Thelephora terrestris* (Egerton-Warburton and Griffin, 1995). Increased uptake of aluminium by host plants mediated by AMF was shown as well (Cumming and Weinstein, (1990). The effect of AM fungi on heavy metal uptake by plants depends on the type and concentration of heavy metal, physicochemical properties of the substrate, on the combination of AM fungal isolate and the host plant, and on cultivation conditions (Leyval et al., 1997). Bacteria in the rhizosphere are involved in the accumulation of potentially toxic trace elements into plant tissues. Rhizobacteria produce metal-chelating agents called siderophores, which have an important role in the acquisition of several heavy metals (Leong, 1986). Rhizobacteria can exude a class of secretions, such as antibiotics, phosphate solubilization, hydrocyanic acid, indole-acetic acid (IAA), siderophores, 1-aminocyclopropane-1-

carboxylic acid (ACC) deaminase which increase bioavailability and facilitate root absorption of heavy metals, such as Fe (Crowely et al., 1991) and Mn (Barber and Lee, 1974), as well as non-essential metals, including Cd (Salt et al., 1995), enhance tolerance of host plants by improving the P absorption (Davies et al., 2001) and promote plant growth (Burd et al., 2000).

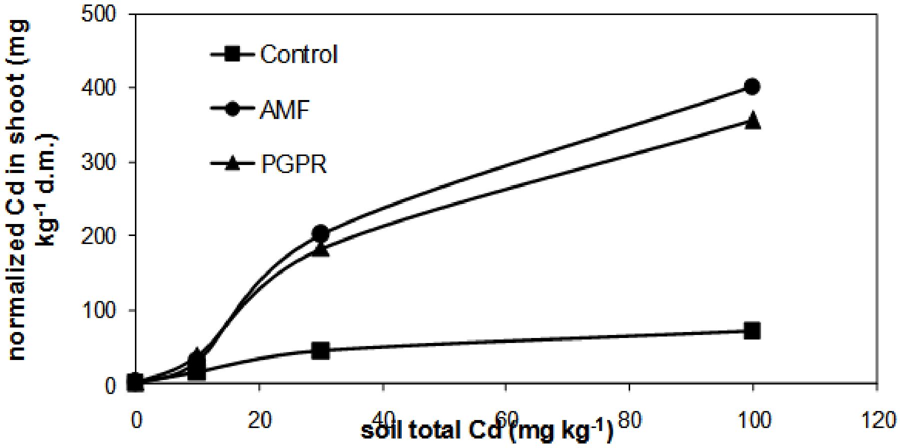

Figure 1. Normalized Cd in shoot (mean 3 R) of *Hyoscyamus* plants under different treatments.

Plant biomass: Shoot dry weights declined with Cd^{2+} concentration, but at every level of treatments the biomass of the inoculation plants were higher than non-inoculated plants. Shoot dry weight had no significant difference at 0 and 10 mg kg^{-1} Cd, but decreased significantly in treatment 30 mg kg^{-1} and higher Cd levels. At 30 and 100 mg kg^{-1} Cd, shoot dry weights were severely decreased (Fig. 1). Compared with the non-inoculation controls, AMF and PGPR inoculation increased shoot dry weights at 10, 30 and 100 mg kg^{-1} Cd addition levels.
Heavy metals are usually toxic to fungi and bacteria and can delay, reduce, and even completely eliminate AMF colonization and microbial population germination in the field (Gildon and Tinker, 1981). An increase in nutrient uptake in the contaminated soils could have resulted in relief of nutrients stress and increase in photosynthetic rates, which obviously could have given rise to an increase in plant growth. Mycorrhizal roots have been known to absorb phosphorus faster than non-mycorrhizal plants (Jakobsen et al., 1992). As the inoculation with PGPR increased the biomass plant, the total Cd-uptake per plant significantly increased when seeds were inoculated with PGPR. At condition in which seeds were inoculated with *P. fluorescens* ACC9 and *P. tolaasii* ACC23, the Cd content per plant increased to 72% and 107%, respectively, compared to non-inoculated plants (Elena et al., 2008).
Translocation efficiency: translocation efficiency increased with increasing amounts of Cd added. Cd translocation efficiency was more in inoculated plants than in control ones at all Cd levels (Fig. 2).
Conflicting results were observed in some cases and significantly enhanced translocation of HMs from roots to shoots of mycorrhizal plants (Moyer et al., 2005). A high cadmium and zinc sorption capacity of the AM fungi in comparison with other microorganisms was shown (Citterio et al., 2005). Enhanced HM concentrations in the shoots of mycorrhizal plants induced by some mycorrhizal fungal isolates represent optimal conditions for phytoextraction technique.

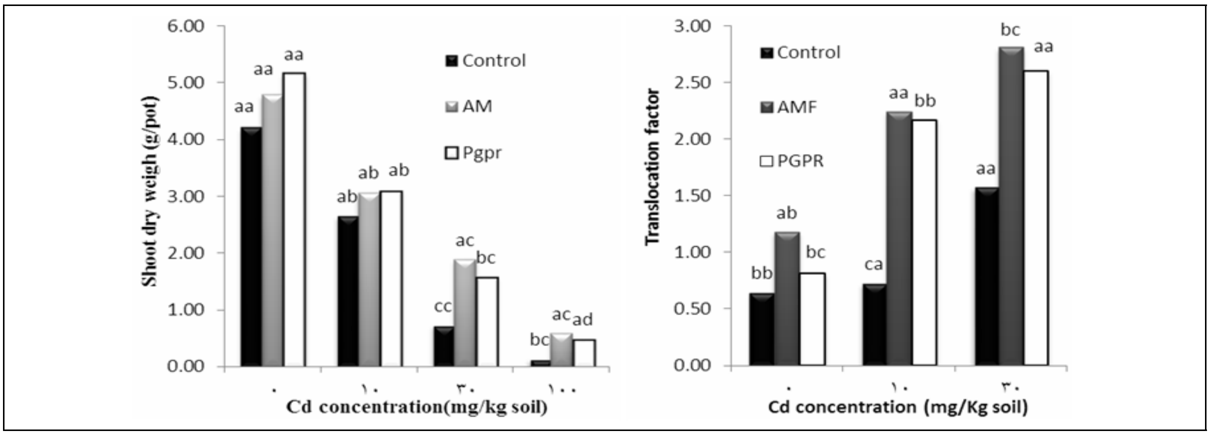

Figure 2. Shoot dry weights (a) and Translocation factor Cd in shoot (b) (mean 3 R) of *Hyoscyamus* plants under different treatments.

Acknowledgment
The technical assistance received from colleagues in Department of Soil Science, College of Agriculture, Urmia University is greatly acknowledged.

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Improving biological properties of a cadmium- contaminated soil with microbial inoculation

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Abstract
Cadmium (Cd) is one of the non-essential and phytotoxic heavy metals, and its toxic concentrations cause numerous responses in plant. The aim of this investigation was study cadmium effects on soil microbial activities and role of arbuscular mycorrhiza and growth promoting rhizobacteria on ameliorating effects of Cd in presence of centaurea plant. This experiment carried out in a factorial design including two factor 1) Cd at four levels (0, 10, 30 and 100 mg kg^{-1} soil), and 2) microbial treatments at three levels (Control, PGPR and AMF) with randomized blocks design at greenhouse with three replicate. Respirations, Soil Microbial Biomass (SMB), the metabolic quotient (qCO2) were evaluated at the end of experiment. Results indicated Cd had negative effect on all measured biological indicators. The addition of Cd caused significant decline in microbial respiration and Soil Microbial. Also it caused increasing qCO_2 non-significantly. Microbial inoculation of resulted in reduction in detrimental effect of Cd on measured indicators. Results indicated Cd has toxic effects on soil microbial activity even at low concentrations. The addition growth promoting microorganisms especially arbuscular mycorrhiza and growth promoting rhizobacteria could declined toxic effects of Cd. therefore, presence of growth promoting microorganisms at Cd-contaminated soils declined undesirable effects of Cd on soil microbial activity and food chain.
Key words: AMF, cadmium, microbial respiration, PGPR, MBC

Introduction
Cadmium is one of the most dangerous soil pollutants, because this heavy metal may easily move from soil to food plants through root absorption, and fairly large amounts can accumulate in their tissues without showing stress symptoms (Oliver, 1997). In this way, Cd may enter the food chain and so affect human health, as poisoning of hundreds of inhabitants of Japan demonstrated (Adriano, 1986). When heavy metals to be in the soil, it causes alterations in the structure and functioning of the agroecosystem. One of the most sensitive components is the microbial community, which can be utilized as an indicator for changes in soil quality (Dick, 1994; Giller et al., 1998). Heavy metals can inhibit microbial activity (Baath, 1989; Pontes, 2002). Respiration, microbial biomass and the metabolic quotient (qCO_2) can be used as biological indicators for changes in soil quality (Baath, 1989; Anderson and Domsch, 1990; Dick, 1994; Wardle and Ghani, 1995; Brookes, 1995; Giller et al., 1998). Soil respiration, metabolic quotient are indicators of microbial activity and of modifications occurred in the soil management option and soil pollutant content (Baath, 1989; Brookes, 1995; Anderson and Domsch, 1990; Wardle and Ghani, 1995; Dick, 1994).
The ratio of biomass C to soil organic C (C mic: C org) reflects the contribution of microbial biomass to soil organic carbon (Anderson and Domsch, 1989). It also indicates the substrate availability to the soil microflora or, in reverse, the fraction of recalcitrant organic matter in the soil; in fact this ratio declines as the concentration of available organic matter decreases (Brookes, 1995). The qCO_2 (the community respiration per biomass unit or the metabolic quotient) has been widely used in literature and is originally based on Odum's theory of ecosystem succession. Although its reliability as a bioindicator of disturbance or ecosystem development has been recently criticized by some authors, it is recognized to have valuable application as a relative measure of how efficiently the soil microbial biomass is utilizing C resources and the degree of substrate limitation for soil microbes (Wardle and Ghani, 1995; Dilly and Munch, 1998). In the present study Cmic: Corg, qCO_2 and respiration were determined on soil samples.
Ecosystem functioning is largely governed by soil microbial activity (Kennedy and Smith, 1995) because biochemical cycles of major plant nutrients are carried out by microorganisms (Barea and others, 2002). Sustainable systems require the understanding of interactions between plants and microorganisms, especially those having a direct influence on plant growth and stress tolerance (Gryndler and others, 2000). Both AM fungi and soil bacteria can adapt to specific environmental

conditions and develop tolerance to stressful environments (Ruız-Lozano and Azcon, 2000; Vivas and others, 2003). Among these microbial groups bacteria and arbuscular mycorrhizal (AM) fungi are ubiquitous in the soil, and there is abundant literature to support the idea that these rhizosphere microbes interact in rather specific ways to influence their relationship with and their effect on plant growth (Marulanda and others, 2006). Plant growth-promoting rhizobacteria (PGPR) play an important role as modifiers of soil fertility and as facilitators of plant establishment and development (Barea and others, 2002; Caravaca and others, 2002). Beneficial soil microorganisms such as bacteria and/or AM fungi can adapt to specific environmental conditions and develop tolerance to stressful conditions. The role of these microorganisms in plant stress tolerance to heavy metals, salt, and drought is known and has been studied in the context of providing a biological understanding of the adaptation of living organisms to extreme environments. The growth effect of PGPR may be mediated by IAA, salicylic acid, and gibberellin signaling pathways (Bent and others, 2001).

Material and methods

Soils and experimental design

Plant-growth promoting rhizobacteria (PGPR) and arbuscular mycorrhizal fungi (AMF) inoculants were prepared from Soil Science Department Microbial Bank. PGPR strains belonged to *Pseudomonas* species (*P. putida, P. fluorescence and P. aeruginosa)*. AMF inoculums contained three most abundant species including *Glomus* sp. (G. *mosseae*, G. *intraradices* and G. *faciculatum*). Plants Seeds of *centaurea* were surface sterilized with 0.5% NaClO solution and subsequently washed several times with distilled water. They were selected for uniformity before sowing. Soil was collected at 0–20 cm depth from west azarbaijan Province, Iran. The soil had the following properties: soil pH (soil: water ratio, 1: 2.5) 8.1, organic matter 2.69%, total Fe 29505 mg kg^{-1}, total Zn 62 mg kg^{-1}, total Pb 21.42 mg kg^{-1}, total Cu 14.11 mg kg^{-1}, total Cd 1.47 mg kg^{-1}. The soil was sterilized by autoclaving at 121°C for 2 h and then air dried. This study was designed as a two-factor experiment: (a) Cd addition levels and (b) inoculation treatments. Four Cd levels (0, 10, 30, 100 mg kg^{-1}) were applied in an analytical grade $Cd(NO_3)_2$ salt mixed thoroughly with the soil in every 40 days. Mycorrhizal treatments (M) received 25 g of mycorrhizal inoculums and bacterial treatments (B) received 15 ml of bacterial inoculums while the control treatment (C) received equivalent sterilized same mycorrhizal and bacterial inoculums to provide a similar condition. Thus, there were 12 treatments in total with three replicates giving a total of 36 pots in a randomized blocks design. Five months after sowing, shoots were harvested separately. Shoots were first rinsed with tap water and then with deionized water. Shoots were weighed after oven drying at 75 °C for 72 h and then ground to < 0.25 mm in a stainless mill.

Microbial respiration

Microbial respiration was measured based on the change in CO_2 concentration. 15 g of subsample of the incubated soil were placed in 110 ml glass bottles which were subsequently put into a 1l jar containing 10 ml water and a vessel containing 20 ml of 1N NaOH solution. The jars were sealed with air-tight plastic lids and incubated at 25±2°C for 7 day. The CO_2 produced in the incubated sample during the incubation period was absorbed by 1 N NaOH solution. Following each incubation intervals, the absorbed solution in the vessel was removed and titrated with 0.5 N HCl after the addition of 3 N $BaCl_2$ solution and phenolphthalein indicator solution (Zibilsje, 1994).

Microbial biomass

Soil microbial biomass carbon (MBC) was determined via fumigation and extraction method (Brookes et al., 1985; Vance et al., 1987). Fifteen grams of subsample of the incubated soil was fumigated with ethanol-free chloroform for 24 h at 25 C. After chloroform removal, the subsample was extracted with 200 ml 0.5 M K_2SO_4 solution for 30 min. Organic carbon in the extract were measured by wet digestion with dichromate and titration with $FeSO_4$.

Statistical analysis
Data were analyzed using analysis of variance. Comparisons between means were carried out using the Duncan's multiple rang test with using the SAS systems. A significance level of 95% was applied.

Results and discussion
Soil basal respiration
The effects of cadmium on CO_2 release at different treatments of incubation were presented in Tables 3. Soil respiration (CO_2 evolution) is the most general and most frequently used parameters for measuring the rate of decomposition of organic compounds in soils. The lowest and the highest CO_2 evolution were observed in 100 mg/kg and 0 Cd levels. Increasing levels of Cd decreased the amount of CO_2 evolution in all soils. Our results indicated that AMF and PGPR improved microbial respiration in all levels. Soil respiration rate, which can be considered an index of general soil microbial activity, also significantly decreases in the polluted soils (Lighthart et al., 1983; Laskowski et al., 1994; Dumat et al., 2006). Early studies on the e□ects of heavy metals on soil respiration show the inhibitory e□ects of Cd, Zn, Pb or Cu (Williams et al., 1977; Coughtrey et al., 1979).

Table 1. Microbial respiration in the soil under different treatments

Cd concentration (mg kg^{-1} soil)	Microbial respiration (mg CO_2-C kg^{-1})	
	AMF	PGPR
0	165±7 a,a	176±2 a,a
10	149±11 a,b	160±12 a,b
30	124±4 a,c	128±6 a,c
100	84±3 a,d	88±1 a,d

The first and second Duncan words on each scalar indicate statistical differences at column and row, respectively. The Control soils sterilized before cultivation and respiration rate was approximately zero.

Soil microbial biomass
The soil microbial biomass values showed significant variation with different Cd (Table 2). The highest microbial biomass values were at AMF treatments and followed PGPR. These data indicate that microbial biomasses were increased at AMF and PGPR treatments. Heavy metals are usually toxic to fungi and bacteria and can delay, reduce, and even completely eliminate AM colonization and microbial population germination in the field (Gildon and Tinker, 1981). The values obtained in the present study are agree those obtained by Dar (1996) observed that microbial biomass decreased in soil samples incubated with sludge containing and not containing added cadmium.

Table 2. Soil Microbial Biomass (SMB) in the soil under different treatments

Cd concentration (mg kg^{-1} soil)	SMB (mg CO_2-C kg^{-1})	
	AMF	PGPR
0	1939±65 a,a	1782±60 b,a
10	1708±78 a,b	1587±33 b,b
30	1277±31 a,c	1260±11 a,c
100	783±80 a,d	756±31 a,d

The first and second Duncan words on each scalar indicate statistical differences at column and row, respectively. The Control soils sterilized before cultivation and respiration rate was approximately zero.

The metabolic quotient (qCO_2)
Table 3 report the metabolic quotient in AMF and PGPR treatments. No clear differences were seen in the ratio of respiration to biomass (the metabolic quotient (qCO_2) between AMF and PGPR

treatments. qCO_2 has often been used to assess the physiological status of the soil community. Stress can reduce qCO_2 (Chander and Brookes, 1991) an effect attributed to reduced efficiency of conversion of substrate to biomass-C, or a shift in the structure of microbial communities between R strategists, with high growth rates and low yields of biomass, and K strategists which have constant population sizes and higher biomass yield efficiencies (Insam et al., 1996). Heavy metals have been reported to have a negative effect on soil functioning and soil biological parameters (Kandeler et al., 1996).
According to the results it can be concluded that, inoculation of AMF and PGPR can affect soil biological parameters. Furthermore considering the effective role of AMF and PGPR in ameliorating Cd toxicity will be useful.

Table 3. Metabolic quotient (qCO_2) in the soil under different treatments

Cd concentration (mg kg^{-1} soil)	Metabolic quotient (qCO_2) (-)	
	AMF	PGPR
0	0.09±0.004 a,b	0.09±0.002 a,b
10	0.094±0.01 a,b	0.09±0.01 a,b
30	0.010±0.01 a,ab	0.10±0.01 a,b
100	0.112±0.01 a,a	0.11±0.01 a,a

The first and second Duncan words on each scalar indicate statistical differences at column and row, respectively. The Control soils sterilized before cultivation and respiration rate was approximately zero.

Acknowledgment
The technical assistance received from colleagues in Department of Soil Science, College of Agriculture, Urmia University is greatly acknowledged.

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Laboratory Evaluation of Eight Chemical Extractants for Determination of Available Fe of Some Calcareous Soils of Iran (Rafsanjan Region)

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Abstract

Iron is an essential element for higher plants. Total soil Fe always exceeds crop requirements but Fe deficiency is a major problem in calcareous soils. Total iron content in soils does not give any information about its availability to plants therefore it is important to find suitable extractants that can predict the plant available Fe in soil.
A greenhouse experiment was conducted in order to evaluated relative efficiency some of chemical extractants for predicting available Fe some calcareous soils with a wide range of chemical properties of Rafsanjan city of Iran. The results showed that iron application significantly increased top dry weight of pistachio seedlings but concentration of micronutrients (Fe, Cu, Zn and Mn) were not significantly affected by application of iron. Among soil properties, pH, clay and EC correlated positively with pistachio top dry weight and clay and EC related positively with Fe uptake.
Fe extracted by the eight chemical extractants was in the order: $Mehlich_3$> EDTA> DTPA-NH_4HCO_3> DTPA-NaOAC> DTPA> EDTA-NH_4OAC> EDTA$(NH_4)_2CO_3$> $MEHLICH_1$. A significant positive correlation was observed between extracted Fe by $mehlich_1$ and absorption Fe by aerial parts of pistachio seedlings. Also, a significant positive correlation was found between Fe extracted by some of chemical extractants with the exception of DTPA with EDTA , EDTA-NH_4OAC and EDTA with EDTA-$(NH_4)_2CO_3$, DTPA-NH4HCO_3, mehlich1, and EDTA-$(NH_4)_2CO_3$ with DTPA-NaOAC and EDTA-NH_4OAC and EDTA-NH_4OAC with $mehlich_1$ and $mehlich_1$ with $mehlich_3$ and DTPA-NH4HCO_3 with DTPA-NaOAC. A significant negative correlation was found between Fe extracted by EDTA-$(NH_4)_2CO_3$ and $mehlich_1$.The highest correlation was found between DTPA and DTPA-NH_4HCO_3 and the lowest correlation between $mehlich_1$ and DTPA-NH_4HCO_3.

Keywords: Pistachio, Calcareous soils, Chemical extractants, Fe available, Fe uptake

Evaluation of environmental risk from metal mobility in mine tailing ponds after mining reclamation works, SE Spain

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Abstract: This study aims to evaluate the long-term effect of the mobility of metals within the different materials used in former reclamation works to cover three tailing ponds. Samples from dumped materials and tailing layers were analyzed for their properties and total, diethylene triamine pentaacetic (DTPA) extractable and water soluble metals. Electrical resistivity imaging (ERI) method helped to identify erosion processes and the thickness of dumped materials and their contact with tailing layers. Properties within dumped material promoted the colonization of natural plants on these tailings. However, total Pb, Cd, and Zn concentrations exceed the maximum admissible concentration allowed by legislation. Risk of mobility of these metals from the surface layer through plant uptake and leaching or runoff water has been significantly reduced. The concentration of some metals in dumped materials was higher than that reported in tailing layers: their immobilization is therefore recommended. According to ERI method, two ponds experienced erosion by water action. Efforts need to be focused to re-cover these areas to reduce the erosion and metal mobility from the tailing layers. The bedrock did not present any discontinuity that could allow the transport of heavy metals to deeper horizons.

Keywords: ERI method, reclamation works, tailing pond, heavy metal, Spain.

Introduction

Depleted mining areas which have undergone intensive mining activity present a challenge to local governments to overcome their potential hazards. The main impact of the abandoned mine areas is the presence of the unconfined tailing ponds which have very high concentrations of metals (Rodriguez et al., 2009). The layers of the unconfined ponds can be eroded by wind or by water runoff (Zanuzzi et al., 2009) and the metals transported to long distances (Chaoyang et al., 2009).

In order to reduce the damage to the environment presented by these tailings, reclamation actions are necessary. A variety of techniques can be used for decontaminating and remedying contaminated soils, including in situ or ex situ processes (soil-washing, physical separation, phytoremediation, leaching, etc.) or those processes used to immobilize the contaminants to minimize their release into the environment. Even some conventional remedial approaches to metal-contaminated soils usually involve removal and replacement of soil with clean materials, although this is not considered to be the most economically or environmentally sound solution available.

At La Sierra Minera Cartagena-La Unión (SE Spain), with >40 unconfined tailing ponds, both public administrators and land-owners in charge of this former mining district were concerned with these tailing ponds, located as they are, near densely populated areas with residential, industrial and commercial developments. So, many years earlier work was carried out to reduce the erosion processes and the impact on the landscape in some of the tailing ponds. This work comprised the dumping of material on the tailing ponds to create a soil cover to encourage the growth of vegetation.

These filling materials had different origins including waste debris from demolition works, artificial cobbles, gravel, and sands extracted from nearby quarries. Although, the works achieved their objectives (reducing the landscape impact and mitigating the erosion of the ponds), limited attention was given to the effect on the behavior of the metals after application of these materials. In fact, limited study had been carried out to assess the effectiveness of these materials in the reduction of the impact on the environment or to the guarantee of the safe condition of the tailing ponds, against heavy metal mobility and bio-availability.

The main objectives of this study were to: 1) determine the degree of contamination of heavy metals in both surface and subsurface layers of the ponds, and 2) evaluate the long-term effect of different materials used in former reclamation action on heavy metal mobility in the surface of the selected three tailing ponds by using geophysical and geochemical techniques,

Material and Methods

Study area

The mine tailing areas are located in the Sierra de Cartagena (Fig. 1). The climate is typically Mediterranean with average temperatures of 18 °C. Mean annual precipitation is ~275 mm. Three tailing ponds were selected, Las Lajas, La Encontrada and El Beal. The reclamation works were carried out from 1970 to 1980 and consisted of covering the surfaces with different materials. The material used in these former reclamation actions was a mixture of waste debris from demolished buildings, artificial cobbles, gravel, sands, and natural soil from nearby areas.

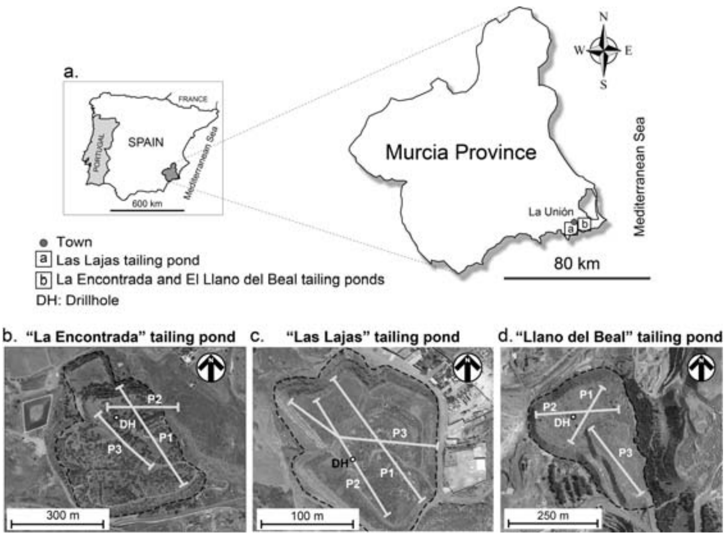


Figure 1. (a) Location map of study area, (b) Location of ERI profiles at La Encontrada tailing pond, (c) Location of ERI profiles at Las Lajas tailing pond, and (d) Location of ERI profiles at Llano del Beal tailing pond.

Geophysical and geochemical techniques

A total of nine profiles of ERI were implemented on the three different tailing ponds, comprising three resistivity profiles on La Encontrada , three profiles on Las Lajas and three resistivity profiles on El Beal.

Surface and subsurface samples were collected from the three ponds. The collected samples were air-dried in the lab, passed through a 2-mm sieve, homogenized, and stored in plastic bags at room temperature prior to laboratory analyses.

Several analyses were carried out: pH and electrical conductivity measured in a 1:1 and 1:5 deionized water/soil ratio solutions, respectively (Peech, 1965). Particle size analysis was carried out using the FAO-ISRIC system (2006). For the quantification of the total metals, a subset of each sample was ground, and an acid digestion (nitric-perchloric) was carried out (Risser and Baker, 1990). Soluble metals were determined using a 1:5 soil-deionised water ratio (Ernst, 1996). DTPA was used in the ratio of 1:2 soil-extractant for soil extractable metals (Norvell, 1984). Measurements were conducted using atomic absorption spectrophotometer.

Variation of metal concentrations between dumped material and subsurface layers

We estimated the variation of total, DTPA extractable and water soluble metal concentrations between tailing layers (subsurface samples) and dumped materials (surface samples) using the following ratio (R_x): $R_x = (X_{dm}/X_{tl})$; where, X_{dm} was the mean concentration (mg kg^{-1}) of the metal in the dumped materials and X_{tl} the mean concentration (mg kg^{-1}) of metal in the tailing layers. The value of $R_x > 1$ indicates that the concentration of metal in dumped material is higher than that in the tailing layers. Values <1 mean that the concentration of metal in dumped material is lower than in tailing layers. Thus, values ~1 indicate a similar concentration in both.

Results and discussion

Soil properties of the dumped material and subsurface layers of the ponds

pH follows the same distribution pattern in the three ponds; slightly higher in the surface than in the subsurface (Table 1). Dumped materials can be classified between neutral and alkaline, and from slightly acid to neutral in tailing layers. Electrical conductivity is higher in the tailing layers than in dumped materials for the three ponds. Dumped materials in La Encontrada and El Beal had a lower sand content and higher clay content than the tailing layers. Dumped material in Las Lajas had a higher sand percentage and lower silt percentage than the tailing layers. This may results in the surface layer having a low water retention rate.

Table 1. Properties of the surface and subsurface samples from the ponds

		pH		EC (dSm-1)		Clay (%)		Silt (%)		Sand (%)	
		Surface	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**
Las Lajas	**Mean**	7.66	6.40	1.34	3.39	10.24	11.75	30.51	53.91	59.24	34.33
	Error	0.07	0.27	0.22	0.21	1.18	1.49	1.76	5.39	2.52	5.90
	Minimum	7.12	3.94	0.31	1.85	3.80	3.67	21.50	26.65	40.80	1.00
	Maximum	8.07	7.67	2.42	4.54	17.10	22.99	46.90	83.35	74.60	65.73
La Encon-trada	**Mean**	7.96	7.40	0.36	2.51	20.93	8.22	26.11	27.67	52.96	64.11
	Error	0.04	0.26	0.13	0.16	1.60	0.57	1.85	2.69	2.49	3.17
	Minimum	7.66	4.05	0.11	1.31	9.93	5.23	14.62	11.35	32.48	41.91
	Maximum	8.17	7.96	2.49	3.27	30.28	12.16	41.51	45.93	72.71	81.89
El Beal	**Mean**	7.84	7.37	1.25	2.60	7.61	3.00	47.54	40.34	44.86	56.66
	Error	0.12	0.31	0.25	0.12	1.15	0.53	5.78	3.45	5.33	3.85
	Minimum	7.04	4.12	0.19	1.87	0.19	0.64	27.06	17.25	1.00	40.98
	Maximum	8.64	8.21	2.88	3.38	16.94	6.64	95.56	54.49	69.95	81.96

Total metal pollution in the tailing ponds

In terms of total metal content, there were marked differences in the dumped materials in Zn, Cd, Cu. and Pb (Table 2). High and positive correlations between total metals in dumped materials and tailing layers (r=0.98 for Zn; r=0.84 for Cd and r=0.68 for Cu) indicated that total metal contents on the surface depend on the metal content in the tailing layers, except for Pb (r= 0.20). Mean concentration of Pb, Zn and Cd in the dumped materials and tailing layers from the three ponds studied, exceed the maximum concentrations admissible by Spanish, Dutch, and Danish legislation (BOE, 1990; Ministerial Decree, 1999; Ministery of Housing, 1994). Cu levels were below the above mentioned threshold levels. Therefore, new remediation action is necessary to reduce their total metal concentrations and to improve environmental conditions in these areas.

Table 2. Total metal concentrations on surface and subsurface samples

		Zn ($mgkg^{-1}$)		Pb ($mgkg^{-1}$)		Cu ($mgkg^{-1}$)		Cd ($mgkg^{-1}$)	
		Surface	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**
Las Lajas	**Mean**	3760a	5250b	5267a	4857b	114a	146b	7.15a	12.5b
	Error	609	555	860	1607	13.9	23.6	1.29	1.91
	Minimum	760	887	750	1228	53.1	61.9	1.94	2.31
	Maximum	9438	10658	13058	25275	219	383	17.9	27
La Encontrada	**Mean**	3861a	4599b	5578a	2137b	160a	128a	17.4a	21.5b
	Error	475	739	1131	140	30.3	15.7	1.39	1.07
	Minimum	2166	1740	2840	1216	38.0	31.8	9.06	14.6
	Maximum	9813	10361	21272	2888	465	257	30.5	28.5
El Beal	**Mean**	12772a	8312b	4650a	2080b	72.3a	80.6b	31.5a	21.8b
	Error	1233	1340	475	196	5.79	6.80	3.78	3.74
	Minimum	5108	846	2080	1051	37.8	39.9	9.52	0.67
	Maximum	22312	17909	9346	4052	114	129	64.1	46.3

DTPA extractable and water soluble metals in the tailing ponds

Table 3 shows the concentration of metals extracted with DTPA. No relationship was found between the DTPA-extractable concentration in the dumped material and tailing layers, which indicated that the available metal content depends on the physico-chemical properties of the soils.

All metals in the three ponds, except for Cd in Las Lajas, had a total concentration of soluble fraction below 1% (Table 4). The highest percentages of Cu and Cd were found in Las Lajas, at 0.04 and 1.15 %, respectively. However, the highest percentages of water-soluble Zn and Pb were recorded at La Encontrada, 0.05 and 0.04 %. The concentration of Zn and Pb were low; below 3 mgkg^{-1} for Zn and Pb and <0.2 mgkg^{-1} for Cu and Cd in the three ponds. Therefore, the risk of mobility of metals by leaching or runoff from the dumped material is not considered to be an environmental problem.

Table 3. DTPA extractable metal concentrations on surface and subsurface samples

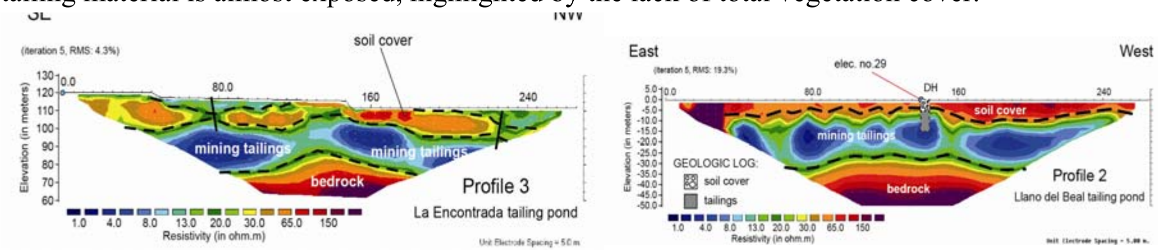
		Zn (mgkg^{-1})		Pb (mgkg^{-1})		Cu (mgkg^{-1})		Cd (mgkg^{-1})	
		Surface	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**
Las Lajas	**Mean**	59.5	163	294	236	2.22	6.07	0.44	2.32
	Error	7.64	13.1	63.0	49.9	0.44	1.00	0.08	0.69
	Minimum	6.66	33.4	39.0	1.01	0.20	1.13	0.10	0.37
	Maximum	119	214	797	532	6.26	13.9	1.15	10.8
La Encontrada	**Mean**	65.3	65.3	304	276	0.74	28.9	0.44	1.00
	Error	12.1	17.2	61.8	89.6	0.08	5.93	0.06	0.25
	Minimum	9.24	11.0	118	36.5	0.28	16.8	0.22	0.34
	Maximum	163	218	976	1182	1.56	90.9	1.08	3.60
El Beal	**Mean**	428	130	145	358	0.72	8.39	2.33	1.58
	Error	47.4	39.8	26.6	52.0	0.11	1.54	0.32	0.25
	Minimum	95.6	2.91	3.46	42.1	0.33	0.36	0.75	0.04
	Maximum	701	648	346	645	1.88	18.68	5.21	3.70

Table 4. Water soluble metal concentrations on surface and subsurface samples

		Zn (mgkg^{-1})		Pb (mgkg^{-1})		Cu (mgkg^{-1})		Cd (mgkg^{-1})	
		Surface	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**	**Surface**	**Drill**
Las Lajas	**Mean**	0.13	21.73	0.30	3.34	0.05	0.52	0.08	0.58
	Error	0.05	6.03	0.06	1.28	0.01	0.49	0.02	0.21
	Minimum	nd	0.21	0.05	0.15	nd	nd	nd	0.11
	Maximum	0.77	64.22	1.01	16.25	0.16	6.87	0.20	3.24
La Encontrada	**Mean**	1.86	3.66	2.41	2.53	nd	0.41	0.17	0.99
	Error	0.31	2.07	0.37	0.51	nd	0.04	0.03	0.08
	Minimum	0.17	0.04	1.09	1.02	nd	0.24	0.01	0.68
	Maximum	5.01	23.42	6.50	7.93	nd	0.58	0.42	1.72
El Beal	**Mean**	6.21	1.74	0.26	0.36	nd	0.02	0.07	0.49
	Error	2.19	1.16	0.10	0.20	nd	0.02	0.03	0.10
	Minimum	0.04	nd	nd	nd	nd	nd	0.01	nd
	Maximum	37.38	17.85	1.81	2.62	nd	0.23	0.51	1.25

Electrical resistivity imaging (ERI)

According to the ERI method (Figures 2), the La Encontrada and Las Lajas tailing ponds displayed areas uncovered by the dumped materials (removed by erosion and water runoff action) so the tailing material is almost exposed, highlighted by the lack of total vegetation cover.



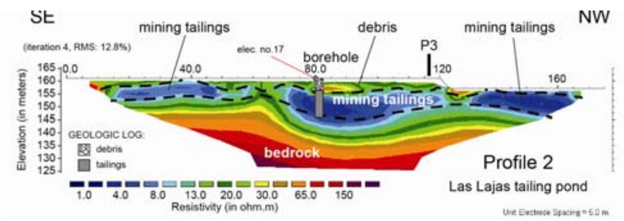
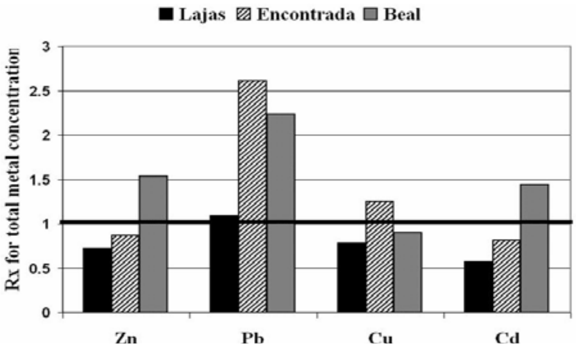


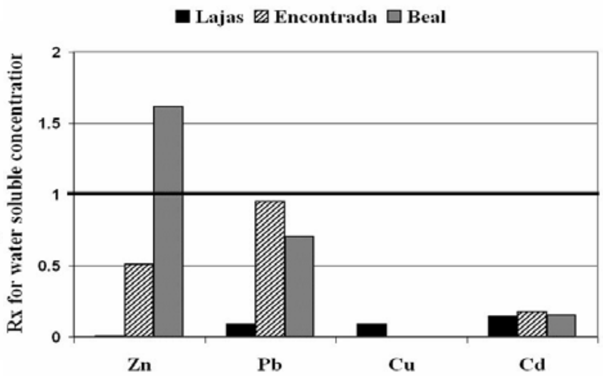
Figure 2. ERI profiles of the studied mailing ponds

Therefore, efforts must be focused on the recovering of these areas to reduce erosion and metal mobility from the tailing layers. The nature of the bedrock does not present any discontinuity that could cause the transport of heavy metals to deeper horizons. The Llano del Beal tailing pond showed the best condition in the soil cover: the ERI method showed no evidence of either any uncovered area on the surface, from runoff or erosion, or any discontinuity in the bedrock creating conditions which could cause the transport of heavy metal to deep aquifers.

Effectiveness of dumped materials in the reduction of environmental risk

The results corresponding to the ratios calculated for total, DTPA-extractable and water soluble metal concentrations are shown in Figures 3. In terms of total content, the dumped material used to cover the Las Lajas pond was the most effective because its total concentration of Zn, Cu and Cd was 28, 22 and 43% lower than those reported in the tailing layers. The material used in La Encontrada was effective in the reduction of Zn and Cd. On the other hand the concentration of Pb and Cu was higher by 160 and 25 % respectively. The dumped material in El Beal has only been effective in the total concentration of Cu. The total concentration of Pb, Zn and Cd was 54, 124, and 44% higher on the dumped material than on subsurface ones. These results suggest that the metals present in the dumped materials come from a source other than the deeper layers of the ponds. Supporting this hypothesis, geophysical analysis has shown that no significant mix has taken place between the dumped material and tailing layers.





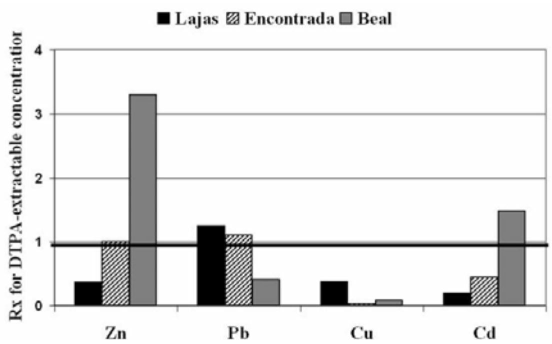


Figure 3. Variation of Total, DTPA extractable and waster soluble metal concentrations in dumped material and tailing layers

The dumped material in Las Lajas presents a DTPA extractable concentration of Zn, Cu and Cd much lower than in the layers of the pond. Therefore, the risk of mobility of these metals through uptake by plants has been significantly reduced. However, concentration and percentage of Pb was slightly higher in the dumped material. In the case of La Encontrada, the contents of DTPA-extractable Pb and Zn in the dumped materials were similar to the other layers of the pond, although the percentage of Pb was lower,. For Cu and Cd, both percentages and concentration were lower, so the risk of mobility of these metals was less. The materials used to cover the El Beal pond had lower percentages and concentrations of DTPA extractable Pb and Cu, however, these were higher for Zn and Cd, increasing the risk of mobility of these metals by plant uptake.

In the dumped materials the concentrations and percentages of water-soluble metals are lower than those reported in the tailing layers for the three ponds, with the exception of Zn in La Encontrada. Therefore, the risk of mobility by leaching or runoff water is very low. The pond with least risk was Las Lajas, where the concentration of all water soluble metals has been reduced by 90%.

Conclusions

High pH, low salinity and balanced texture have likely promoted the natural plant colonization of these tailing ponds. However, total Pb, Cd and Zn concentrations reported in the three ponds exceed the maximum admissible concentrations determined by legislation, and consequently, new remediation actions are needed.

The results have shown that the total Zn, Cd, and Cu concentration in the dumped materials depends on the metal content in the tailings. However, Pb, Zn and Cd in El Beal, Pb and Cu in La

Encontrada, and Pb in Las Lajas were higher in the dumped material than in tailing layers. We believe that the mining activities carried out in the surrounding areas after these reclamation works have contaminated the new surface layers by the transport of metals into suspended particles.
Whilst the total metal concentrations have not been reduced below admissible concentrations in the dumped materials, the DTPA-extractable metal concentrations and their percentages were much lower in dumped material than in tailing layers. Therefore, the risk of mobility of these metals through uptake by plants is very low. Based on our results we recommend that the roots of the vegetation used for reforesting the tailing ponds, where dumped materials exist, are shorter than the thickness of the dumped materials themselves.
Water soluble concentrations and percentages are significantly lower in the dumped materials than tailing layers in most of the metals and ponds, except Zn in El Beal. Therefore, the risk of mobility of metals by leaching or movement in the runoff water is not considered to create an environmental risk.
According to the ERI method, the La Encontrada and Las Lajas tailing ponds displayed areas uncovered by the dumped materials so the tailing material is almost exposed, highlighted by the lack of total vegetation cover. The nature of the bedrock does not present any discontinuity that could cause the transport of heavy metals to deeper horizons. The Llano del Beal tailing pond showed the best condition in the soil cover.
This study has shown that former reclamation works were effective in reducing the erosion of tailing layers and metal mobility; however action is needed to cover those areas now exposed. In addition, action is needed to reduce the bio-availability of some metals by immobilization.

Acknowledgements
This work has been supported by the Project No: CP-IP 213968-2 IRIS, funded by the European Union FP7. J.A. Acosta acknowledges a grant from Fundación Seneca. R. Zornoza acknowledges a “Juan de la Cierva” contract from the Ministry of Science and Innovation.

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Recreational features of mining areas: Study case of Cartagena-La Unión Mining District, SE Spain

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Abstract
A mine is an excavation made in the earth for the purpose of extracting minerals. Such excavations may be surface and underground ones. As a result of mining activities, important changes of topographical structure come up that may provoke serious environmental problems. These topographical changes can be utilized for different uses by realizing various reclamation techniques that may minimize the risks. One of the most important uses is recreational activities. In this study, El Lirio Mining Pond and its surroundings located in Cartagena-La Unión Mining District, SE Spain, which is the most historical mining area in the Europe, was investigated in terms of recreational potential which occurred by the result of physical changes. Varied landscape types of the study area create different recreational activities such as picnic, camping, climbing, nature investigations, mining area excursions, sight-seeing, and sport (running, walking, bicycling, motorcycling, etc.). Land use suggestions related to these activities were made taking into account the minimization of the risks.
Keywords: Mining area, recreational activities, reclamation, topographic structure, land use.

Introduction
Landscape and reclamation planning have to be carried out together with mineral mining planning, in the beginning of mining activities. By this means, the area is explored in terms of multifarious factors, and its compatibility to various land uses is planned from the beginning, so that optimal utilization of resources can be achieved by minimizing environmental problems and the land can be regained with a more economic way without wasting too much time. However, in most developing countries, this kind of task cannot keep pace with mining activities, and it is usually carried out in the post-mining period (Akpinar et al., 1993; Zhang et al., 2011). Advanced planning for mine closure does not only mitigate negative economic impacts, but may also create new land use opportunities to bring positive benefits to the local community (Otchere et al., 2004).
These land use opportunities mainly can be classified in four divisions as agriculture, forest, recreation, settlement-industry (Akpinar et al., 1993; Topay et al., 2007). In some classifications while forest is included in conservation class, recycling and storage classes are seen additionally (USGS, 2000). In this study recreational features of the study area will be handled.
Indeed, for any piece of land can be found an adequate land use and for any land use a piece of land (Akpinar et al., 1993). From this point of view surface mining operations present a tremendous opportunity to create landscape architectural art (Lewis et al., 2000). As planners consider, the most contribution of closed mines is the special legacy they left. Mining areas could be considered a special type of industrial sites in that they encompass not only architectural but also landscape elements related to geology or topography, which can be developed for tourism (Zhang et al., 2011). When the area used for tourism, effectively stimulate economic and social benefits, aiming restoring the economic and recreational potential of a given landscape (Edwards and Llurdes i Coit, 1996; Conesa et al., 2008). Lopez-Jimeno (1986) indicates that besides landfill sites, combustible storages, water reserves, refuges, storages of dangerous merchandises; surface mines can be transformed to touristic places, touristic and educational places, and experimentation centers. Winslow III and Law (2000) also gives examples of recreational activities and among those golf courses, arboretums, museums, stadiums, outdoor theaters, nature trails, camping, motorized trial bike park, bicycle trail park, boating take place.
From different countries of the world it is possible to see various examples of land use transformations in abandoned mining areas and derelict industrial areas.

In The United States a granite quarry in Minnesota was transformed to a zoological garden (Ruelle et al., 2000), while a copper mine in Montana to a golf course (Berger, 2002). An abandoned gravel pit in King Country, Washington was designed as a sculpture. A coal mine in Vintondale, Pennsylvania was transformed to a park which integrates science and art including different recreational activities (Fisher, 2006). In New York, Fresh Kills Parkland (once the world's largest sanitary waste landfill) is one of the most ambitious and innovative public works projects in the world, in terms of environmental reclamation, renewable energy, urban ecology and green technologies, regional recreational amenities, environmental education and arts and culture (Loures and Panagapoulos, 2007). Soil making, successional planting and landform manipulation are indicated as three primary large-scale landscape architectural techniques in Fresh Kills Parkland by Corner (2005).

In Germany, the company of Latz + Partner transformed a former industrial site (Duisburg-Nord) into a park, comprising industrial remnants, vegetative remediation, public space, and recreation. Peter Latz's project at "Landscaftspark Duisburg-Nord" illustrates how experiments can fit into a design aesthetic and how experiments might contribute to urban regeneration, takes advantage of post-industrial land or brownfields, reinterprets the industrial features and natural processes already occurring on the site, without eliminating the memory contained in the landscape which otherwise pose constraints to redevelopment (Tate, 2001; Felson and Pickett, 2005; Loures and Panagapoulos, 2007). The prime location of abandoned industrial areas provides high potential real estate value. Latz explored the science of cleaning contaminated soils by phytoremediation and converting post-industrial sites into parkland. Remediation gardens on contaminated land are off-limits to pedestrians, but are viewable from an elevated walkway (Felson and Pickett, 2005).

In Spain there are several examples of recreational utilization of post-mining areas such as Rio Tinto (metal mine), Almaden (mercury mine), Bellmunt (metal mine), Las Medulas (gold mine), El Entrego (coal mine), Cardona (salt mine). These mines were partly transformed to geo-mining parks and some includes sport and other recreational facilities (Berrezueta et al., 2006).

For Cartagena-La Unión Mining District several authors asserted different ideas about its historic, didactic, archaeologic, and geological values that have to be conserved and kept alive.

In this study, for the increment of recreational attraction, the utilization of artificial topographical structure and varied landscape types to create different recreational activities such as picnic, camping, climbing, nature investigations, mining area excursions, sight-seeing, and sport (running, walking, bicycling, motorcycling, etc.) are discussed.

Materials and Methods

Study area

The study area is located in Cartagena-La Unión Mining District, in Murcia Province, southeast Spain (Figure 1), one of the post-mining areas in Iberian Peninsula, in which intense metal mining activity had been under operation for more than 2500 years. The activities were ended in 1991. The area covers almost 50 km^2, including five population nuclei with around 20.000 total populations. The surroundings of the mining district have a population of more than 200.000 inhabitants, including the city of Cartagena and the rest of its Municipality. In summer the population of the region increases because of the tourism around Mar Menor Lagoon and Mediterranean Sea beaches.

In the north agricultural areas, in the west a petrol refinery, in the south Mediterranean Sea, and in the east and north-east respectively newly emerging resorts, golf areas and Mar Menor Lagoon are located. The altitude of the district is between 0 and 500 m above sea level. The climate is semiarid Mediterranean, long warm summers and short moderate winters with mean annual temperature of 18ºC and mean annual rainfall of 275 mm.

Most of the taxa typically from Mediterranean forest identified by Garcia-Martinez et al. (2008) are: gymnosperms; *Pinus halepensis*, *Pinus pinea*, *Juniperus* sp., *Ephedra* sp., and angiosperms; *Daphne gnidium*, *Thymelaea hirsuta*, *Olea europea*, *Pistacia lentiscus*, *Quercus ilex*, *Rosmarinus officinalis, Artemisia* sp., *Erica* sp., *Prunus* sp., and varieties from the families of Cistaceae, Compositae, Leguminosae. Also some Iberian-African varieties seen in this region due to the arid

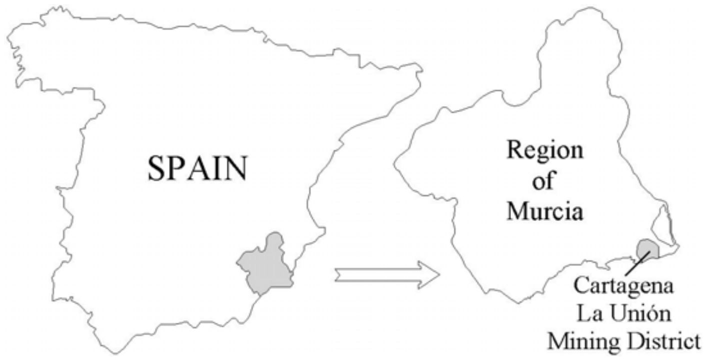

Figure 1. Cartagena-La Unión Mining District.

climate conditions are: *Tetraclinis articulata* which is endemic in this zone and therefore have a high botanic interest, *Periploca angustifolia, Withania frutescens* both are indicative of dry conditions and absence of frost. Also halophyte varieties such as *Tamarix* sp. and *Atriplex halimus* exist in the area.

For a long time the mines constituted the only economic activity for local people. So the socio-economic situation of this community was totally depended on the mining activity throughout the years. Mining-dependence caused a lot of population fluctuations with a decline from 30.000 citizens in 1900 to 13.900 in 1991 when the mining activity ceased. These aspects left a strong mark in the idiosyncrasy and character of La Unión mining town's citizens (Conesa et al., 2008).

The environmental impacts of the long-history of mining activities in southeast Spain include large areas of soils characterized by strong acidification processes, high salinity and accumulation of metals. These mining activities have generated high amounts of sterile materials for many years; the wastes are accumulated in pyramidal structures called tailing ponds. Throughout the area there are approximately 85 tailing ponds which contain materials of high Fe-oxyhydroxides, sulphates, and potentially leachable elevated contents of heavy metals (mainly Cd, Pb, Cu and Zn) due to extreme acidic conditions. As a consequence, these mine soils have scarce or null vegetation due to the poor properties of soil, and most of the natural vegetation formations are degraded due to the atrophic use of the soil. While unvegetated tailings have been exposed to eolian dispersion, on the other hand for a long time, these mine residues have been transported downstream during periods of high rainfall and runoff; as a consequence the pollutants have migrated long distances. The visual pollution comes out as an additional disadvantage of these degradation.

The selected area is the representative of different landscape types seen in the mining district. The proximity to newly emerging resorts increases the recreational potential of the selected area and also brings priority for the resolution of environmental problems.

Procedure

Natural, socio-cultural and economic characteristics of the study area and environmental problems originating from the mining activities were inventoried. Most recreational activities taking place in abandoned mining areas were revealed from the relevant literature and similar projects from the different countries of the world. The area was divided into different landscape types examining its visual characteristics (land form, vegetation pattern, color, scale, appearance and special land uses) by the help of photographs, maps, and in situ observations (Anonymous, 1973; Ellsworth, 2000). In order to find the spatial compatibility percentage of each previously determined recreational activity, they were marked according to the factors (climate, soil, water, scenery, rare geologic and geomorphologic formations, flora, fauna, historical-archeological remains, proximity and accessibility) that affect the feasibility of activities. The compatibility percentage of the activity was useful to make comparison between the spatial suitability of different activities (Sözen, 1981). Land use suggestions related to these activities were made taking into account the minimization of the environmental risks.

Results and Discussion

The recreational activities given place in the area and their ranking according to the spatial compatibility percentage are as follows; mining area excursion, nature investigations, camping, sport (running, walking, bicycling, motorcycling, etc.), climbing, sight-seeing, and picnic. This ranking can be a guide for the administrative authorities to help their landscape planification priorities.

Currently several foundations organize guided excursions in the area, and these excursions attract attention of remarkable amount of local people and tourists. These excursions get start from a mining village, then a path way which was already in the mining area is used and following this way; mining pit, mining buildings-chimneys, engine houses, deep mine shafts and mine tailing ponds are visited passing through the bare soils and forestal area. While the route is interesting, dereliction and negligence of the site totally shade the attraction of the history and mining heritage.

Nature investigations constitute one small part of these mining excursions, but are not realized intentionally.

For several sport activities (running, walking, bicycling, motorcycling, etc.) the area presents a convenient topography. All these mentioned sport activities are realized in the area, but not in suitable conditions.

Even though for camping, sight-seeing, climbing, and picnic activities, suitable places can be found in the area, any of these activities cannot be realized in these conditions.

In order to be able to realize these activities; reclamation of the soil system, recovery of the vegetation cover and stabilization of mine tailing ponds, in required places, have to be assured. These reclamation planning has to be planned parallel to the landscape planning suitable to the new land use of the area.

After the application of necessary reclamation techniques, for the planned activities following suggestions have to be considered.

For the mining excursion, different routes, which include various attractive natural or cultural points, have to be determined and the route paths have to be organized suitable to these excursions.

Natural investigations can include the investigation of autochthonous and endemic vegetation, fauna and geological formations.

Information panels for the mining heritage and history, flora-fauna explanation panels, orientation panels and maps, reclamation explanation panels, presentations of before and after reclamation should be given place.

Camping and picnic facilities can be arranged especially in the forest areas; while for climbing, topographical advantages of mining pits can be used. For sight-seeing especially the points seeing the Mediterranean Sea or Mar Menor Lagoon can be preferred. Running, walking and bicycling routes can be organized together with the routes of excursions for prevent the fragmentation of the area. Existing traffic way in the site after a renovation work also can serve for motorcyclists; a soil covered area special for motorcycling can be organized for this sport activity. Some of the mine tailing ponds after taking necessary precautions can be designed as golf driving ranges for making golf practices and some can be designed as experimental areas to show how a mine tailing pond can be reclaimed by using different reclamation techniques such as phytoremediation.

Before the establishment of these recreational activities; beside reclamation of the soil system, recovery of the vegetation cover and stabilization of mine tailing ponds; also unsafety places such as open mine shafts, mine tailing ponds and ruined buildings have to be reclaimed and restorated.

In developed countries in a territorial scale inventories of natural and cultural elements were done and macro scale land-use decisions for main uses (agriculture, forest, recreation, wild life etc.) were made. These macro scale land-use decisions have to be considered in micro scale land plannings. Integration of micro and macro scale land use decisions is an unchangeable rule of landscape planning discipline. But in most countries the absence of macro scale landscape plannings constitutes a big deficiency in planning and decision making process, so that this deficiency imposes obligation of the compatibility in adjacent surroundings of micro scale landscape planifications, instead of a macro scale compatibility. So, from this point of view at least these recreational land uses have to be connected to each other functionally and economically by taking into account the future developments and needs.

Acknowledgements

This work has been supported by the Project No: CP-IP 213968-2 IRIS, funded by the European Union FP7. J.A. Acosta acknowledges a grant from Fundación Seneca. R. Zornoza acknowledges a "Juan de la Cierva" contract from the Ministry of Science and Innovation.

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Soil chemical and biochemical properties as affected by slope aspect and position in a rangeland ecosystem

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Abstract
There is an urgent need to understand the processes controlling soil fertility in rangeland ecosystems. A study was conducted to investigate the effects of slope aspect and position on soil chemical and biochemical properties. We examined soils on contiguous south- and north-facing slopes of a rangeland in Chelgerd area (west central Iran), influenced by the same climate, vegetation and parent material. In each aspect, soil samples were collected from 0-10 cm depth of three distinct slope positions including summit, backslope and footslope. Soil organic carbon (SOC), EC, pH, calcium carbonate equivalent (CCE), urease (UR), L-asparginase (L-AS) and L-glutaminase (L-GL) activities were analyzed. Results showed that slope aspect and position have significantly effect on soil properties. A higher content of SOC, EC and enzyme activities were observed in north- facing slope. Also SOC, CCE, UR, L- As and L-GL activities were significantly different on slope positions. It can be concluded that, slope aspect and position are key factors controlling soil chemical and biochemical properties, factors responsible for soil fertility.
Keywords: soil chemical properties, enzyme activities, slope aspect, slope position

Introduction

Soil properties vary spatially and are influenced by some environmental factors such as landscape features, including topography, slope aspect and position, elevation, climate, parent material and vegetation (Tsui et al., 2004; Sidari et al., 2008; Zhang et al., 2011). Topography is the main factor influences local microclimate, runoff, evaporation and transpiration. These factors in turn influence soil chemical and biological properties (Tsui et al., 2004; Khalili-Rad et al. 2011). Related to topographic position, Khalili- Rad et al. (2011) investigated the effect of slope position on some soil biochemical and microbiological properties in a semi-arid eroded toposequence and found that the greatest values of organic C, total N, inorganic N, potentially mineralizable N, microbial biomass N, soil basal respiration and L-glutaminase activity in the toeslope. Bergstrom et al. (1998) observed that soil enzyme activities distributed differently along a landscape and showed that activities of soil enzyme increased in the lower positions. Ulrich and Wirth (1999) also found that the total number of soil bacteria decreased downslope while a population density of cellulolytic bacteria ignored topography. Tsui et al. (2004) examine spatial differences of soil properties in a lowland rain forest of southern Taiwan to clarify the relationships between soil properties and the landscape. The study showed that organic carbon, available N, available K, extractable Fe and exchangeable Na were highest on the upper slope, while pH, available P, exchangeable Ca and Mg were significantly higher in the downslope.

In addition to slope position, topographic aspect is also as a significant factor in generating differences in ecosystem characteristics (Sidari et al., 2008). North-facing slopes generally have less sunlight and in turn have higher moisture levels and greater productivity and species diversity resulting in more organic matter and also biological activities (Begum et al., 2010; Sigua et al., 2011). However, contrasting results have been observed (Sidari *et al*. 2008).

In the current study, we measured some soil chemical and biochemical properties in three slope positions (Summit, Backslope and Footslope) within two slope aspects (north and south-facing slope) in a rangeland ecosystem. We hypothesized that the variability in soil chemical and biochemical properties in different slope positions is influenced by slope aspect. Little information is available about the variation of soil properties in relation to both slope aspect and position in a rangeland ecosystem in semi-arid region. Understanding the effects of these factors on soil properties is vital for modelling soil–landscape relationship and establishing sustainable management practices. Therefore, the objective of this study was to investigate the effect of slope aspect and position on soil chemical and biochemical properties in a rangeland ecosystem.

Materials and methods

Site and sampling

The study site was located in chelgerd area, west central Iran (50º 13′E, 32º 33′N). The mean annual precipitation and temperature are 1500 mm and 9.8º C. The land use of area is rangeland and dominant vegetations at the location are *Daphne mucronata, Gypsophila sp., Astragalus sp. and Ciricium bracteusum.* Two contiguous north and south-facing slope were selected and soil samples were collected from 0-10 cm depth of three distinct slope positions including summit, backslope and footslope. Soil samples passed through a 2 mm sieve and kept at 4°C before biochemical analysis. A sub-sample was air-dried for determination of chemical properties.

Soil analysis

Soil pH and EC was measured in distilled water using a 1:2 (soil: water) suspension. The soil organic carbon (SOC) was measured by wet digestion analysis. Calcium carbonate equivalent (CCE) was measured by back titration (Burt 2004). Urease (UR), L-asparginase (L-AS) and L-glutaminase (L-GL) activities was assayed by a toluene and buffer based technique (Tabatabai, 1994).

Statistical analysis

A two way ANOVA (analyses of variance) was applied for analyzing the effects of slope aspect and position on soil properties and treatment means were compared using LSD's test (SAS Institute, 1990).

Results

Slope aspect effect on soil chemical and biochemical properties

Soil properties showed significant variation ($p<0.05$) with respect to topographic aspect except CCE (Table 1). All of soil parameters were typically highest on northern slope than that of southern one. In the north-facing slope, SOC, UR, L-AS, L-GL activities were 2.48, 1.99, 2.55 and 2.92 times greater than that of south-facing one, while pH and EC varied moderately between two aspects (Table 2).

Slope position effect on soil chemical and biochemical properties

Slope position had significantly effect on soil properties ($p<0.05$) except EC and pH (Table 1). A general decreasing trend was observed in SOC and CCE from summit to footslope. Mean SOC value at summit was 16.8 and 22% greater than that of backslope and footslope respectively (Table 2). The lowest values of enzyme activities were observed in backslope position. The distribution pattern of enzyme activities along the slope was not similar to that of SOC (Table 2).

Table 1 Statistical results (F-values) of two-way ANOVAs for soil chemical and biochemical properties

Source of variation	SOC	pH	EC	CCE	UA	L-AS	L-GL
Aspect (A)	362.92***	41.14***	6.00*	1.84 ns	181.10***	141.33***	185.91***
Position (P)	11.34***	1.83 ns	0.17 ns	9.07***	18.34***	78.78***	29.14***
A×P	0.09 ns	1.98ns	3.50 ns	4.98*	9.81***	16.41***	30.57***

Soc: soil organic carbon; EC: electrical conductivity; CCE: Calcium carbonate equivalent; UR: Urease activity; L-AS: L-asparginase activity; L-GL: L-glutaminase activity

* P<0.05, *** P<0.001, ns: No significant difference

Table 2. The main effect of slope aspect and position on soil chemical and biochemical properties

Slope parameters		SOC	pH	EC	CCE	UA	L-AS	L-GL
		$g\ kg^{-1}$		$ds\ m^{-1}$	$g\ kg^{-1}$	$mg\ NH_4^+$ -N $kg^{-1}h^{-1}$		
Aspect	North	22.1a	8.27a	0.28a	65.0a	51.90a	9.43a	22.74a
	South	8.9b	8.21b	0.20b	60.0a	26.08b	3.69b	7.79b
Position	Summit	17.8a	8.2a	0.25a	65.8a	45.98a	9.6a	17.01a
	Backslope	14.8b	8.2a	0.25a	70.0a	31.74c	2.45c	9.50b
	Footslope	13.9b	8.2a	0.25a	51.7b	39.29b	7.45b	19.30a

SOC: Soil organic carbon; EC: Electrical conductivity; CCE: Calcium carbonate equivalent; UR: Urease activity; L-AS: L-asparginase activity; L-GL: L-glutaminase activity. Values followed by different letters in columns between aspects and positions separately are significantly different (LSD, $P < 0.05$).

Interaction effect of slope aspect and position on soil properties

Two-way ANOVA was employed to examine the interactive effect of topographic attributes on soil properties (Table 1). The effect of slope aspect and position was clearly interacted ($P<0.05$) on CCE, UR, L-AS, L-GL activities (Table 1). In north-facing slope, a decreasing trend in CCE was observed from summit to footslope (Fig 1.a). There was only significant difference between summit and footslope in CCE content in this aspect. In southern slope, the distribution pattern of CCE along the slope was not similar to northern one and the greatest value of CCE was observed in the backslope position (Fig 1.a).

Distribution pattern of UR activity along the slope was different between two aspects (Fig 1.b). In the northern slope, the lowest activity of UR was observed in backslope, while no significant difference was observed between summit and footslope. In the southern slope, the distribution pattern of UR was different in comparison to northern slope. Summit showed the greatest value of UR, however there was no significant difference between backslope and footslope. It should be noted that in south- facing slope, UR activity declined from upslope to downslope more rapidly than that of the north-facing one (Fig 1.b).

L-AS activity showed similar distribution pattern along the slope in two aspects (Fig 1.c). In north- and south-facing slope, lowest activity of L-AS was observed in backslope position. There was no significant difference in L-AS activity between summit and footslope in northern slope but that difference was significant in southern one. In consistent with UR activity, L-AS activities along the slope positions in southern slope varied more rapidly than that the northern one (Fig 1.c).

L-GL activity showed different trend along the slope position when compared two north- and south-facing slopes. In northern slope, the greatest and lowest activity of L-GL was observed in the footslope and backslope position respectively. In southern slope, L-GL activity decreased from summit to footslope but those differences were not significant (Fig 1.d).

Discussion

Slope aspect effect on soil chemical and biochemical properties

Results of our study showed that slope aspect could be an important factor involving variability of soil parameters. The greatest values of SOC and enzyme activities were observed in northern slope (Table 2). Slope aspect may be acting as an important topographic factor influencing local site microclimate mainly because it determines the amount of solar radiation received. The low content of SOC on south-facing slope could be considered as a result of higher soil temperature and consequently more rapid soil moisture evaporation, less plant growth and greater mineralization of soil organic matter (Begum et al., 2010; Sigua et al., 2011). Our result is agreement with previous researches (Begum et al., 2010; Sigua et al., 2011), however contrasting result have been obtained (Sidari et al., 2008). Sidari et al. (2008) showed a lower content of organic matter and microbial activity on the north-facing slope. In this study, soils on the north-facing slope had lower moisture and high temperature with lower productivity.

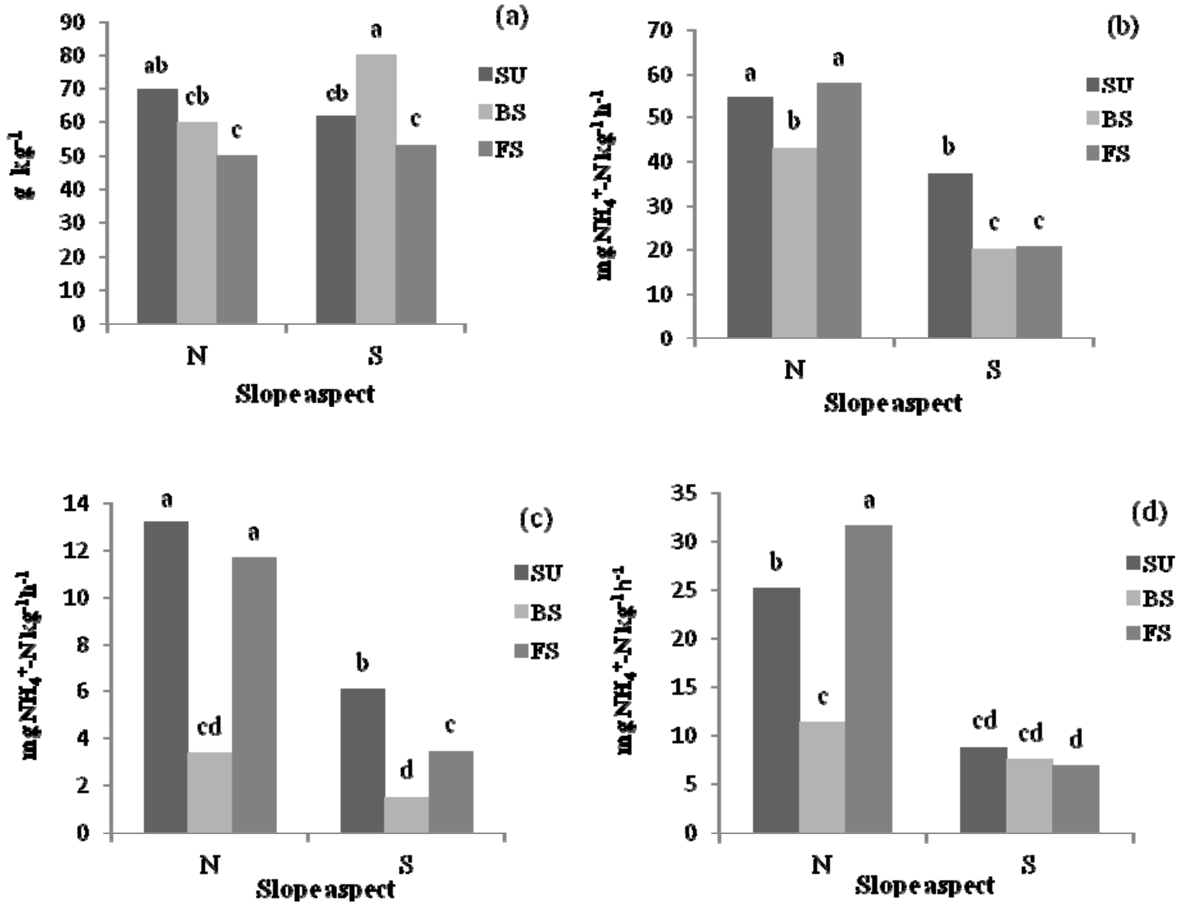

Fig 1. The interaction effect of slope aspect and position on (a) calcium carbonate equivalent (CCE), (b) urease activity (UR), (c) L-asparginase activity (L-AS) and (d) L-glutaminase activity (L-GL). N: north, S: south, SU: summit, BS: backslope, FS: footslope. Means with the same letter are not significantly different from each other.

Slope position effect on soil chemical and biochemical properties

Our result demonstrated that soil properties are not uniformly distributed along the slope. The greatest value of SOC was observed in the upper position than the other ones (Table 2). Our results are consistent with other finding (Tsui et al., 2004; Griffiths et al, 2009), which showed that SOC increase with increasing elevation. Reduced temperature and increased moisture are probably factors responsible for reduced decomposition rates and thus the accumulation of SOC at the higher elevation.

EC and pH were not significantly influenced by slope position in our study (Table 2), however, other studies showed that slope position affect on EC and pH. Previous researchers observed increasing trend in EC and pH from upper to lower position along the slope (Rezai and Gilkes, 2005). The trend of decreasing in soil EC and pH from lower to upper position in hilly area could be due to decreasing of basic cations in the higher elevations that received greater precipitation.

The decrease in CCE was observed in footslope (Table 2). In lower slope position, the groundwater probably saturates the soil profile, so calcium carbonate dissolved and leached from upper layers to deeper ones.

Soil enzyme activities influenced by different slope positions. The greatest values of soil enzyme activities were observed in the summit position and this is inconsistent with SOC value (Table 2). Greater content of SOC in the upper position has probably provided greater source of carbon and energy for microbial biomass and consequently has resulted in greater enzyme activities (Kallili-Rad et al., 2011). The lowest enzyme activities were observed in the backslope, while there was no significant difference in SOC value between backslope and footslope. It was demonstrated that other reasons may affect on enzyme activities along the slope position. Such variations can be attributed to differences in quality of the present substrate between slope positions (Sariyildiz et al., 2005). These results demonstrate that biological properties are more sensitive to environmental conditions than that of soil chemical properties.

Interaction effect of slope aspect and position on soil properties

Our results support our hypothesis that slope aspect and position are jointly influenced soil properties and their effects were mostly interacted.

CCE distributed differently along the slope on two slope aspect. The greater value of CCE was observed in the backslope on the southern slope (Fig 1.a). Surface soil in the middle of slope has suffered serious erosion due to slope steepness and length (Zhang et al., 2011). In south-facing slopes with low vegetation, erosion processes may have more effect on soil and in many cases parent material has been exposed in the middle of the slopes. Since the parent material in study area is calcareous, with erosion processes, top soils of backslope position on southern slope may has been eroded down and showed greater CCE value in this position.

In our study, the significant interaction between slope aspect and position was observed on enzyme activities whereas on SOC was not. Our results demonstrate that soil enzyme can be used as a sensitive indicator to environmental conditions. Previous researches showed that enzyme activities respond more rapidly to perturbation and management practices than that of SOC (Bandick and Dick, 1999).

It can be concluded that landscape attributes (slope aspect and position) affect soil chemical and biochemical properties. Our results also showed that soil enzyme activities distributed differently along the slope and the distribution pattern of the enzymes are different between two slope aspects. Therefore, landscape attributes such as slope aspect and position should also be considered simultaneously as key factors to conservation strategies and sustainable managements.

Acknowledgment

The authors thank the Soil Science Center of Excellences, Isfahan University of Technology, for funding the project.

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The kinetics of β-glucosidase as affected by Pb and management practices

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Abstract

Several studies have been carried out on the effects of Pb on soil enzyme activities. However, little information is available concerning the effect of Pb on enzyme kinetic in natural soils. Moreover, the effect of management practices on the response of soil enzymes to Pb is not well understood. The main objective of this work was to investigate the effects of Pb on kinetic properties of soil β-glucosidases (βG) in soils under different management practices. Soils were sampled from two sites in Central Iran. At Lordegan forest site (LOR), soil under an oak forest was compared with its adjacent deforested counterpart. At Fozveh Research Station site (FRS), adjacent fields cropped to alfalfa and tall fescue was compared. Pb was applied as Pb-acetate at 25 μmol g^{-1} soil. Kinetic parameters of βG were measured in the absence and presence of Pb. At LOR site, deforestation resulted in significant decreases in V_{max} and K_m of βG. At FRS site, the soil which was cropped to alfalfa showed significantly greater value of V_{max} and lower value of K_m than that of tall fescue. The addition of Pb as Pb-acetate significantly decreased both V_{max} and K_m of the enzyme. In conclusion, management practices influenced the degree of reduction in V_{max} and K_m values when the soils exposed to Pb indicating that management practices may interact with the rate at which Pb can influence kinetic parameters. Uncompetitive inhibition was observed by Pb in the both sites and paired management practices.

Keywords: β-glucosidases; enzyme kinetic; lead; soil management, uncompetitive inhibition

Introduction

The continuous application of large amounts of fertilizers and other soil amendments to agricultural lands has raised concern regarding the possible accumulation of toxic levels of their trace element constituents and potential harm to the environment (Raven and Loeppert 1997). Lead is omnipresent in various environmental matrices including air, water, soil and plants. Lead originates from various sources, like mining and smelting of lead-ores, burning of coal effluents from storage battery industries, automobile exhausts, metal plating and finishing operations, fertilizers, pesticides and from additives in pigments and gasoline (Gopal and Rizvi 2008). Lead affects the growth, morphology, and metabolism of microorganisms through functional disturbance, destruction of the integrity of cell membranes or can produce changes in enzymatic activities, possibly leading to a decrease in the rates of the biochemical processes in the soil environment (Effron et al. 2004). Several studies have been carried out on the effects of Pb on soil enzyme activities. Eivazi and Tabatabai (1990) found that the inhibition rates of β-glucosidase by Pb were much lower (3-29%) than these obtained for α-glucosidase activity (33-41%). Effron et al. (2004) also reported a decrease in arylsuphatase, acid phosphatase, protease, and urease activities by Pb but little or no effect was detected on the β-glucosidase activity.

Previous researches has shown that β-glucosidase can detect soil management effects and has potential as a soil quality indicator, but mechanisms for this response are not well understood (Knight and Dick 2004). In the present study, we measured kinetic parameters of β-glucosidase in the absence and presence of Pb in two different sites under different land use (forest and agricultural). Two management practices were observed for each land use type in two adjacent fields. We hypothesized that management history may influence the nature and status of β-glucosidase in soil and this issue may interact with the potential effects of Pb on kinetic parameters of β-glucosidase.

Most studies regarding the effects of heavy metals on soil enzyme activities have two major approaches: first, the overall activity of the soil enzymes has been assayed in the natural and heavy metal applied soil and an inhibition percent calculated (Eivazi and Tabatabai 1990). Second, an ecological dose (a dose corresponds to a specific decline in the enzyme activity) has been calculated in soils which received increasing concentration of a heavy metal (Renella et al. 2003). The effect of heavy metals on kinetic parameters of soil enzyme has received less attention. Therefore, the objectives of this study were to investigate i) the effect of Pb on kinetic parameters of β-glucosidase in soils received different management practices and ii) the type of inhibition of β-glucosidase by Pb.

Materials and Methods

Sites and sampling

This study was conducted in two sites: i) Lordegan forest (LOR), West Central Iran (31º 19′ N, 51º 10′ E). Two adjacent forest and deforested counterparts of a Calcic Haploxeralf soil were selected. The mean annual temperature and precipitation are 15.2 ºC and 509.6 mm, respectively. The region is naturally covered by oak forests (*Quercus brantii* Lindl.) and has been partially deforested during the last 30 years. The deforested counterpart is currently under cultivation as irrigated conventional vegetables. ii) Fozveh Research Station (FRS), Isfahan, Central Iran (32º 36′ N, 51º 26′ E), an agroecosystem, two adjacent cropping management of a Typic Haplargid soil were selected. The adjacent fields have been cropped to alfalfa (*Medicago sativa* L.) and tall fescue (*Festuca arundinacea* Schreb.) under irrigated condition for last 10 years. The mean annual temperature and precipitation are 14.5ºC and 140 mm, respectively. Fall and winter precipitation comprise about 75% of annual precipitation at both LOR and FRS sites. At each site, and within each counterpart (treatment), 10 soil cores of 0-15 cm depth were taken within 2 m radius and mixed. The soil samples were air-dried at room temperature and then through a 2 mm sieve and stored in glass containers at 4 °C until analysis.

Soil analysis

Soil particle size distribution was measured by the hydrometer method, Soil pH was measured in saturation paste, electrical conductivity (ECe) was determined in the saturation extract of the soils, soil organic carbon (SOC) was measured by wet digestion analysis (Burt, 2004).

Enzyme kinetics

To determine the effects of Pb on kinetic parameters of βG, 1 g of soil in a 50 ml volumetric flask was treated either with 1 ml of solution containing 25 µmol of Pb or with 1 ml of distilled water as control soil (Eivazi and Tabatabai 1990). The solution was added dropwise to moisten the entire soil sample. Pb used was reagent grade chemical and was added as $Pb(CH_3COO)_2$. After 30 min of equilibration, βG activity was assayed at different substrate concentrations both in Pb-treated and control soils. The substrate concentrations were 2.5, 5, 10, 15 and 25 mM (Knight and Dick 2004). Lineweaver-Burk linear transformation (plotting 1/V against 1/S) of Michaelis-Menten equation was used to calculate K_m and V_{max}. All results reported are averages of triplicate determinations calculated on an oven-dry basis and moisture was determined after drying the soils at 105°C for 24 h.

Statistical analysis

Data was checked for normality and then analyzed by using the ANOVA procedure of SAS (SAS Institute, 1990). The ANOVA procedure and mean separation (LSD, $P<0.05$) were run for the LOR and FRS sites, separately.

Results and discussion

The pH of the forest and the deforested area varied within a narrow range of 7.5 -7.7. Likewise, ECe ranged narrowly between 0.83 to 1.04 dS m^{-1}. In FRS site, Soil pH was lower in alfalfa counterpart than that of tall fescue while greater values of ECe were observed in alfalfa. Soil texture has not been changed by changing management practices at both sites (Table 1). The lack of significant difference in soil particle size distribution can be attributed to the small-scale variability of the parent material (Dinesh et al., 2003). This confirms visual observations and soil surveys of the sites that the paired sampling counterparts were on the same soil type and hence, provides justification that we can attribute significant effects to management and not due to inherent or soil type differences (Knight and Dick, 2004).

Marked differences in SOC content occurred between paired management practices at both sites (Table 1). The loss of organic matter following deforestation (LOR site) as a typical consequence of soil cultivation in the region has been previously reported (Nourbakhsh 2007). This is possibly resulted from reduced inputs of organic residues and increased rate of decomposition induced by plowing and the consequent increased aeration (Haynes and Tregurtha, 1999; Ogle et al., 2005). At FRS site, SOC content of the alfalfa counterpart were greater than that of tall fescue. More plant detritus was observed on the surface of alfalfa field (data not shown). This implies that larger amounts of the plant biomass have been incorporated to the soil in the alfalfa cultivation and this consequently has lead to greater content of SOC.

Table 1. Soil physical and chemical properties at two sites (LOR: Lordegan forest; FRS: Fozveh Research Station

Site	Management	Texture	pH	EC_e (dS m^{-1})	SOC (g kg^{-1})
LOR	Forest	Clay	7.5 (0.07)*	0.83 (0.06)	44.3 (0.00)
	Deforested	Clay	7.7 (0.05)	1.04 (0.00)	16.2 (2.12)
FRS	Alfalfa	Clay	8.0 (0.02)	1.86 (0.08)	16.5 (0.99)
	Tall fescue	Clay	8.4 (0.00)	0.99 (0.00)	11.7 (1.13)

EC_e (electrical conductivity), SOC (soil organic matter), * Values in parenthesis are standard deviation

Influence of management practices on βG kinetics

At LOR site, Deforestation caused significant decrease in V_{max} which is consistent with decreased SOC. Similarly, greater amounts of V_{max} at alfalfa compared to the tall fescue counterpart of the FRS site, was coupled with greater SOC contents (Tables 1 and 2). The reduction in SOC, which is an index of organic matter, helps to explain the reduction in V_{max} values of βG activity, as organic substances provides sites for the stabilization and protection of extracellular enzymes in soils (Farrell et al. 1994; Knight and Dick; 2004). The current results are in agreement with the previous findings (Farrell et al; 1994), which showed that V_{max} values of arylsulfatase were positively correlated with soil organic C. They suggested that the soil organic C is the parameter describe the energy status of the soil and therefore can represent the content of the enzyme in soil. A reduction in V_{max} values of βG in response to soil management was also reported by Knight and Dick (2004). The reduced V_{max} values of βG in the managed soils compared to unmanaged soils were attributed to the reduction of the activity of enzymes in the stabilized fraction than that associated with viable microbial population (Knight and Dick 2004).

Table 2. Kinetic parameters (determined by the Lineweaver-Burk equation) of β- glucosidase (βG) in the absence and presence of lead at two sites (LOR: Lordegan forest; FRS: Fozveh Research Station**)**

		V_{max}		K_m	
Site	management	- Pb	+Pb	-Pb	+Pb
LOR	Forest	1000.0(0.09)a	909.1(0.09)b	4.80(0.15)a	4.27(0.80)b
	Deforested	769.2(0.09)c	714.3(0.09)d	3.76(0.11)c	3.21(0.18)d
FRS	Alfalfa	288.8(7.44)a	265.5(2.37)b	3.18(0.08)b	2.17(0.13)c
	Tall fescuce	85.8(2.69)c	49.1(1.07)d	8.66(0.47)a	3.05(0.24)bc

V_{max} and K_m are reported as mg pNP kg^{-1} soil h^{-1} and mM respectively.Values in parenthesis are standard deviation (n=3).Values followed by different letters within each site indicate significant difference (LSD, $P<0.05$)

At LOR site, a significant decrease in K_m value was observed in deforested soil compared to the forest counterpart. At FRS site the K_m value of alfalfa cultivated soil was significantly lower than that of tall fescue counterpart (Table 2). The non-uniformity of K_m values, between the two paired management practices within each site suggests that the management practices not only influenced the total enzyme in soil but also the nature and status of the enzyme is also affected. Enzyme K_m

values are used as measures of affinity of enzymes for their substrates (the lower the value, the higher the affinity). Deforestation (at LOR site) and cultivation (at FRS site) influenced enzyme-substrate affinity. Differences in K_m values of an enzyme due to changes in management practices can be described by different isoenzymes that are presumably originated from various sources (Knight and Dick 2004). Many isoenzymes, produced by a large diversity of microorganisms, exist in the soil (Farrell et al. 1994; Tabatabai et al. 2002); they catalyze the same reaction with different kinetics.

It had been shown that enzyme immobilization had a substantial effect on the Michaelis constant, distortion of the configuration or obstruction of the access to the enzyme's catalytic site being the main reasons (Marx et al. 2005). Several studies have been investigated the behavior of immobilized enzymes in presence of soil or other solid phases. Farrell et al. (1994) suggested that the stabilization of arylsulfatase on solid phases would decrease substrate affinity (i.e. increase K_m). Acid phosphatase followed this trend in a study by Rao et al. (1996), showing an increase in acid phosphatase K_m after immobilization on artificial mineral, organic, or organo-mineral complexes. However, Gianfreda and Bollag (1994) reported that K_m values of immobilized laccase and peroxidase remained virtually unchanged.

Since the natural forest soil (at LOR site) contains larger amounts of organic matter compared to the deforested counterpart (Table 1), it can be presumed that the βG in this soil is mainly occurred in complexes with humic colloids (Nannipieri et al; 1996). These changes in substrate affinity most likely reflect the effects of incorporation of surface litter into the soil. At FRS site, we observed lower K_m value in soil under alfalfa cultivation which had higher organic matter than tall fescue counterpart (Table 1 and 2). This would suggest that management practices have differently affected the immobilized enzyme fraction. Differences in type or quality of organic matter in addition to quantitative changes in soil organic matter could be expected to result from different management and cultivation practices (Farrell et al; 1994). This may have affected the degree of stabilization of enzyme in soil matrix and consequently K_m values of the enzyme.

Influence of Pb on βG kinetics

We observed that the V_{max} and K_m values of βG consistently decreased after exposing to Pb (Table 2). At LOR site, Pb decreased the V_{max} values of βG in the natural forest and the deforested counterpart by 9.1 and 7.1%, respectively. Similarly, Pb reduced the V_{max} values in FRS site regardless of the crop type. The V_{max} values were decreased by 8.1 and 42.8% in alfalfa- and tall fescue-cultivated soils, respectively (Table 2).

The K_m values of soil βG were generally decreased at both sites when treated with Pb. At LOR site, the K_m values were decreased in the natural forest and the deforested counterpart by 11.0 and 14.6%, respectively. At FRS site, the K_m values in alfalfa- and tall fescue-cultivated soils decreased by 31.8 and 64.8%, respectively (Table 2).

In all soils studied uncompetitive inhibition were observed. Indeed, an uncompetitive inhibitor is defined kinetically as one which decreases K_m and V_{max} (Dixon and Webb 1979). Our results indicated that Pb can only combine with the enzyme-substrate complex and not with the free enzyme. Actually, the binding of Pb decrease the amount of enzyme which is in the form that can break down to products (enzyme-substrate complex) and hence decrease V_{max}. This will also decrease the rate of breakdown of the enzyme-substrate complex to free enzyme and substrate and hence the K_m will also be decreased (Dixon and Webb 1979). The results obtained in this study are consistent with findings of Siddiqui et al. (1997), which showed that only at higher substrate (carboxymethyl cellulose) concentrations, Mn inhibited carboxymethylecellulase (partially uncompetitive). However, in attempt to investigate the response of soil enzymes kinetic to heavy metals, contradictory results have also been achieved. The information available about inhibition of other enzymes by metal ions indicates that the inhibition usually is noncompetitive in nature. Metal ions are assumed to inactivate enzymes by reacting with sulfhydryl group, a reaction analogous to the formation of a metal sulfide. Sulfhydryl groups in enzymes may serve as integral parts of the catalytic active sites or as groups involved in maintaining the correct structural relationship of the enzyme protein (Frankenberger and Tabatabai 1981). Frankenberger and Tabatabai (1981) reported that Ag (I), Hg (II) and Se (VI) decreased V_{max} of amidase without altering the apparent K_m value but As (III) altered only K_m value and not the V_{max}. They suggested that As (III) is a competitive inhibitor of amidase, whereas other three elements are noncompetitive inhibitors. Data from experiments with soil catalase (Perez-Mateos and Gonzales-Carcedo, 1987) showed inconsistent results about the effect of heavy metals on enzyme kinetics. Thus, increased, decreased or no change in K_m and V_{max} values were obtained for soil catalase in the presence of Cd, Ag, and Pb, respectively. Metal ions may inhibit enzyme reactions by (1) complexing the substrate, (2) combining with the protein-active groups of the enzymes, or (3) reacting with the enzyme-substrate complex (Effron et al. 2004). This issue can affect the inhibition mode of the enzyme by inhibitors. Also, the effect of metal ions on enzyme kinetic is dependent on the type of metal, substrate and enzyme (Frankenberger and Tabatabai 1981).

In this study management practices has not affected the mode of βG inhibition by Pb (uncompetitive inhibition) however, the degree of reduction in V_{max} and K_m values by Pb are affected as affected by management practices.

Overall, our results indicate that management practices either in the forest or in the agricultural ecosystems would influence the maximum velocity of βG and also the substrate affinity in soil. The addition of Pb as Pb-acetate significantly decreased both V_{max} and K_m of the enzyme. Management practices influenced the degree of reduction in V_{max} and K_m values when the soils exposed to Pb, indicating that management practices may interact with the rate at which Pb can influence kinetic parameters. Uncompetitive inhibition was observed by Pb in both sites and paired management practices. Further research is required for better understanding of the underlying mechanisms controlling enzyme behaviors as affected by management and heavy metals.

Acknowledgement

The authors appreciate Soil Science Center of Excellences, Isfahan University of Technology for funding the project.

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Evaluation and comparison of soil nutrient status under the canopy of five populus clones

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Abstract
Development in plantation of fast growing species, especially poplars have occurred in the plain of Guilan province North of Iran, in recent years. Different clones of poplar have been planted by the villagers and big companies at various levels in these areas. Poplars require specific conditions of soils and on the other hand;clones of poplar can have different effects on soil properties. This study was carried out to study the influence of poplar clones on availability of some soil nutrients in Safrabasteh Poplar Research Station (Astaneh, Guilan Province). Experimental design was a completely randomized block with three replications and five treatments as:1. *Populus euramericanatriplo* 2.*Populus deltoids*69/55 3.*Populus deltoides*63/51 4.*Populus euramericana*45/51 and 5.*Populus caspica*as native poplar specie. The soil samples were randomly taken from 0-20 cm depth of soils in each clone and OC (organic carbon), N (total Nitrogen), P (absorbable phosphorus) and K (potassium)in soil were determined. Analyze of variance showed that differences among the clones are significant at 5% level. Means comparison showed that *Populus deltoides* 63/51 had greater positive effects on the soil parameters and then soil quality.

Keywords: Populus, soil, nutrients, availability

Introduction

The majority of northern Iran is covered by the Caspian forest, a deciduous temperate commercial forest, of about 1.8 million hectares located on the northern slopes of the Alborz Mountains overlooking the Caspian Sea (Hosseini 2006). Between mountain region and Caspian Sea, there are plain areas that during last decades have been involved in agriculture, reforestation or deforestation activities. Guilan province, as one of the provinces located in north of Iran, has vast plain areas covered by natural forests, crops and poplar plantations.

Poplars *(Populus L. spp.)* are preferred plantation species, because their fast growth is expected to meet the extensive demands of wood for poles, pulp and fuel (Kiadaliri 2003, Ghasemi 2000, Ziabari 1993). Productivity of plantation depends strongly on soil nutrient supply and it may be malleable under the influence of management practices and species (Binkley 1997). Repeated harvesting of fast growing trees such as poplar plantation on short rotation may deplete site nutrient. Soil nutrient such as N. P, K and OC losses are likely to be very important for future growth because adequate supply of nitrogen, stimulate growth and root development and also can be absorb other nutrients. The presence of nitrogen after phosphorus as the most important nutrient needed for growth plants and strength of timber against frost and disease is essential. Potassium, like nitrogen and phosphorus is necessary for plant life: it is necessary to produce dry matter and is involved in photosynthesis. Dickmann and Stuart (1983) declared that poplars could grow almost everywhere, but perform up to their full potential only on the best sites. Poplar as a species of calendar, are developed in gap area and the best of it's habitat is on the alluvial areas with good drainage, adequate moisture, with at least moderate fertility with a solution of the nitrates and phosphates with certain cations of potassium and calcium. Singh and Sharman (2007), and Augusto et al. (2002) stated tree plantations influence soil chemical properties negatively or positively through the litter fall, accretion and decomposition of organic matter. It seems that different poplar plantations with various quality and quantity have been able to change some soil properties in recent years in Guilan plain. Trees in forest ecosystems create fertilize soil through the biogeochemical process under its canopy. Successful growth of trees requires appropriate soil and adequate amounts of nutrient. On the base of above mentioned matters, it seems that there are complex relationships between soil properties and poplar plantations. This study was carried out to study the influence of poplar clones on availability of some soil nutrients in Safrabasteh Poplar Research Station (Astaneh, Guilan Province).

Materials and Methods

2.1 Site characteristics

The study was carried out in research station populous of Safrabasteh Guilan province / north of Iran near the Sepidrud River at an altitude of 15 m.The climate is strictly maritime,with an average temperature of 17.5 ˚C and an average precipitation of 1186 mm year^{-1}.57˚49′eastlongitude,19 37′ northlatitude.

2.2 Experimental design

The experimental design was a completely randomized block with three replications and five treatments as: 1.*Populus euramericana triplo* 2.*Populus deltoids* 69/55 3.*Populus deltoides* 63/51 4.*Populus euramericana* 45/51, and 5.*Populus caspica* as native poplar specie. The soil samples were randomly taken from 0-20 cm depth of soils in each clone.In this way, thirty soil samples were taken from 0-20 cm depth stands and transferred to soil laboratory for analyzing.All of soil samples were air-dried and passed through a 2mm mesh.In the lab total nitrogen by Kjeldhal method (Bremner, 1996), organic carbon (OC %) by Walkley and Black method (Walkley& Black, 1934) were analyzed. Available P (Olsen) was analyzed according to the standard methods (Olsen et al. 1954). Exchangeable K was analyzed after extraction using 1 M ammonium acetate at pH 7.0 by flame photometry (Black*et al.*165).

2.3 Statistical Analyses

Two-way analyses of variance (ANOVA) were used to compare soil chemical properties. Tukey-HSD test were used to separate the means of dependent variables which were significantly affected by treatment. For statistical analysis, SPSS (version 17.0) and SAS were used.

Results

Results showed that OC, N and P differ significantly among the treatments.

Table1. Mean ± (S.E) of soil properties in depth of 0-20 cm between the different poplar clones

Sig	***P.e.45.51***	***P.e.triplo***	***P.d.63.51***	***P.d.69.55***	***P.caspica***	Chemical soil properties
0.00	1.7±(0.27)b	1.78±(0.13)b	2.85±(0.31)a	2.41±(0.2)ab	1.61±(0.14)b	OC (%)
0.01	1.59±(0.16)ab	2.07±(0.34)ab	3.03±(0.450a	2.6±(0.59)ab	1.17±(0.270b	P (ppm)
0.14	1.90±(20.66)a	1.7±(15.16)a	2.5±(26.26)a	2.27±(32.59)a	1.7±(5.73)a	(ppm) K
0.00	0.14±(0.02)b	0.15±(0.01)b	0.24±(0.02)a	0.21±(0.01)ab	0.13±(0.01)b	N (%)

The results of Tukey at 5% level, indicating that the amount of organic carbon with mean of 2.85% in *Populus deltoides* 63/51 is higher compared to the other clones. *Populus euramericana* 45/51, *Populus euramericana triplo* and *P.caspica* clones didn't show any differences for OC. Nitrogen as an essential element in the growth with mean of 0.24% in soil of *Populus deltoides* 63/51 that has better condition than the other clone. In this study, the most amount of P in the soil of *Populus deltoides* 63/51 and the least amount was clone cultivation soil *Populus caspica*. The amount of N, P and OC varied between clones and it can be considered as one of the factors that influence the differentiation of clones.

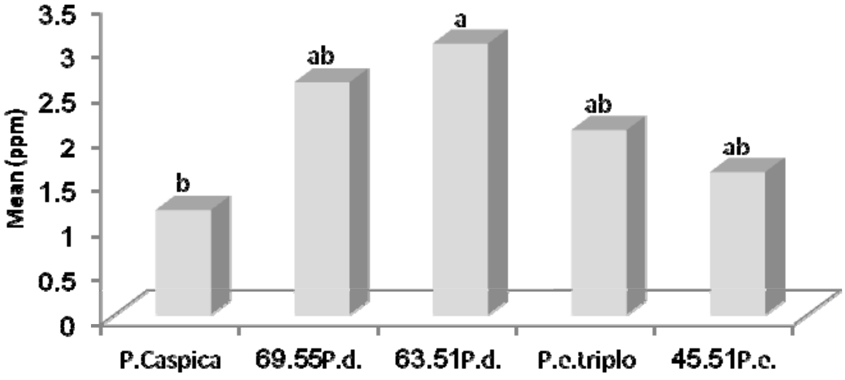

Fig 1. Mean comparison P (ppm) between the different treatment

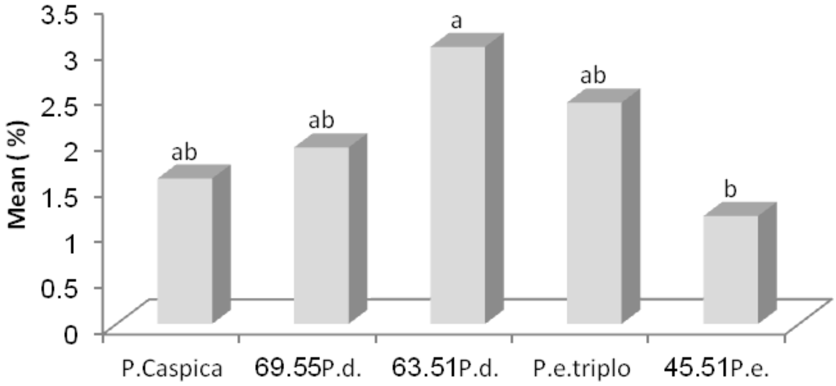

Fig 2. Mean comparison OC (%) between the different treatment

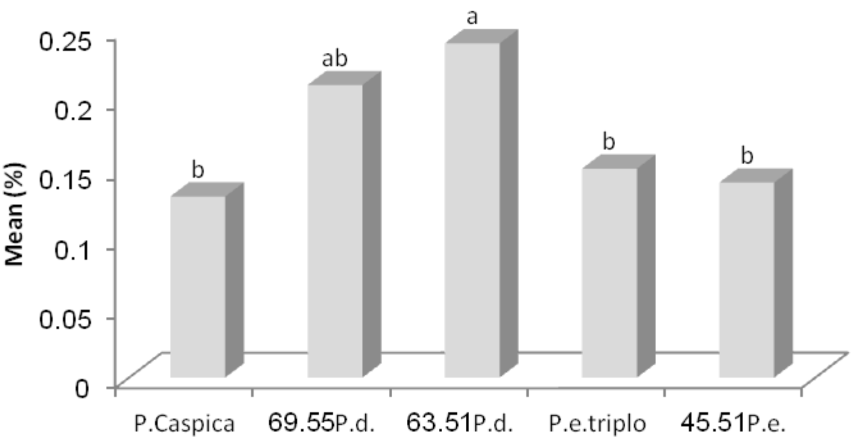

Fig 3. Mean comparison N (%) between the different treatment

Discussion

Growth of poplar depends upon various factors such as clone, quality of planting stock, spacing of trees, intercrops, site quality, nutrient return, climate and management practices (Tewari 1995). Binkley and Sollins (1990), Augusto et al. (2002), Singh and Sharma (2007) noted the effect of poor quality and quantity of litter on inappropriate decomposition of them and weak nutrient release to the soil.The rates of forest litter falls and decomposes of them contribute to the regulation of nutrient cycling, primary productivity, and the maintenance of soil fertility in forest ecosystems (Fioretto *et al.* 2003, Onyekwelu *et al.* 2006). As Wang *et al.* (2008) demonstrated that litter decomposition provides organic and inorganic elements for the nutrient cycling processes and controls nutrient return to the forest ecosystem. The results of this study indicated that in during 10 years, species and clones alternation can change soil properties as in results of analyze of variance in depth 0-20 cmin soil of 15 years old clones indicated that clones could change soil properties and this change with elicited results was consistent.

In the depth of 0-20 cm of soil, higher organic carbon content, P and N were differentiation factors of clone *Populus deltoides* 63/51 from other clones.The ability of trees on soil properties occur mostly dueto the increase of organic matter and the release of nutrient from it (Salehi, 2004).Generally, canopy is considered as the most important nutrient sources in for the soil surface (Augusto et al 2004).

It seems that increasing of canopy and consequently increasing of litter, as the main source of organic matter; produce important nutrients of soil such as nitrogen, phosphorus and potassium followed by process of litter decomposition.

The most important difference between elements such as C ،N and K is related to clone *Populusdeltoides* 63/51 In which widespread canopy and massive litters under the trees in one hand and making currents of food element cycles on the other hand fertile the soils under the canopy (Holland, 1973; Kay, 1987; Jackson *et al*., 1990; Callaway *et al*., 1991; Klemmedson, 1991). Finally, it can be concluded that clone *Populusdeltoides* 63/51 have the positive effects on soil parameters and the quality of the soil.

Acknowledgements

We special thanks to poplar Research Station of Safrabasteh. They have guided us through the various steps of the preparation of our research.

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Phytoremediation Mechanisims and Applications

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Abstract
Contamination of soil and water is a widespread problem worldwide. Several methods exist for remediation of polluted soil and water. Pytoremediation is new approach for clean-up, a natural method and a promising environmental technology. It is defined as use of green plants to remove pollutants from environment or to render them harmless. This technology bases on the ability of plants to accumulate heavy metals and/or to convert them in to safe compounds. Although, novel studies are only new being in Turkey, it continues to study in USA and European for a while and becomes commercial. Especially, fast growing species such as poplars and willows are preferred to use. Phytoremediation offers a number of economic and environmental advantages such as; (i) This technology is used for removal pollutants, (ii) It requires lower cost, (iii) It offers generation of a recyclable metals-rich plant residue, (iv) It has applicability to a range of toxic metals and radionuclides, (v) t has minimal environmental disturbance, (vi) Elimination of secondary air or water-borne wastes, (vii) It offers ability of metal accumulation of plants and/or convert them in to safe or more harmless compounds, (viii) It is low-tech method-implementing and requires basic agricultural practices, (ix) It meliorates physical, chemical and biological characteristics of soils, (x) Public participation occurs and technology is accepted. Six main subgroups of phytoremediation are defined as; (i) phytoextraction (phytoaccumulation), (ii) phytodegredation, (iii) phytostabilisation, (iv) phytovolatilization, (v) phytoimmoilizatin and (vi) rhizofiltration. In this study, these subgroups related to mechanisms and applications are investigated. It is important the assimilation, absorption ability, buffer and accumulation capacities of soil and plant in this mechanism.
Keywords: Phytoremediation, contamination, clean up, soil, plant.

Introduction
Soil and water Contamination is a widespread problem worldwide. Several methods exist for remediation of polluted soil. In most cases, soil clean up is a very difficult operation with very high costs. Therefore, there is an urgent need for low-cost remediation technologies. Moreover, techonogies that simultaneously treat and remove contaminants from mixed waste, radionuclides, metals and organics, are desired (Wenzel et al., 1999a).

A series of scientific innovations are combined with interdisciplinary research. In this way, one of the new approaches for development of a promising environmental technology is called phytoremediation. Phytoremediation is defined as use of green plants to remove pollutants from environment or to render them harmless. This technology uses the ability of plants to accumulate heavy metals and/or to convert them in to safe compounds (Gleba 1999).

Phytoremediation is particularly advantageous where large areas of soil are contaminated with only moderate concentrations of organic pollutants. However, phytoremediation also commonly takes a longer time to remove large quantities of contaminants than do the more costly engineering procedures. However, this technology makes positive contribution to be a greener and cleaner world for all of us to live in besides, remove and minimisation of polluters from the environment completely or partly (Memon, 2011). It is new being in Turkey but it is applied in European Countries and USA for a while (EPA 2000; EPA, 2005).

Materials and Methods
Phytoremediation is categorised as *in situ* technologies and biological methods. Target contaminants are selected organics, heavy metals, radionuclides in this method (UN-ECE, 2000). Phytoremediation refers to the techniques of using specially selected terrestrial plants to remove, stabilize or destroy contaminants from the soil. The mechanisms are varied: organics may be remediated at an accelerated rate near the plant root systems, or the plants may metabolize certain organics, or transport them above-ground where they are transpired or chemically altered; metals can be accumulated in the roots or above ground (EPA, 1993; EPA, 1994; EPA, 1997; EPA, 1999).

Two approaches to phytoremediation the use of plants to help clean up contaminated soils. Hyperaccumlating plants the up and tolerate very high concentration of an inorganic or organic contaminant. In the case of metal contaminants, the addition of chelating agents may increase the rate of metal uptake, but can add a major expense and may allow metals to migrate below the root zone. In enhanced rhizosphere phytoremediation, the plants do not take up the contaminant. Instead, the plant roots excrete substances that stimulate the microbes in the rhizosphere soil, speeding their degradation of organic contaminants. Transpiration–driven movement of water and dissolved contaminants to the enhanced rhizosphere zone improves the system's effectiveness (Brady, 2002).

Specifically, several subsets of metal phytoremediation methods exist including rhizofiltration, , phytostabilisation, phytoimmobilisation, phytovolatilization and phytoextraction (Salt et al., 1998 and Wenzel et al., 1999b) :

- Rhizofiltration : Plants roots grown in aerated water, precipitate and concentrate toxic metals from polluted effluents.
- Phytodegradation : The use of plants and associated microorganisms to degrade organic pollutants.
- Phytostabilisation : Plants stabilize the pollutants in soils thus rendering them harmless.
- Phytoimmobilisation : A process to prevent the movement and transport of dissolved contaminants by plant mediated chemical processes in the root zone of plants.
- Phytovolatilization : Plants extract volatile metals (e.g. mercury and selenium) from soil and volatilize them from the foliage.
- Phytoextraction : High biomass metal-accumulating plants and appropriate soil amendments are used to transport and concentrate metals from the soil in to the above-grounds shoots, which are harvested with conventional agricultural methods.

Results and Discussion

Research has shown that some plant species are better than others at stimulating, the degredation of specific compounds in their rhizospheres. Many plant species, domesticated and wild, have been used in phytoremediation. Prairie grasses can stimulate the degredation of petroleum products, including PAHs, and spring wild flower plants in Kuwait were recently found to degredate the hydrocarbons in oil spills. Fast-growing hybrid poplar can remove ammunition compounds, such as (TNT), as well as some pesticides and excess nitrates (Brady, 2002).

Higher plants can also participate in bioremediation, a process termed phytoremediation. For years, plant-based systems have been used for the removal of municipal wastewater contaminants. More recently, this concept has been extended to industrial pollutants and to the removal of shallow groundwater pollutants of all kinds, both organic and inorganic. Phytoremediation is particularly advantageous where large areas of soil are contaminated with only moderate concentrations of organic pollutants. However, phytoremediation also commonly takes a longer time to remove large quantities of contaminants than do the more costly engineering procedures.

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Continuous Removal of Perchlorate by Salt-Tolerant Perchlorate-Reducing Bacteria

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Abstract
Perchlorate ($ClO4^-$) is major contaminant of soil, surface and ground waters. It is used in the manufacture of propellant, rocket fuel, fireworks, automobile air bag, explosives, and many other products. Known main sources of perchlorate in Korea are wastewaters form LCD monitor manufacturer and Zinc refinery. Perchlorate inhibits iodine uptake of thyroid and reduces production of thyroid hormone that is involved in metabolism and brain development in human body. Ion-exchange is the simple process that can effectively remove perchlorate at a relatively low cost. The regeneration of ion exchanger produces brine solutions containing high concentrations of NaCl and perchlorate, causing secondary pollution. Since perchlorate-reducing bacteria (PRB) can convert perchlorate to harmless end products, salt-tolerant PRB were enriched in a fed-batch mode using activated sludge as inoculum. NaCl concentration was increased stepwise up to 5% (w/v) while perchlorate was spiked into the reactor after every disappearance of perchlorate. The enrichment culture completely removed about 100 mg ClO_4^-/L under 5% NaCl as analyzed by ion chromatography. The enrichment culture was introduced as inoculum into the bioreactor to treat artificial wastewater that mimicked regeneration solution produced from ion exchange used for removal of perchlorate. Hydraulic retention time was reduced stepwise to increase areal perchlorate-loading rate. The enriched salt-tolerant PRB were proven to be useful to remove perchlorate in brine solutions produced from regeneration of ion-exchanger used for perchlorate removal.
Keywords: Biodegradation, bioreactor, perchlorate, perchlorate-reducing bacteria (PRB), salt-tolerant PRB.

Phytoremediation Abilities of Maize (*Zea Mays* L.) Inoculated With Plant Growth Promoting Rhizobacteria in Zinc and Cadmium Contaminated Soils

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Abstract
Heavy metal contaminated soils are a worldwide problem. Efforts to reduce their high impact and diminishing their concentration by using sustainable and low-cost strategies such as phytoremediation may be a promising path in remediation techniques and may lead to positive impact towards the resolution of this problem. Maize is one of the most cultivated crops worldwide and beyond its food energy value it is also considered as an accumulator and a metal tolerant plant especially for Cd and Zn suitable for biomass production. It has been reported that crop yield can be increased by plant growth promoting rhizobacteria which induce mechanisms that can increase absorption of heavy metals from soil.
In this work, *Zea mays* was grown in Cd and Zn contaminated soils at four different concentrations of each metal in greenhouse conditions. After germination, pots were inoculated with two plant growth promoting rhizobacteria - *Ralstonia eutropha* and *Chryseobacterium humi.* At the end of the experiment plants were harvested and levels of Zinc and Cadmium in their roots and shoots were determined. Dry biomass, nitrogen and phosphorus levels were also assessed. The bacterial dynamics were evaluated by using molecular tools such as denaturing gradient gel electrophoresis.
Bacterial inoculation was significant in *Zea mays* growth, providing a better settlement of these plants in contaminated soils. Hence, this study is a contribution to recognize the importance of the interaction of several factors, such as bacteria, soil and heavy metal levels, with plant growth in order to develop phytoremediation applications.
Keywords: Phytoremediation, soil pollution, *Zea mays*, heavy metal, plant growth promoting rhizobacteria.

Determination of heavy metal concentrations in parts of canola *(Brassica Napus)* on tannery sludge and soil combinations

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Abstract

In this study, the effect of tannery sewage which was applied to the soil in specific ratios and torf and zeolite on the physical-chemical properties of soil and growth, yield and the quality of the canola plant was investigated. With this aim, the sewage sludge which was taken from the tannery embroidery foundations were placed in a closed area for 4 months for the microbial decomposition and desiccation in a natural way and then its physical and chemical properties were examined. These wastes were mixed with the soil in 4 different ratios (% 0, %25, %50, and % 75). Torf and zeolit were added as 6 t da^{-1} in some of the treatments. A pot experiment with canola plant was conducted in greenhouse according to the coincidence block design. The experiment was consisted of 45 pots with 3 replications for each treatment. During the vegetation period the growth of the plants was examined. At the end of the vegetation period, plant and soil samples were taken. Plant nutrients and some of the heavy metal contents (Cr, Co, Pb, Ni, Cd) of root stem and leaf parts of the plant and soil samples were determined. At the end of the study, generally the contents of many elements were increased parallel with tannery sludge ratio. Cr, Ni,Pb were accumulated in roots> leaves> shoots. Co and Cd were accumulated in roots more than leaves and shoots. Co, Cd ratios showed differences from application to application for leaves and shoots.

Keywords; Tannery sludge ,Canola, Torf, Zeolit.

Introduction

The major leather production centres in the world are found in Mexico, Brazil, Japan, South Korea, China, India and Pakistan. Korea, Japan and Italy import hides from countries which have a large meat production industry i.e. USA, Australia, and the European countries. Moreover, the Turkish leather industry, has an important place among the world countries. Leather industry, 10. large industrial arm in Turkey.

In the tanning industry raw skin is transformed into leather by means of a series of chemical and mechanical operations. Chromium salts (in particular chromium sulphate) are the most widely used tanning substances today. Hides that have been tanned with chromium salts have a good mechanical resistance, an extraordinary dyeing suitability and a better hydrothermic resistance in comparison with hides treated with vegetable substances (Basegio,2002).

The order of priority in waste management and treatment is (1) prevention, (2) reduction, (3) re-use, (4) recycling and recovery, (5) thermal treatment for certain types of waste and (6) landfill. The most common way to manage solid waste is by disposing of it on controlled land sites. Because of the amount of chromium compounds and other pollutants this sludge is considered as toxic and hazardous. Composted tannery sludge can be viewed as useful on farmland because of its obvious fertilizer effect due to the high levels of nitrogen. However, an excessive level of chrome application may cause accumulation in the soil as well in farm crops and possibily endanger human health through the food chain. Since heavy metals have a strong adsorption and fixing ability in soil the question is; will a small quantity of chrome in the composted sludge be able to enter the food chain and consequently endanger human health?

The tannery sludge is a combination of hair, fleshings, shavings, splits, hide/skin trimmings, leather trimmings, buffing dust, leather finishing residues, general plant wastes, and waste water treatment sludge (Owoeye, 1993; FME, 2001).

The concept of using plants to clean and restore soil and wastewater has been employed for over 300 years. Phytoremediation is the use of vegetation and its associated microorganisms, enzymes and water consumption to contain, extract or degrade contaminants from soil and groundwater. Both organic and inorganic contaminants can be successfully contained or degraded using phytoremediation in a variety of media (i.e. soil, sediment, sludge, wastewater, groundwater, leachate and air) (Susarla, 2002).

Although the first metal-hyperaccumulating plants were identified in the mid-1970s, this information has only recently been explored for purposes of remediation. A 1989 Baker review of terrestrial hyperaccumulators and a 2003 Reeves review of over 30 years' work.

One of the most important factors determining metal phytoremediation success is contaminant bioavailability. Metal bioavailability is determined by physical factors (contaminant coarseness, soil texture, etc.), chemical factors (concentration, speciation, pH, Eh, cation exchange capacity, acidity, redox potential), and biological factors (plant, mychorrizal, and microogranism activity) (Ernst, 1996).

The removal of heavy metal ions from industrial wastewaters using different adsorbents is currently of great interest. Clinoptilolite was shown to have high selectivity for certain heavy metal ions such as Pb^{2+}, Cd^{2+}, Zn^{2+} and Cu^{2+}. A significant number of researchers have done experiments, which have determined different selectivity sequences of natural zeolites for a range of various metals (Kocaoba,2007).

Materials and Methods

The sewage sludge which was taken from the tannery embroidery foundations were placed in a closed area for 4 months for the microbial decomposition and desiccation in a natural way and then its physical and chemical properties were examined. Torf and zeolit were added as 6 t da^{-1} in some of the treatments. A pot experiment with canola plant was conducted in greenhouse according to the coincidence block design. The experiment was consisted of 45 pots with 3 replications for each treatment. Plant nutrients and some of the heavy metal contents (Cr, Co, Pb, Ni, Cd) of root stem and leaf parts of the plant and soil samples were determined.

Combinations:

- Control
- Control + Peat
- Control + Zeolit
- Control + Mineral Fertilizer
- Control + Mineral Fertilizer + Peat
- Control + Mineral Fertilizer + Zeolit
- %25 Tannery Sludge + %75 Soil
- %25 Tannery Sludge + %75 Soil+ Peat
- %25 Tannery Sludge + %75 Soil+ Zeolit
- %50 Tannery Sludge + %50 Soil
- %50 Tannery Sludge + %50 Soil+ Peat
- %50 Tannery Sludge + %50 Soil+ Zeolit
- %75 Tannery Sludge + %25 Soil
- %75 Tannery Sludge + %25 Soil+ Peat
- %75 Tannery Sludge + %25 Soil+ Zeolit

Soil & Soil-Sludge Sampling

Mechanical analysis of the Soil and soil-sludge combination were performed with the hydrometer method (Bouyoucos, 1962), and soluble salt content and pH were measured in saturated soil and soil-sludge combination (U.S. Soil Survey Staff, 1951; Jackson, 1967). Organic C was determined according to Walkley and Black, (1934) and total N according to Bremner (1965). Macro- and microelement analyses of organic materials were determined spectrophotometrically in samples digested by a mixture of 1 N NH4OAc and DTPA + TEA by AAS (Lindsay and Norvell 1978; Hornburg and Brümmer, 1987). Available B, the samples are extracted with hot water was determined colorimetric methods (Riehm, 1957). Some physical properties of tannery sludge after 4 months composting were moisture %76, pH (1:5 water) 7,79, E.C (dS m^{-1}), ash %51,2, Total Organic C %44,6, C/N 8,2, Lime 24,07.

Plant Sampling

At harvest plants were collected and washed with tap and deionized water. Separated into edible roots, leaves, stem and dried in an oven at 65^{O} C for 48 h. Macro- and microelement analyses determinated samples digested by a mixture of HNO3 and HClO4 (Kacar, 1995).

Statistical analysis

Statistical analyses were carried out using TARİST 4.01 DOS for Windows and the results are expressed as mean values. Significant differences between management systems were evaluated by Duncan's test.

Table 1. Available Macro-Micro Plant Nutrients of tannery sludge after 4 months composting

Available Macro-Micro Plant Nutrients			
P* (mg kg $^{-1}$)	508	**Fe** (mg kg $^{-1}$)	98
K (mg kg $^{-1}$)	346	**Mn** (mg kg $^{-1}$)	21
Na (mg kg $^{-1}$)	6760	**Cu** (mg kg $^{-1}$)	6,2
Ca (mg kg $^{-1}$)	8000	**Zn** (mg kg $^{-1}$)	18
Mg (mg kg $^{-1}$)	1639	**B**** (mg kg $^{-1}$)	242
		Na (mg kg $^{-1}$)	8150
* water-soluble		** hot water-soluble	

Table 2 . Total Macro Plant Nutrients of tannery sludge after 4 months composting

Total Macro Plant Nutrients			
NH_4-N (%)	0,08	**P** (mg kg $^{-1}$)	2802
NO_3-N (%)	0,75	**K** (mg kg $^{-1}$)	413
Organic-N (%)	2,58	**Ca** (mg kg $^{-1}$)	9524
Total N (%)	3,17	**Mg**(mg kg $^{-1}$)	3540

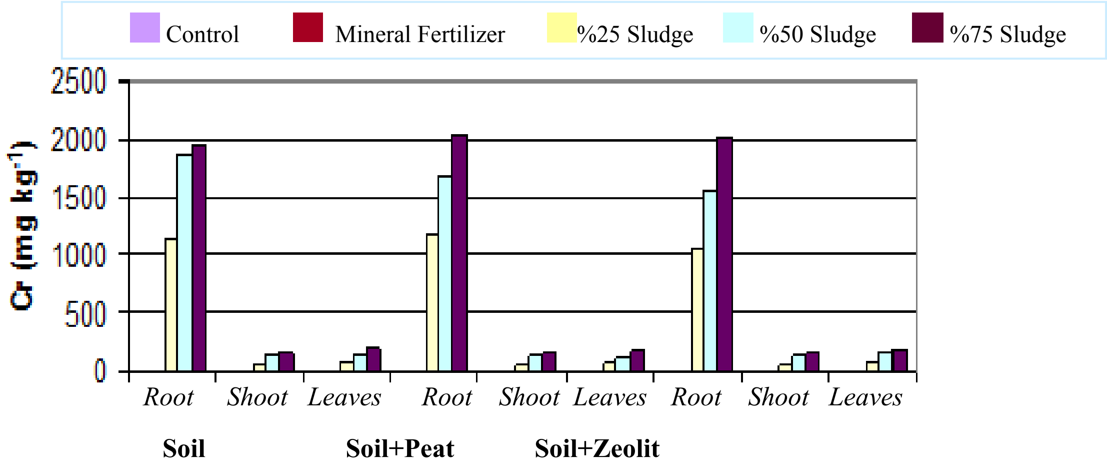
Table 3. Water-souluble, Total Micro Plants Nutrients and Heavy Metals of tannery sludge after 4 months composting

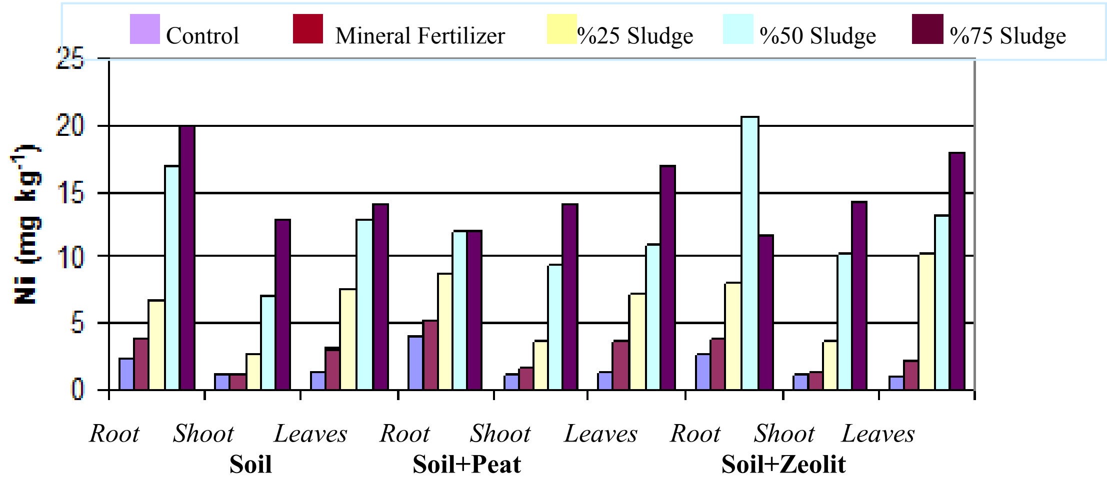
	Water-Soluble	**Total****		**Water-Soluble**	**Total****
Fe (mg kg $^{-1}$)	7,2	1389	**Cr (mg kg $^{-1}$)**	4,3	8220
Mn (mg kg $^{-1}$)	0,46	24	**Cd (mg kg $^{-1}$)**	0,3	2,5
Cu (mg kg $^{-1}$)	0,52	40	**Co (mg kg $^{-1}$)**	0,7	6,5
Zn (mg kg $^{-1}$)	0,8	62	**Pb (mg kg $^{-1}$)**	4,9	25
B (mg kg $^{-1}$)		322	**Ni (mg kg $^{-1}$)**	3,5	21

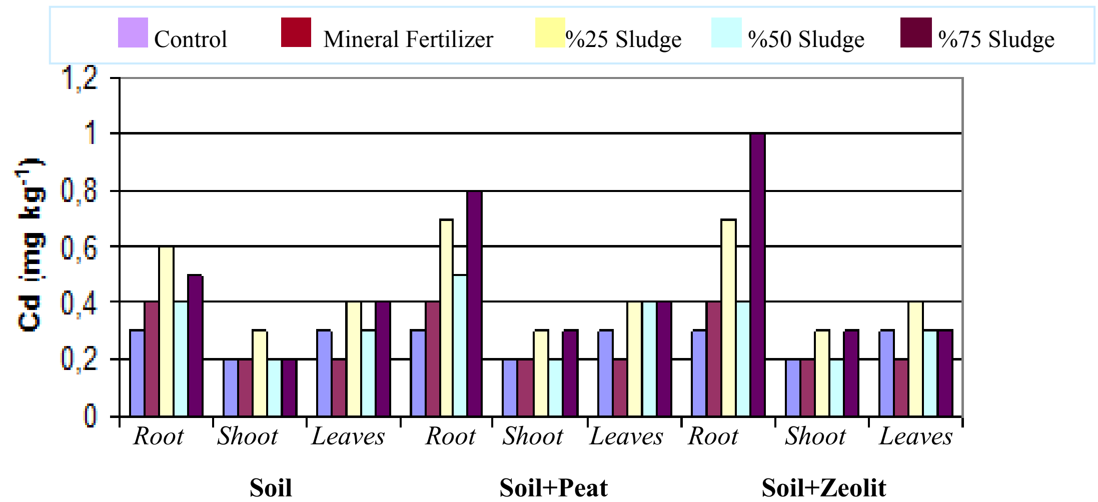
** Ash of sample+HCl ekstraction

Results and Discussion

Parts of Plants







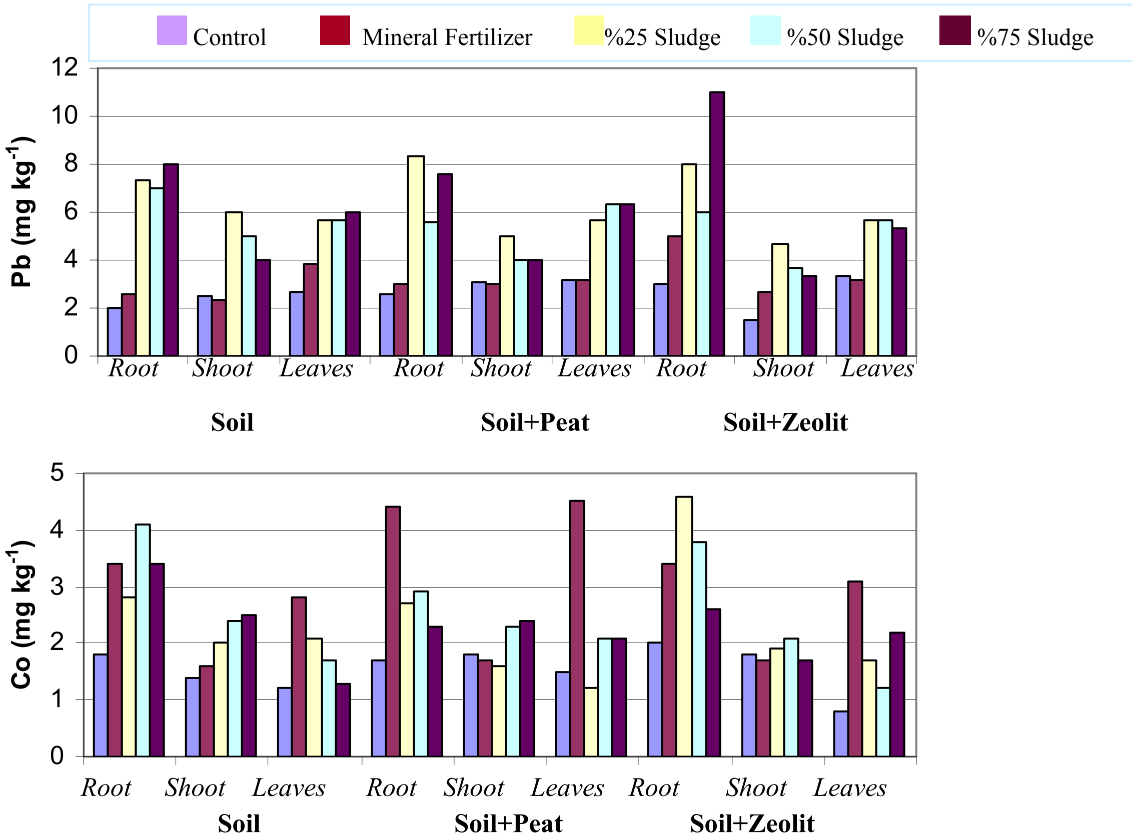


Figure 1: The concentration of heavy metals (Cr, Ni, Cd, Pb, Co) in plant parts of canola.

Heavy metal content has increased with tannery applications (Figure 1). As expected, the concentration of heavy metals measured in the tissues of plants grown on polluted soil was higher than in the controls. Many variable results were obtained between applications. In addition, different data were obtained from supplements of peat and zeolite. Heavy metal concentrations in leaves compared with other heavy metals (except Cr) were within allowable limits. Cr content of plant roots, soil and additives application interaction effect $p < 0.01$ level were significant. Compared with Cr contents of plant parts, particularly in roots more than shoot and leaves. Cr accumulation was observed more in 25% and 75% tannery sludge with peat applications and %50 tannery sludge with no added. The amount of Cr determined in the control and mineral fertilizer applications below the critical value determining the, applications in the addition of toxic waste has the values. Maximum Pb content was determined of %75 tannery sludge with zeolit applications in roots.

Canola also showed a good metal accumulation performance.In addition,canola didnt showed any toxicity during vegatation. But with tannery applications, germination of seeds were delayed until 1 week. As a result, Phytoremediation by canola would remove adequate quantities of heavy metals from the contaminated soil and it would therefore be an appropriate remediation technique for the soil.

Phytoremediation is widely considered as a low cost and ecologically responsible alternative to the expensive physical-chemical methods currently practiced, and an emerging bio-based and low cost alternative technology in the clean up of contaminated soils (M. Turan, A. Esringü,2007).

The results of this study, generally the contents of many elements were increased parallel with tannery sludge ratio. Cr, Ni, Pb were accumulated in roots> leaves> shoots. Co and Cd were accumulated in roots more than leaves and shoots. Co, Cd ratios showed differences from application to application for leaves and shoots.

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Study the impact of sulfur and *Thiobacillus* bacteria inoculants on ability to absorb phosphorus and zinc from the soil and results in the *Canola* plant

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Abstract

The nutrient elements uptake in many of soils, is a problem because of high pH and plenty of calcium ions in them. Some of these elements are phosphorus and microelements. It is possible to increase absorption of these nutrient elements by addition of sulfur in soil and biological oxidation. The rate of this reaction is very slow and Thiobacillus bacteria are the most important oxidators of sulfur in soil. Inoculation of soil with this bacteria results to increase rate of sulfur oxidation, so sulfur utilization with this bacteria in alkaline and calcareous soils will be useful. In order to consider the effect of sulfur and *Thiobacillus* inoculant on soil pH decreasing and increasing in ability of phosphorus and microelements absorption, a greenhouse experiment was carried in Azad University of Karaj, in factorial form and Randomized Complete Block Design (RCBD) with 15 treatments containg 5 levels of elemental sulfur (200, 400, 600, 800, 1000kg/ha) and 3 level of inoculants (without, 5 & 10 gram with 10^7 bacteria per gram) in 3 replications in 2010-2011. After seven months shoots of plant were cut and their dry matter and plant extracts were prepared. Soil samples also were analyzed to measure availability of elements. The results indicated that there was significant difference between treatments in viewpoint of phosphorus and zinc absorption in level of 1%. Amount of available zinc and phosphorus significantly increased and soil pH decreased 1.05 unite compared with primeval soil, this decreasing was significant in level of 1%.

Keywords: Biologic fertilizer, Inoculants, Sulfur, *Thiobacillus* bacteria

Introduction

Soil is one of the key components and basic resources as the plant culture mainstream, and is a unique environment for types of life (Malekouti *et al*., 2005). Phosphorus is one of the most sedentary and most inaccesible elements in soil, so in most soils it is resistant to leaching. However, its defficiency in meny of soils results to decrease agricultural production; because more than 80% of this element, after entering the soil becomes non-removable, and reach out of plant through absorbing, precipitate and convertion to organic (Fallah, 2010; Schachtman *et al*.,1998; Yahya and Al-Alzawi, 1989). Phosphorus is the most sensitive element to soil pH. In pH less than 5.5, Aluminum and Iron iones are combined with phosphate and convert to insoluble residues. In pH higher than 7.5 (calcareous soils) with plenty of active calcium ions, mostly occur insoluble compounds like calcium phosphates. The best pH for phosphorus absorption by plant is 6.5 (Malekouti and Homayi, 1994).

Zinc releases as Zn^{2+} in result of weathering, and in this case it is usable for plant and absorbable in the cation exchange positions. Zinc defficiency and its low availability is common in calcareous soils because of high pH, and in acidic soils because of leaching. Organic soils also are very poor in view point of zinc storage, and their plants often are Zn-defficient. In some cases addition plenty of phosphorus fertilizers results to zinc defficiency (Foth, 1984). Acidic, sandy soils low in total Zn, calcareous soils,soils heavily fertilized with phosphorus, and subsoil exposed by land leveling operations or by wind and/or water erosion are prone to zinc defficiency (Power and Prasad, 1997).

Many researchers have reported sulfur consumption and sulfuric acid production due to its oxidation, results to reduce soil pH, and increase phosphorus and microelements absorption (Tisdale *et al*., 1993; Kaplan & Orman, 1998; Zapata and Roy, 2004).

Oxidation of elemental sulfur mostly is carried out by *Thiobacillus* chemo-synthesis species. *Thiobacillus* can have sizable effects on environment pH. Due to acid production by *Thiobacillus*, increases elements solubility and facilitates their availibility (Fallah *et al*., 2010).

Many researchers through to investigations reported the positive effect of *Thiobacillus* bacteria inoculation on increased ability to uptake nutrient elements (Besharati, 1998; Pathiratna *et al*., 1989; Deluka *et al*., 1989; Rosa *et al*., 1989). In the present study effect of elemental sulfur and *Thiobacillus* inoculant on soil pH and soil absorbable phosphorus and zinc, and absorbed phosporus and zinc by *Canola* plant was studied.

Matterials and methods

At first *Thiobacillus* inoculant was prepared. For ease of isolation of bacteria from soil samples and preparation of pure culture, the *Postgate* culture medium that is a rich environment for Thiobacillus bacteria was used :

$Na_2S_2O,3.5H_2O$ 5 gr , KH_2PO_4 3 gr

$(NH_4)_2SO_4$ 3 gr , $CaCl_2$ 0.25 gr

$MgSO_4$,7H2O 0.5 gr , $FeSO_4,7H_2O$ 0.01 gr

Microelements solution 10 ml (Vishniac & Santer, 1975).

Different dilutions were prepared from soil samples, and of each dilution 0.1^{cc} was poured on solid *postgate* medium, then the prepared inoculant was added to the *Perlite* carrier. In the next step agricultural soil that its taxonomy in Soil Taxonomy System was "Lomy skeletal,mixed(calcareous)mesic typichaploxerepts" was sampled in $0\text{-}20^{cm}$ depth, then the soil was passed through 5^{mm} sieve and were distributed in 6^{Kg} pots. Canola (*Okapy* figure) greenhouse cultivation was carried out in factorial form and Randomized Complete Block Design (RCBD) with 15 treatments containg 5 levels of elemental sulfur (200, 400, 600, 800, 1000kg/ha) and 3 level of inoculants (0, 5 & 10 grams in pot with 10^7 bacteria per gram) in 3 replications in Azad Karaj University. Powder sulfur to 50 mesh was added to soil of pots and was well-mixed. After inoculation canola seeds were planted in 2^{cm} depth. At last 45 pots were prepared with 7 seeds in every one, after 10 days plants were thinned to 3 in every pot.
After cultivation, N fertilizer of urea ($400^{Kg/ha}$, in 3 times) and K fertilizer of potassium chloride ($100^{Kg/ha}$, in 2 times) based on soil test were added to soil. During plant growth, soil moisture was mointained at 70% FC (field capacity). After seven months shoots of plant were cut and their dry matter and plant extracts were prepared. Soil samples also were analyzed to measure availability of elements. Soil pH, soil absorbable phosphorus, and absorbed phosphorus by plant (Olson, 1972), soil absorbable zinc by Lindsy(1979) DTPA method and absorbed zinc by plant were measured (Atomic Absorption device). Data analysis software was MSTATC, signification test was Duncan's new Multiple Range Test (DMRT), and graphs were plotted by Excel software.

Results

Some properties of used soil in pot culture before applying the fertilizer treatments are presented in table 1. The amount of absorbable phosphorus is less than the critical level required for *Canola* plant $20^{mg/Kg}$ (Malekouti *et al.,* 2005).

Table1- Physical and chemical properties of the soil

Structure	Particle size analysis			Total N %	Absorbable P mg/Kg	Absorbable Zn mg/Kg	Usable K mg/Kg
	Cl	si	sa				
S.L.	5	34	61	0.17	10.8	1	250.2
Saturation moisture %	EC dS/m			Organic matter %	Equivalent $CaCO_3$ %	pH	
34.5	3.48			1.66	6.2	7.95	

The variance analysis (Table2) indicated the effect of treatments on pH and soil absorbable phosphorus and zinc, and absorbed phosphorus and zinc by plant were significant in level of 1%.

Table2- Analysis of treatments effect on soil pH , absorbency of elements and absorbed elements by plant

		Mean Square (MS)				
S.O.V	DF	Soil P	Soil Zn	pH	Plant P	Plant Zn
Replication	2	4.604 $^{n.s}$	0.03 $^{n.s}$	0.001 $^{n.s}$	0.0001 $^{n.s}$	8.26 $^{n.s}$
Bacteria	2	186.06 **	7.03 **	0.255**	0.0001 *	398.46 **
Sulfur	4	485.68 **	3.31 **	0.267 **	0.004 **	779.2 **
Bacteria×Sulfur	8	17.22 **	0.06 **	0.012 **	0.0001 *	30.32 **
Error	28	0.39	0.004	0.0001	0.0001	0.76
Coeficient of Variation (%)		2.53	1.95	0.25	1.87	3.02

* and ** are significant in 5% and 1% level and n.s. is not significant

Signification test on single effect of bacteria (Table3) indicated that absorbency of soil P and Zn increased in inoculated treatment 33.5% and 54.06% than non-inoculated treatment, and absorbed P and Zn by plant increased 6.2% and 42%.

Table3-Single effect of bacteria on traits, by DMRT method

Bacteria Levels	Soil P mg/Kg	Soil Zn mg/Kg	Plant P %	Plant Zn mg/Kg	pH
T_0	21/00 ^{c}	2.503 ^{c}	0.145 ^{b}	23.00 ^{c}	7.33 ^{b}
T_1	24.94 ^{b}	3.25 ^{b}	0.154 ^{a}	30.93 ^{b}	7.52 ^{c}
T_2	28.03 ^{a}	3.87 ^{a}	0.151 ^{ab}	32.67 ^{a}	7.27 ^{a}

Treatments with similar symbol have not significant difference

Signification test on single effect of sulfur (Table4) indicated that absorbency of soil P and Zn increased in most sulfur fertilizer treatments 112.4% and 62.34% than treatment with the lowest sulfur fertilizer, and absorbed P and Zn by plant increased 48.9% and 136.4%.

Table4-Single effect of sulfur on traits by DMRT method

Sulfur Levels	Soil P mg/Kg	Soil Zn mg/Kg	Plant P %	Plant Zn mg/Kg	pH
S_1	16.48 ^{e}	2.47 ^{e}	0.123 ^{d}	17.06 ^{e}	7.57 ^{e}
S_2	19.62 ^{d}	2.8 ^{d}	0.137 ^{c}	22.56 ^{d}	7.47 ^{d}
S_3	23.6 ^{c}	3.18 ^{c}	0.151 ^{b}	29.61 ^{c}	7.403 ^{c}
S_4	28.57 ^{b}	3.57 ^{b}	0.162 ^{b}	34.78 ^{b}	7.29 ^{b}
S_5	35.01 ^{a}	4.01 ^{a}	0.176 ^{a}	40.33 ^{a}	7.13 ^{a}

Treatments with similar symbol have not significant difference

Signification test on interactive effect of bacteria and sulfur (Fig1&2) indicated 165% and 161% increase in soil P and Zn absorbency.

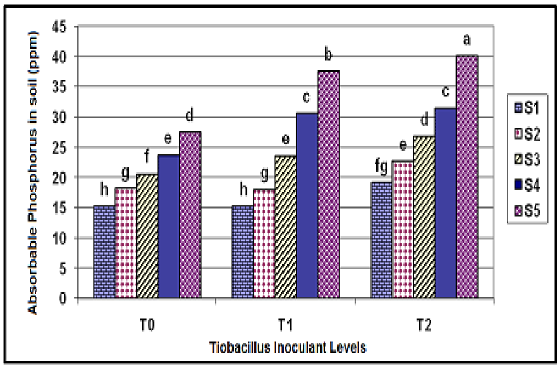

Fig1-Interactive effect of bacteria and sulfur on soil absorbable phosphorus

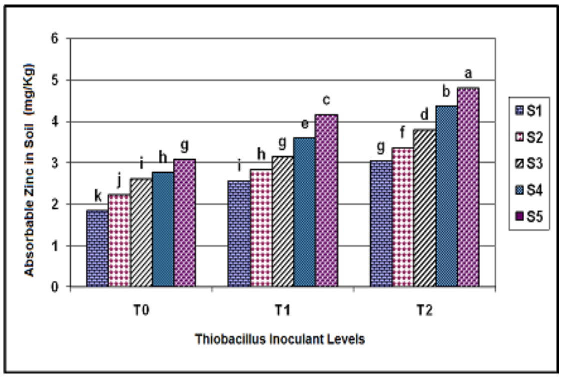

Fig2- interactive effect of bacteria and sulfur on soil absorbable zinc

Interactive effect of bacteria and sulfur (Fig3) resulted to 0.81 decrease in soil pH.

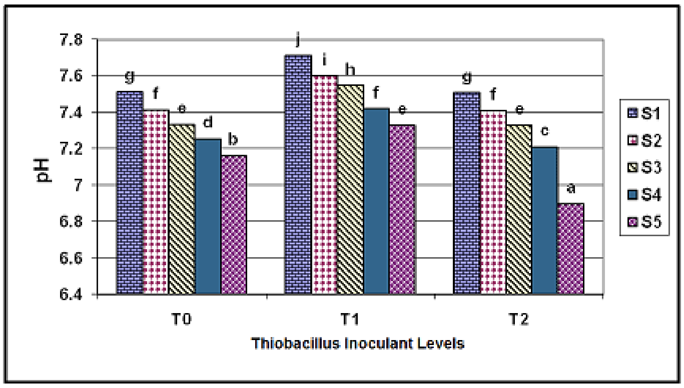

Fig3-Interactive effect of bacteria and sulfur on soil pH

Signification test on Interactive effect of bacteria and sulfur (Fig4&5) indicated 165% and 161% increase in absorbed P and Zn by plant.

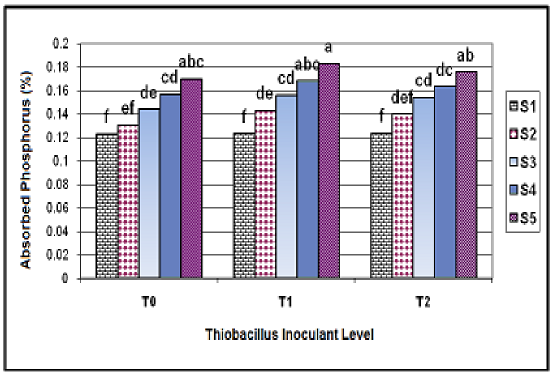

Fig4-Interactive effect of bacteria and sulfur on absorbed phosphorus by plant

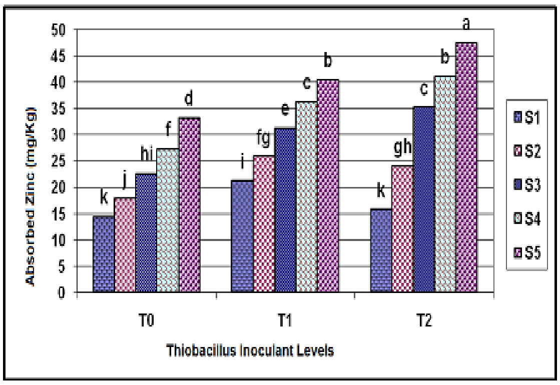

Fig4-Interactive effect of bacteria and sulfur on absorbed zinc by plant

Discussion

Phosphorus and microelements sorption by plants in many soils is difficult because of high pH and plenty of calcium ions. In this study soil pH was decreasing by adding sulfur into the soil and its oxidation and production of sulfuric acid, therefore P and Zn sorption was increased. As regards this reaction is very slow speed and *Thiobacillus* bacteria are the most important sulfur oxidants in soil, inoculation of soil with this bacteria resulted to increase sulfur oxidation speed. Similar results have been achieved in many other researches (Kalbasi, 1986; Kittams and Attoe, 1965; Miller, 1965; Modaihsh *et al.,*1989; Morvedt *et al.,* 1991; Tisdale *et al.*, 1993; Kaplan and Orman, 1998; Deluca *et al.,* 1989; Pathiratna, 1989; Kalbasi *et al.,* 1988;Besharati *et al.*,1998).

Conflicting results regarding the effect of phosphorus on different chemical forms of zinc have been reported, such that phosphorus addition to soil results to change in the distribution of zinc in various forms, this means that zinc transfers from manganese oxide and crystalline iron oxide to exchange zone, thus increases zinc absorbency. On the other hand, other researchers reported that phosphorus application has no effect on zinc forms. Singh *et al.*,1992 When studying on effect of phosphorus on various forms of zinc, observed no evidence of zinc deficiency in plant due to phosphorus effect on exchangeable locations, organic adsorption, remaining iron and manganese oxide. While the results of Tagwira Suggested that distribution various forms of zinc have been affected under phosphorus levels, so that phosphorus increase resulted to decrease in absorbable and organic zinc, but increased unusable forms. The researchers know the reason of absorbable zinc decline related to effect of soil colloids therefore more absorption of zinc by colloidal particles.

Acknowledgements

The basic components of sustainable agriculture are the soil fertility management by biological fertilizers. The idea of sustainable agriculture is to maintain crop production in acceptable level to feed a growing population, without damage and harm to the environment.

According to researches biological fertilizers are discussed as the most natural and most desirable solution for keeping alive and active life-system in soil. Although, what was said should not be interpreted to reject chemical fertilizers completely. Chemical fertilizers considerate to priority are acceptable for plant natural nutrition as the biological fertilizer supplement (such as sulfur in this study).

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Analysis of Phisico-Chemical Composition and Content of Humic Acids in Sediments Modrac Lake

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Abstract
This paper presented the results of phisico-chemical composition and content of humic acids in the sediments at the mouth of the river Spreča prevent the lake Modrac and data assessments capabilities using sediment as fertilizers.Comparing the results of research the quality required in organic fertilizers, sediment from the mouth of the river Spreča in the lake Modrac there is little deviation.This sediment contains enough organic matter and humic acids and distribution of related humic acids, and easily and heavily soluble humate in the comparision to the total humic acid is optimum that is of significant amounts of carbon mass in sediment. Therefore, there is need of further studing this site and finding ways for the modification of the sediment and use as fertilizers.
Keywords: sediment, humic acids, organic matter, fertilizer, phisico-chemical analysis

Introduction
Lake Modrac, an artificial accumulation,was built in order to provide process water required for industrial and energy facilities. Water from this lake , since 2007. used to supply drinking water to the city of Tuzla, after purification of the water factory "Cerik".
River Basin Spreča, which flows into Lake Modrac, more than 60% of the entire basin of this river. With the confluence of rivers Spreča are rich deposits of coal, limestone, silica sand, asbestos and other mineral resources, based on which to develop mining production, chemical industry, non-metal industry, processing industry and urban and suburban areas. A characteristic of all the listed industries that discharge their waste water directly or indirectly into the river to prevent this. Based on the quality of the displayed status Spreča River can be concluded that the aquifer meets the prescribed classes only in the upper basin, while the rest of the basin significantly polluted.
In the upper basin of the river Spreča streams that are due to receipt of waste water from coal mines (including open pit and separation), timber and other waste water does not meet the prescribed quality and are classified as III - IV category of water quality. The Modrac accumulation is classified in Category II water quality. These streams are characterized by a large amount of suspended matter and dissolved organic and inorganic substances. Since these substances are constantly discharged into surface water streams entering the accumulation Modrac is done continuously, leading to the creation of deposits mainly at the mouth of the river Spreča into the lake Modrac in the wide area of Lake Modrac, which is influenced by pouring rivers. The aim of this paper is to investigate and define the physico-chemical composition and content of humic acids in sedimentary deposits at the mouth of the river Spreča in Lake Modrac in an area of approximately 50 m from the mouth, and that on the basis of the physico-chemical analyses and content of humic acids of sediment, assessing the possibility of using this sediment as fertilizers.

Material and methods
The stated aim of the research was conducted sampling sediment from river Spreča and lake Modrac at six sites and the samples were subjected to tests in the following instruments and methodologies:
Sampling and sample preparation (Standards for quality of soil 1994.)

- Sampling for testing from the sedimentary layers (bottom) of rivers and lake is carried out semi-automatic tool for sampling soil – BAS ISO 10 381 – 3: 2003. Mass of test sample ranged around 500 g / sample.
- To speed up the drying process of determining the free moisture was done in the oven

"Heraeus" under the same conditions, hence 20°C i φ = 50 %, to constant sample weight.
Soil quality (Standards for quality of soil 2003.)

- Soil quality – Determination of pH BAS ISO 10 390:2000, on the pH-meter type Eutech Instruments pH 510, Malaysia.
- Soil quality – Determination of carbonate BAS ISO 10 693:2000 (Scheibler-ov kalcimeter, the production EIJKELKAMP HOLANDIJA).
- Soil quality – Determination of organic mass in the sediment was done by burning a sample of sediment from 450°C. Gravimetric treatment of samples before and after burning determined the percentage of organic mass in the samples.
- Soil quality – Determination of loss on ignition, was performed on ignition the sample at 1000 º C to constant mass.
- Soil quality – Determination of silicon dioxide, SiO_2, in sediment samples were performed according to standard BAS ISO 1009:2003, gravimetric method.
- Soil quality – Determination of iron (III) oxide, Fe_2O_3, was performed according to standard BAS ISO 1011:2003, volumetric method with potassium permanganate.
- Soil quality – Determination of aluminum oxide, Al_2O_3, was performed according to standard BAS ISO 1013:2003, gravimetric method – phosphate procedure.
- Soil quality – Determination of calcium oxide, CaO, was performed according to standard BAS ISO 1014:2003, complexometric method.
- Soil quality – Determination of magnesium oxide, MgO, was performed according to standard BAS ISO 1015:2003, complexometric method.
- Soil quality – Determination of sulfur in the form SO_3 according to standard BAS ISO 1018:2003, gravimetric method, by precipitation with barium chloride.

Instruments

Analysis of humic acid by a standard Shamidae with calcium acetate

Results and Discussion

Table 1. shows the results of content moisture, pH-value, content of organic matter, carbonate content, loss on ignition and ash content in the sediment samples with 6 localities. Table 2. shows the results of the content of oxides (SiO_2, Fe_2O_3, Al_2O_3, MgO, CaO, SO_3).

Table 1. Results of Analysis

Sample	Content of moisture % m/m	pH	Organic matter (OM) % m/m	Loss on ignition	Content of $CaCO_3$	Content of ash
MM – 1	51,00	7,25	30,35	6,47	9,35	63,23
MM – 2	56,58	7,12	28,16	10,60	10,09	61,97
MM – 3	49,00	7,18	31,23	6,09	7,71	61,72
MM – 4	48,57	7,23	33,24	10,95	11,81	59,50
MM – 5	50,10	7,02	38,81	21,34	8,29	54,83
MM – 6	31,48	7,19	18,72	14,04	9,19	68,23

Table 2. Analysis of sediment

Sample	The chemical composition of sediments						
	SiO_2	Fe_2O_3	Al_2O_3	MgO	CaO	SO_3	Total
	% m/m						
MM 1	49,40	7,35	21,18	3,54	8,37	2,23	98,54
MM 2	47,26	6,01	17,26	2,82	12,85	2,21	99,01
MM 3	51,33	6,79	15,10	2,11	15,17	2,31	98,90
MM 4	48,41	6,35	20,46	1,77	8,51	3,10	99,55
MM 5	54,29	5,59	5,77	2,01	7,28	2,69	98,97
MM 6	59,43	5,55	11,26	3,34	4,92	0,61	99,15

Table 3. Basic parameters of quality for fertilizer-Regulation of official newspaper 72/09

Indicator of quality fertilizer	Content % or mg/kg
Moisture	40 – 60
pH	6,50 – 6,20
Organic matter	> 46 %
Ash	< 54 %
Nitrogen	1,60 – 1,90 %
P_2O_5	1,30 – 1,60 %
K_2O	1,30 – 1,60 %
Calcium	1,30 – 1,60 %
Magnesium	0,90 – 1,10 %
Iron	1,00 –1,30 %

On the basis of characteristics related to sediment quality, the requirements that must be fulfilled materials to be used as organic fertilizer, which are defined by the law, an assessment of sediment quality in the lake sediment Modrac as possible to use organic fertilizers in agriculture.

- On the basis of concordance of the required quality parameters of moisture, organic matter, ash and pH can be concluded that the moisture content in the sediment from all sites within the limits required and prescribed values. Specifically this means that the sediment in relation to this parameter could be applied on the agricultural soil. Yet it is clear that the moisture content in the sediments is very variable, and this parameter has no special significance in defining the assessment and should be viewed with caution.
- Content of organic matter in sediments is a significant parameter in considering the use of sediment as organic fertilizer . Although the requirements for the content of these components in organic fertilizers and allow stricter application of organic fertilizer with a minimum of 46% m/m OM, it can be concluded that of all the analyzed sediment layers of sediment from the site at the mouth of river Spreča in Lake Modrac has a lower content of organic mass (18,72-38,81 m / m), which are lower than the required 46%.
- The maximum ash content in the organic fertilizer to 56% m / m. In relation to this parameter, the quality of sedimentary layers does not have the required content, since the lowest ash content in the analyzed sediment drifts above this value. However it should be noted that the ash content in the sediment from the river sites Spreča (location 5) 14% higher than the allowed value, so this parameter can be conditionally evaluate a potentially satisfying.
- The pH values of sediment layers is nearly uniform, ranging from 7.02 to 7.23 for all locatios, and is generally slightly higher than the required value. As the pH value still shows a neutral to weakly basic environment this parameter is conditionally request, since the pH changes in the locality 5 shows pH changes less than 10% . Alluvial soils are characterized by weak alkaline reaction, which has significant impact on the retention of heavy metals.
- The pH values of sediment layers is nearly uniform, and soil in the territory of Bosnia are acidic character, which is poor in relation to the characteristics of plants. Application of sediment from the river Spreča and lake Modrac could be improve the quality of soil and neutralize soil acidity, expressed in all the soils with pH below 6.0.
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The analysis of sediment from the all localites showed that the contents:

- calcium in the sediment Spreča higher by 1,4 times
- magnesium content in the sediment Spreča higher by 1,4 times
- iron in the sediment Spreča higher by 3,4 times

The average standarized composition of the soil are: 0.50% nitrogen, 0,25% P_2O_5; 0,50% K_2O and 20% organic matter.Everything that applies to the soil should be such that it meets a given quality of organic fertilizer, that does not substantially impair the quality of the base substrate (M.Veladžić at al., 2003.).

Based on chemical analyzes of sediment and the established aluminum oxide, iron, calcium and magnesium, it is obvious that the dominant presence in the sediment of clay minerals and iron

oxides are present as well as subordinate carbonates of calcium and magnesium (Brankov at al., 2006.; Nešić at al., 2003.). The final assessment of whether the sediment from the river Spreča into the lake Modrac be used as organic fertilizer or fertilizator gave an analysis of humic acids in sediments (Nešić, 2004.). Humic acids are the main components of humus, which represents the organic matter in soil. These are high molecular weight organic compounds in soil resulting from the partial decomposition product of dead organic matter (plant and animal remains). Chemical analysis showed a high content of organic matter and humic acids in the sedimentary deposits, with particular locality in the mouth of the river Spreča the lake Modrac. Futher analyse of humic acids should indicate whteher the sediment could be applied in agricultural practice.
Figure 1. shows the relationship of organic matter and humic acid content in the river Spreča sedimet.

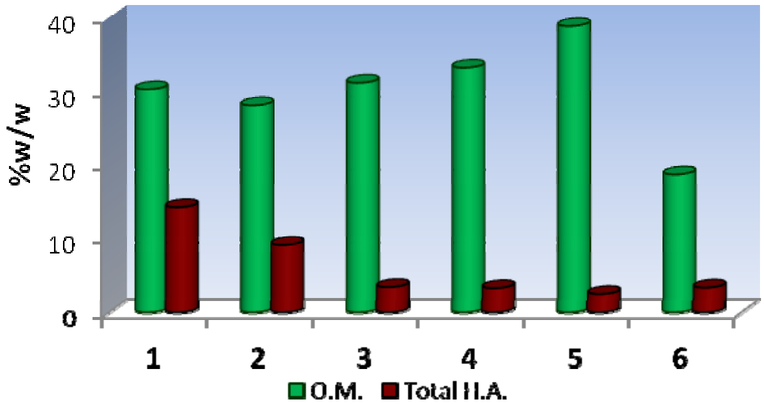

Figure 1. Relationship of organic matter and humic acid content in the sediment of river Spreča

The content of humic acids is the highest in the mouth of Spreča in Modrac and directly in the lake sediments, and can be safely stated that in relation to this parameter sedimentary layer could be used as organic fertilizer. This sediment could be placed in a very humic soil, and as such would significantly improve the quality of agricultural soils that would be applied for.
As humic acids originating from coal, it has been proved that their high contents make good charcoal adsorbent, resulting in extremely high affinity of nutrients to the coal. These nutrients are retained on its surface, and thus carbon in the sediment has a very high stability and more importantly - long life, and once mixed with soil retaining effective properties compared to plants . Besides the ability to retain carbon in its structure, coal reserves in sedimentary deposits and makes available to plants significantly higher levels of minerals and nutrients than other organic materials (fertilizers such as compost or manure) - including nitrogen, phosphorus, calcium and organic matter (Lehman at al., 2006.). It should be noted that other organic material (fertilizer) can not retain some biogenic elements such as phosphorus, which it maneges to coal .
Since even 43.46% in the watershed area of river Spreča arable agriculture soil, the use of sediment from the river sediment as organic Spreča regulators, to achieve the following effects:

- Raised to the level of soil fertility,
- To stop the environmental pollution from agriculture and the further degradation of arable soil which led to today's methods of intensive farming methods,
- Because of the high affinity of nutrients to the coal, which are retained on its surface, sediments which contains coal, applied as organic fertilizer, have high stability and longevity, because once mixed with the soil they long retained their effective properties,
- These causes would be a good regulator of organic soil, which would enrich the soil humic acids (H.Resulović at al., 2002.)

Table 4. The content of humic acids in Lake Modrac sediments

The measurement site	Total humic acid	Bound humic acid	Free humic acid	Easily soluble humate	Heavy soluble humate
	% w/w				
MM 1	14,35	14,07	0,28	4,06	10,01
MM 2	9,10	7,84	1,26	1,33	6,51
MM 3	3,50	3,25	0,25	1,15	2,10
MM 4	3,35	2,87	0,48	1,01	1,86
MM 5	2,57	2,02	0,55	0,59	1,43
MM 6	3,43	3,00	0,43	0,75	2,25

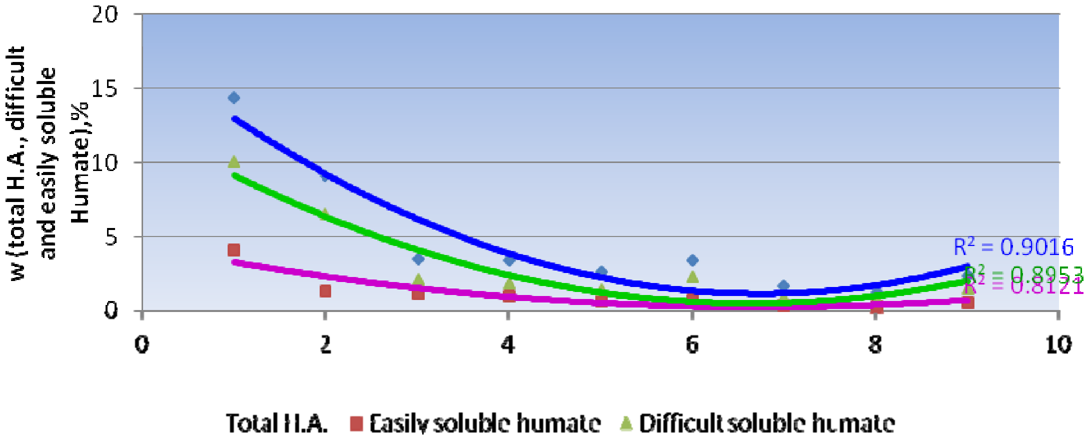

Figure 2. The correlation between easily soluble, heavy and total soluble humate humic acid

This analysis shows that the distribution of bound humic acid, and the easy and heavy soluble humate in coal in relation to the total humic acid optimum, which favors long-term positive effects of this sediment to stabilize the soil and the capacity of the soil in relation to the nutritional value. This phenomenon comes from the significant amounts of carbon mass in the sediment, making sediment causing a good organic soil regulator, which entered the soil, the plant is the most important component, humic substances. That means that causes sediment to the river Spreča sites in the lake have two specific characteristics: a very high affinity of nutrients to the carbon in the sediment, as long they stay on the surface of the carbon in the sediment provides high stability and durability, and assumption that be mixed with a long ground hold effective properties, such as was demonstrated for coal-or Terra Pretu (Lehman at al., 2006.)

In relation to the pH-value, generally it can be concluded that the sediment is applied to sites in the mouth of the river Spreča Lake Modrac, suitable for use in agriculture as organic fertilizer. As the pH of an aqueous solution of the sediment in the range of 7.02 to 7.23, indicating a slightly alkaline environment of the application of sediment could be carried out on all soils where the pH 6.0 and lower. Since most soils in the Bosnia have acidic character, the application of sediments would have a twofold effect:

- primarily be achieved intake of humic substances in soil, and
- carried out to neutralize the soil and raise the pH value, which would improve conditions for long term growth of crops, and eventually frozen by the presence of heavy metals in the soil unavailable to plants in the complexes.

In relation to the content of humic acids in the sediments, the organic mass, calcium carbonate content, pH, generally it can be concluded that the sediment is applied to sites in the mouth of Spreča in Lake Modrac, suitable for use in agriculture as fertilizers, of course, with further detailed study of the site and according to the results, finding ways to modify the terms of sediment enrichment and use as organic fertilizer.

Artificial lake Modrac was filled coating is substantially suspended matter due to the tributary waters of the lake. Using these sediment allowed to not only clean the Modrac, which in the ecological and economic terms was a significant undertaking, but the cyclic operation of the process as it occurs in nature, where waste is an industrial raw material being the other branches. The analyzes that were performed in order to determine the physico-chemical characteristics of sedimentary deposits, which is mainly waste of mining, have shown that it is possible to use these sediments as organic fertilizer.

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Investigation of the Effect of Biological Stabilization Practice on Soil Nutrients (Iran)

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Abstract
One of the ordinary methods to protect, rehabilitate, and enhance an ecosystem function in arid and semi arid areas of the world is sand dune stabilization using biological practices. The investigation of the effects of species plantation on other components of the ecosystem, mainly soil, plays a great role in sustainable management of the system. This research studies the effects of cultivation of *Haloxylon ammodendron* and *Atriplex canescens* on physical-chemical characteristics of soil. The study area was Yousefabad, Neyshabour, located to the northeastern part of Iran in which these two plant species were cultivated 20 years ago. The study area was then compared with a control area near the area under investigation. Two different sites within the study area as well as a site in control area were selected for soil sampling. Six samples were taken at each site from depths of 0-20 cm and 20-80 cm, totaled 36 soil samples. The percentage of clay, silt, sand, electrical conductivity, soil acidity, organic matter content, nitrogen, phosphorus, potassium, calcium, sodium, and calcium carbonate of each sample were measured. The means of data were then analyzed using LSD approach by SAS, SPSS, and Excel softwares. The results showed that the three sites have different soil characteristics and *Haloxylon ammodendron* has positively developed the physical-chemical characteristics of soil in the study area more than the other species.
Keywords: biological stabilization, soil nutrients, arid and semi-arid areas, Neyshabour.

1. Introduction
Iran is one of the world's arid and semi arid areas so that the average annual rainfall in more than 80 percent of its area is about 50 to 250 mm. About 472562 square kilometers (29/12 %) of the country is covered by the Dry climate (Jafari, 2009). Using methods of rangeland reclamation and development, including cultivation suitable plants is one of the most important ways that stabilize the soil and creating a new microclimate that Leads to changes in the soil physical and chemical properties gradually. Due to stabilishment of vegetation in this condition is not easy, so for improving the rangelands the plants are needed that have adapted to arid and semiarid areas and environmental conditions. Among the plants that have adapted to arid and semiarid areas are Chenopodiacae family plants such as: *Haloxylon ammodendron* and *Atriplex canescens* that are widely cultivated in Iran. Despite numerous studies concerning the influence of plants on their habitat has been done, different results have been reported from positive and negative effects of this species on the environment. And this point highlights the importance of deep research and evaluate the effects of planted them after a few years that by Accurate information with regard to its impact on other factors in the ecosystem in the long term, is decided to continue, stop and replace the culture of this species. Rahbar (1987) suggests that the measures to stabilize the sand in Iran began in October 1960 in about 18 ha of surrounding areas of Ahvaz. Orlovsky & Birnbaum(2002) said that *Haloxylon ammodendron* is growing naturally on sandy soils and clay deserts of Central Asia from the West China and Mongolia to the Caspian Sea, Central Asia and the Middle East. And its cover over a million km^2 in the hot deserts in the Middle East. Javanshir *et al,.* (1998) Expressed this plant belonges to early stages of sequences in sandy soils. Azarnivanad *et al,.* (2004) concluded in areas that *Ha. ammodendron* was planted, the organic carbon was increased so that causes to improve of the soil structure in the long time. And also the elements of N, P, K, which are the essential needs by plants has increased in the soil. And creating an appropriate environment for micro-organisms activity and accelerates the processes of pedogenes and have increased clay and silt in the dunes. And this suitable conditions led to return native species and the fauna of the region. Farzaneh (2004) said that in the area that have been cultivated *Ha. Ammodendron,* with

increasing depth, pH and EC levels are increased and this trend is opposite about organic carbon. Jafari *et al,.* (2006) stated that this sites that *Ha. ammodendron* has plantting the amount of nitrogen, potassium, electrical conductivity, acidity, increase significantly and phosphorus is reduced.The physiochemical analysis results show that the soil porosity, total organic carbon, total nitrogen and phosphorus levels increased during time and its values is high under its canopy cover (Miyoko Inoue *et al.,* 2008).
Atriplex canescen is a native shrub of South America arid regions that has been planted in different parts of Iran-Turan (Asadi, 2002). Among the species imported to Iran, this plant has been planted at the highest area of country (Moghimi, 2006). Khalkhali (1998) reported that the positive influence of planting *Atriplex sp.* on the soil structure is more specific than a negative impacts. Arzani *et al,.* (2001) in their study on the ecological effects of cultivation *Atriplex canescens* on the environment expressed that the EC and Na solution in the soil increase at the *Atriplex* site compare with control area, but phosphorus does not follow a clear trend. And this plant led to the saltier the surface soil. Jafari *et al,.* (2006) were expressed that cultivation *Atriplex* increase the amount of nitrogen, phosphorus, potassium, organic matter significantly and soil acidity is reduced. Azarnivand and zare chahouki (2009) stated that *Atriplex* along with these positive characteristics, such as soil stabilization, high forage in unfavorable environmental conditions, fuel production and carbon storage, has negative effects on ecosystems. McKeon *et al.,* (2005) Showed that in a desert area near Monument Valley, Arizona, which established a uranium factory led to pollution of soil with ammonium nitrate, planting *Atriplex canescens* cause rapid uptake of nitrate from the desert soil.

2. Materials and methods

2.1 Study area

Field experiments were conducted in Yousefabad ranges (25 kilometers southeast of Neyshabur) of Khorasan razavi province, north east of Iran. The range has 500 ha of area and between 59º 00' and 59º 05' geographical lengths and 36º 00' up 36º 05' latitude. The average of height is 1200 meters above the sea level, the average of long-term rainfall based on the nearest stations (Eshgh abad) is 213 mm and the average of temperature is 14.8° C. The average of maximum monthly temperature is 27.6 in July and average minimum temperature is 2° C in January. The soil of the area is sandy and clay, alkali with relatively good drainage; the structure is amorphous and is poor in organic matter compounds. The minerals composition is made up of gypsum and clacic. Soil depth is 20 - 50cm and the lower class, in foothills areas is gypsum and claic. The study site is flat having numerous foothills. The maximum slope is 10% which has east – West direction mostly. The area has seasonal winds starting to blast at second half of spring and continue up to summer, their direction is usually East - West with intensity of about 24 kilometers per hour. The wind causes erosion in the area therefore to prevent erosion and sand transport to the villages, *Atriplex canescens* and *Haloxylon ammodendron* species have been planted. These rangelands are winter pastures which are grazed by the village livestock (Behzad Nia and Bagheri, 1996).

2.2 Field measurements and methods of experiment

At first with field visits, the area under cultivation of *Haloxylon ammodendron, Atriplex canescens* and control region was identified and selected. These sites are similar of climate conditions and topography and then the map of the areas under cultivation of these plants and control area was prepared using GPS and topographic maps. Then for compare soil elements of each area six samples were taken at each site from depths of 0-20 cm and 20-80 cm, totaled 36 soil samples. The percentage of clay, silt, sand, electrical conductivity, soil acidity, organic matter content, nitrogen, phosphorus, potassium, calcium, sodium, and calcium carbonate of each sample were measured using common methods. Then the normality of data was tested using kolmogorov – smirnov (k-s) test and in a one-way completely randomized design. The means of data were then analyzed using LSD approach by SAS, SPSS, and Excel softwares.

3. Results

Results of the comparison this sites shows that these three treatments had significant differences of EC, %sand, %silt, nitrogen, potassium, calcium and sodium, but they had no significant different about other factors. The site of *Haloxylon* has the most amounts of organic matter, nitrogen, phosphorus, potassium, acidity, electrical conductivity, sand, calcium and sodium than the other two sites (Table 1).

Table 1. Comparison of soil elements in different sites

Factor	Most	Least	Significant
pH	Ha= 8.4	At=8.26	n.s
Organic matter (%)	Ha=0.42	At=0.28	n.s
Phosphorus (ppm)	Ha=2.57	At=2.57	n.s
Potassium(ppm)	Ha=213.08	At=113.92	*
Sand (%)	Ha=40.33	At=24.17	*
Nitrogen (%)	Ha=0.04	At=0.01	*
Ec	Ha=2.84	At=0.85	*
Calcium (meq/lit)	Ha=3.88	At=1.83	*
Sodium(meq/lit)	Ha=21.25	At=3.92	*
C (%)	At=61.33	At=40.5	**
T.N.V (%)	At=27.07	At=23.4	n.s
Clay (%)	Co= 19.17	At=14.5	n.s

Ha = the site of *Haloxylon ammodendron,* at= the site of *Atriplex canescens,* Co= control region
* and ** respectively indicate significant differences in levels 1% and 5% , n.s =no significant difference

Comparing two different depths in the treatments showed significant differences in the factors of N, P, K, EC, calcium and sodium. The amount of N, P, and K in depth 0-20 cm and EC, calcium and sodium in depth of 20-80 cm was much that shows the nutrient material and its Fertility has increased in surface soils.
Depth of 0-20cm of *Haloxylon* site has the most amounts of nitrogen, phosphorus, organic matter and potassium. The result of this study also shows that the amount of Phosphorus and Silt in the site of *Atriplex canescens* is more than control area but it's not significant. The amount of acidity, organic matter, sand, clay and N in control area is more than *Atriplex* site. Also the salinity in *Atriplex* site is slightly increased compared to control area that results of research of Jafari (2005) show this, too. The interaction of depth and treatment shows that the N, P, K in the surface layer of soil is more than depth but other factors are more in depth of 20-80 cm that there is no significant difference in any one of elements.

4. Discussion

It seems the highest amount of sand in *Haloxylon* site is for this reason that in this area, *Haloxylon* have been cultivated on soils with more sand at first. As Javanshir *et al,*. (1998) stated that *Haloxylon ammodendron* belonging to the early stages of sequence is in sandy soil (Azarnivand and Zare chahouki 2009, Henteh 2002, Jafari 2004 , Orlovsky & Birnbaum 2002). Cultivated *Haloxylon ammodendron* increased organic matter in soil that has been improving soil structure in the long time. Also has been increased N, P, K, electrical conductivity, acidity and salinity. The results of Azarnivand *et al,*. (2004), Jafari *et al,*. (2004) and Zandi Esfahan *et al.,* (2007) are in agreement too. Nitrogen in control area is more than *Atriplex* that could be due to this plant will absorb nitrates from the soil, thus nitrogen content reduced in soil McKeon et al,.(2005). In the *Atriplex* site has seen an increase in salinity (Jafari, 2005). Cultivate *Haloxylon ammodendron* in this area reducing wind speed and causing an increase in the Fertility of surface layer of soil, which is especially evident between the *Haloxylon* shrubs. About the elements, should be mentioned to their role in improving soil structure. Calcium is involved in the evolution of organic matter and making clay thus in the formation and stability of the soil structur. It is very important in improve the soil physical properties, and cause to absorb the other mineral elements (Jafari and Sarmadiyan, 2004). Also, there is the relationship between clay content and soil organic matter and it is because of food and water stored in these types of soils thus production and accumulation of organic matter is more in fine texture soils. With increasing amounts of organic matter in soil, nitrogen and phosphorus that are important components constituting this materials increases (Mahmoodi and Hakimiyan, 2008). According to the Observations, native range species and amount of litter are increased between shrubs in the *Haloxylon* site compared with the control area.

Therefore, based on test results and observations can be concluded that the cultivated *Haloxylon ammodendron* cause to improve vegetation condition, soil structure and soil fertility especially at between shrubs.

The more Organic matter and nitrogen content in the control area compare with site of *Atriplex canescens*, may be due to that *Atriplex canescens* will absorb nitrates, so the percentage of nitrogen decreases in the soil. McKeon *et al*., (2005) conducted the research in a 1.6 ha plot of Atriplex canescens was established in a desert soil at a former uranium ore-processing plant, in Arizona, to remediate nitrate and ammonium N contamination. The plants were irrigated to stimulate growth and N uptake. However, NO^{3-} loss from the soil was unexpectedly rapid. Additionally, microcosm studies indicate significant potential denitrification rates on the plot but not for control soils.

This findings of the rapid denitrification in desert soil, is a low-cost method for the recovery of nitrate can be used in similar areas.

In *Atriplex* site salinity has increased in compared with control area that are in agreement with Jafari results (2005). He told that salinity is Leaching by rain and transferred to the below depth of soil. Also in the present study EC was much higher in the *Atriplex* site than the control area.

Totally and according to the results can be stated that cultivation Atriplex canescens changes soil very slow such as the study area that there is not significant differences after past 20 years in the soil.But despite this, can not be ignored the increase in soil nutrient factors and soil fertility under shrub canopy in the surface layers, although its value is negligible. But it is recommended that research be conducted about planting other species that are adaptable to the ecological and edaphical conditions than in addition to sand dune stabilization, have viewed improvement of soil chemical and physical properties in such areas.

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Soil Degradation and Wheat Yield in Dry-Farming Lands in A Semi-Arid Region, Iran

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Abstract
Land degradation is one of the most serious global environmental issues of our time. Water erosion is a physical factor influencing land degradation because of its irreversible decline in soil productivity. Soil erodibility factor (K) can be considered as one of important indicators for assessing the soil's susceptibility to degradation. This study was conducted in a semi-arid agricultural region (900 km^2) in Hashtroud, north west of Iran to determine the relationship between the crop yield and K factor. Thirty six dry-farming lands with a uniform slope 9% were selected in the study area. Soil erodibility factor and wheat grain yield were separately measured at three unit plots (1.83m × 22.1m and 9% slope) installed in each land under natural rainfall conditions for a two-year period. Results indicated that distribution of rainfalls in the study area was uniform. The K factor and wheat grain yield significantly varied among different dry-farming lands ($p< 0.001$). These differences were just due to variations of soil properties in the study lands. The wheat grain yield negatively correlated with the soil erodibility factor ($R^2= 0.71$). Multiregression analysis showed that aggregate stability and permeability were the most important soil properties that significantly affected the soil erodibility factor ($R^2= 0.90$) and crop yield ($R^2= 0.74$) in the study area.
Keywords: Soil productivity; Physical properties, Soil erodibility

Introduction

Soil degradation is usually a complex process in which several features of soil deterioration can be recognized. Soil degradation may lead to the loss of land or soil; limitations to normal soil functions; decrease of soil fertility and 'productive capacity' (Várallya, 1989). This phenomenon is generally divided into three classes: (1) physical degradation, (2) biological degradation, and (3) chemical degradation (Barrow, 1991). Different factors consist of environmental factors (climate, vegetation, soil) and anthropogenic factors (management) can be considered in assessment of potential of the land degradation in different regions (Lavado Contador et al., 2009). Soil erosion has long been recognized as an important factor in reducing the productivity of many lands (Fenton et al., 2005). That is perhaps the most serious form of land degradation throughout the world (Lal, 2005). Soil erosion diminishes productivity by reducing topsoil depth (Lal et al., 2000), the availability of water (Bossio et al., 2010), nutrients (Kothyari et al., 2004) and organic matter (Fenton et al., 2005) and also by restricting rooting depth. Sheet and rill erosion are dominant kinds of water erosion particularly in the croplands (USDA, 1981). Soil erodibility is one of the factors affecting erosion, which expresses the soil's susceptibility to erosional process influencing in developing sheet and rill erosion. In the universal soil loss equation, USLE (Wischmeier and Smith, 1978) it (K factor) can be determined on the basis of soil's susceptibility to sheet and rill erosion. Deterioration of soil by erosion often results in decreasing crop productivity (Bakker et al., 2004). Thus, soil erodibility factor can be considered as one of the most important indicators to assessment of degree of land's vulnerability to degradation (Chikhaoui et al., 2005). Since, soil degradation is also a major environmental and economic problem in the north west of Iran that threatens the sustainability of agricultural lands. Assessment of soil's susceptibility to degradation (soil erodibility factor) is essential for management decisions in the agricultural lands. Therefore, the objectives of this study were to assess soil degradation and identify soil properties influencing it in dry-farming lands of a semi-arid region.

Materials and Methods

The study area was an agricultural region with 900 km^2 in area located between 37° 18' 39" - 37° 35' 0" latitude, and 46° 46' 5"- 47° 6' 5" longitude in the Hashtroud Township, located in the East Azarbijan Province, northwestern Iran (Fig. 1). The region had a semi-arid climate, with four distinct seasons and an average annual precipitation of 322 mm. The study area consisted of 36 grids with a dimension of 5 km × 5 km. To investigate soil erodibility and wheat yield, a dry-farming land under the fallow condition located in a uniform southern slope of 9% was specialized according to the USLE criteria (Wischmeier and Smith, 1978) in each grid. To field measure of soil loss and crop yield, two separate parts with an area of about 200 m^2 and 10 m spacing were considered in slop direction of each dry-farming land.

Wheat grain yield was determined at 108 plots installed in 36 dry farming lands in the study area. Spring wheat was sown in area about 200 m^2 at three plots in each land right after plowing at last March. The size of each plot was 22.1 m length by 1.83 m width with a buffer bed 1.2 m in between the plots. The Sardary variety, normally grown for bread, was planted in depth of about 4-6 cm, with a 20-cm row spacing and 5-cm plant spacing. For providing similar conditions between the crop plots and erosional plots (Wischmeier and Smith, 1978), was avoided from fertilizer application to enhance crop yield in the planted plots. Mean grain yield of each dry-farming land (t ha^{-1}) was calculated from averaging the yield values of each plot. The mean wheat yield for a two-year study period was computed using the yield values of the first and second year (t $ha^{-1}yr^{-1}$).

To detyermine soil's sucpetibility to water erosion, (erodibility factor of K) three unit plots with 1.83-m wide and 22.1-m long (Wischmeier and Smith, 1978) and 1.2-m spacing were installed in other area (about 200 m^2) beside the planted area in each dry-farming land. At all, soil erodibility factor was investigated at 109 standard plots in the study area. The soil loss in each rainstorm was calculated through multiplying the total tank's contents volume by the sediment concentration (Zhang et al., 2004). Field measurements of the soil loss were performed for a 2-year period from March 2005 to March 2007 and accordingly mean annual soil loss was computed. The soil erodibility factor, K (t h MJ^{-1} mm^{-1}) of each plot was determined as the average rate of annual soil loss (t ha^{-1} yr^{-1}) per unit of rainfall erosivity factor (MJ mm ha^{-1} h^{-1} yr^{-1}).

To identify soil properties influencing degradation, soil samples (0-30 cm depth) were taken randomly from three locations within each plot before plowing. The particle size distribution consisted of coarse sand (0.1-2 mm), very fine sand (0.05-0.1 mm), silt (0.002-0.05) and clay (<0.002 mm) was determined by the Robinson's pipette method (SSEW, 1982). Gravel (2-8 mm) was determined using the weighting method (Gee and Bauder, 1980). The total soil organic carbon was measured by the Walkley–Black wet dichromate oxidation method (Nelson and Sommer, 1982). Soil pH and electrical conductivity (EC) were measured by pH meter and EC meter, respectively. Total nitrogen (TN) was determined using semi-micro Kjeldahl after digested by H_2SO_4. Soil phosphorus was measured using spectrophotometer after wet digestion with H_2SO_4 and $HClO_4$. Soil available potassium was determined using flame spectrometry after wet digestion with H_2SO_4 and $HClO_4$ (Parkinson and Allen, 1975). To determine lime amount, the total neutralizing value (TNV) on the basis of calcium carbonate was measured using acid acetic volume consumed to neutralizing carbonates (Goh et al., 1993). The aggregate stability was determined using the wet-sieving method based on the mean weight diameter (MWD) as proposed by Angers and Mehuys (1993). The soil infiltration rate was determined in the field based on the final infiltration rate for each plot using double-ring infiltrometer (Bouwer, H. 1986).

Results and discussion

During this period, out of 97 rainfall events, 41 rainstorms produced runoff and sediment (soil loss) at the unit plots in the study area. There was no significant difference among the rainstorms values of the different rain gauge stations. In fact, the spatial distribution of the rainstorms was uniform. Thus, variations of soil loss at different unit plots were directly related to their soil's susceptibility to degradation (soil erodibility factor). Mean values of the wheat grain yield varied from 0.801433 t ha^{-1} yr^{-1} (in dry-farming land 1) to 3.484342 t ha^{-1} yr^{-1} (in dry-farming land 8), with an average of 1.937798 t ha^{-1} yr^{-1} in the study area for a 2-year study period (Table 2). Wheat grain yield significantly ($p<0.001$) varied among the dry-farming lands. Differences of the wheat yield among the dry-farming lands were due to just variations of the soil properties among them. The mean values of the soil erodibility factor also ranged from 0.002032 to 0.007172 t h MJ^{-1} mm^{-1} with an average of 0.004447 t h MJ^{-1} mm^{-1}. There was a significant difference among different dry-farming lands from view point of the soil erodibility factor. This difference was also related to kinds of the soil properties in the dry-farming lands. The wheat grain yield linearly correlated (R^2= 0.714, p<

0.001) with the soil erodibility factor (Fig.2.). With a increasing in the soil erodibility factor, the wheat yield remarkably decreased. Regarding both variables i.e. soil erodibility factor and wheat yield directly were related to the soil properties, it can be resulted that soil properties that negatively affect the erodibility factor (K) so could increase the wheat grain yield.

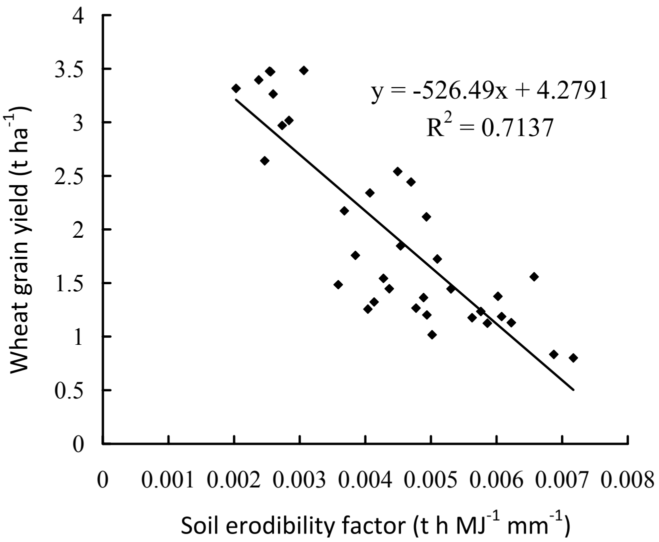

Fig. 2. Relationship between wheat yield and soil erodibility in the study area.

Soils were mainly clay loam containing 1.1% organic matter. Soils were calcareous with 12.7 % calcium carbonate equivalent on average. Soil pH varied from 7.3 to 8.2, with an average of 7.8. Soil hydraulic conductivity (EC) was ranged between 0.32 dS m^{-1} to 2.19 dS m^{-1}, with an average of 0.8 dS m^{-1}. Soils had very low amounts of nitrogen (1.0 %, on average). Soils had the high amounts of potassium (314.7 mg kg^{-1} on average) that was suitable to wheat nutrition. The aggregate stability values of the soils on the basis of the mean weight diameter (MWD) were ranged between 0.27 and 1.91 mm with an average of 1.13 mm. The soil permeability value on the basis of the final infiltration varied between 1.4 and 5.8 cm h^{-1} with an average value of 3.5 cm h^{-1}. Results of the correlation matrix (Table 1) showed that wheat grain yield and soil sceptibility to degradation (K-factor) had the highest correlation with the aggregate stability and infiltration rate. Our results also agree with Bronick and Lal (2005) who noted that favorable soil structure and high aggregate stability are important to improving soil fertility, increasing agronomic productivity, enhancing porosity and decreasing erodibility. This study as noted by Franzluebbers (2002) showed that the infiltration rate is an important soil feature that controls runoff. With an increasing in infiltration rate, runoff decreased and crop water demand was supplied. So, the infiltration rate was a vital soil factor in crop production.

Table 5. Regression analysis of the relationships between the soil erodibility factor and wheat yield, and its effective soil properties

Soil property*	Wheat grain yield			Soil susceptibility to degradation (K-factor)		
	Coefficient	Std. error	Sig. level	Coefficient	Std. error	Sig. level
Constant	-0.85762	0.29723	$p < 0.01$	0.00940	0.00029	$p < 0.001$
Aggregate stability	1.01786	0.17472	$p < 0.001$	-0.00170	0.00017	$p < 0.001$
Infiltration rate	0.46062	0.06636	$p < 0.001$	-0.00085	0.00007	$p < 0.001$

The results showed that aggregate stability and permeability were significantly affected by soil particles (coarse sand, very fine sand, silt and clay), organic matter, and lime. Soil properties that considerably enhanced the aggregate stability and soil permeability significantly decreased the soil erodibility factor and in consequence improved the wheat grain yield. Coarse sand, clay, organic matter, lime contrary to very fine sand and silt improved either the aggregate stability or soil infiltration rate and in consequence declined the soils' susceptibility to degradation and enhanced wheat grain yield in the study area. The importance of soil organic matter (SOM) as a parameter of the sustainability of ecogeomorphic systems was emphasized by many authors (Marqués et al., 2005). Therefore, from management approach, adding organic matter to soil as retention of plant remains and application of organic manures is an effective management practice to improve soil properties for declining soil's susceptibility to erosion and enhancing crop yield.

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Challenges and strategies for management of soil resources

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Abstract:
as we know soil and water have an important role in our lives and social, economic and political firmness for human kind so soil and water sources recognition and correct preservation and also correct management and exploitation of them for our aim progress and agricultural and country's natural sources programming has a special importance and place. With attention to world population increasing for providing sufficient food and arriving to agricultural and natural sources programs many countries have established many educational executive and promotional organization in soil and water commands. Soil as a non renewable natural source and national capital exposed to deterioration humid activities can be the main cause of soil deterioration to become useless so correct evaluation of soil sources with attention to it's capacity and natural and human threats it is too important that with and water quality decreasing green house gases prolapsed to atmosphere and worlds weather warming poverty food deficiency and economic problems are it's consequences also content of soil sources as an national capital deal with many constraints and managerial structures in this regard have developed very low the air of this article is to descript the soil sources as a national capital and evaluating it's importance and it's detritions and it's threatened factors and in the end to find ways for preventing soil sources destruction
Keywords: management, sources, constraint, soil and water

Introduction:
Soil as an unrenewal resource and national source and the life basis had destroyed in the world 562 million hectare of agriculture land and 685 million hectare of range lands have destroyed 75% of soil waste is results of water erosion and 83%, 90% and 60% are respectively results from wind erosion ,chemical destroy and physical destroy and the most destroy is in developing countries the growth rate of word is 18% annually and other factors such as unbalanced distribution of soil resource in the word, human try to produce food and other agriculture products, the soil destroy . The soil erosion is not a new phenomena. And during the history accrued in recent era the water and wind erosion discussed in a new shape and it's main factor is the non correct agricultural activities. In Iran there is annually 1 milliard ton soil erosion. The current observations showed that the organic methods decrease the soil erosion dramatically and increase the soil structure with increasing it's activity and improving soil Aggregate. The non correct activity caused 28% soil erosion during the past 50 years. But the appropriate systems with soil structure improvement have increased the microorganisms activity especially the fungal and bacterial activity.

Result and discussion:
Threatened the life of I million person in more than 110 country understanding the environmental problems of these phenomenon's because of the comply effect mechanism or climatology, demography, population and social programs is very hard. So it's control needs a multilevel perspective. Also the world population had 1/8% increase and it has predicted that in the 2025. (Ahlander, 1994). The most growth is there in developing countries the world need to food during

the 1990-2030 would twice and predicted that the third world countries would increase more than 2/5 or 3(Dailey et al., 1998) despite these challenges the human society needs to regarded as the life basis and a has dynamic balance of hydrosphere, lithosphere and atmosphere. An sustainable human activity result the soil destroying. So the soil resource evaluation with attention to it's capability and human and natural threats is too important, and if not many problems such as water quality decrease green house as production and climate warming would occurred.

The sustainable soil management as a national resource also have many limitation and it's managerial structures had low development. In the world , 562 million hectares of agriculture lands and 685 million hectares of range lands had destroyed physical process such as food destruction soil erosion and chemical process such as food destruction result of soil acidification and biological process such as weather changes drought have aggravate the soil destruction(Lal 2000).

Table (1): soil destruction in third-world countries (Oldeman, 1994)

Area	**Water erosion**	**Wind erosion**	**Chemical destruction**	**Physical destruction**	**Total**
Africa	227/3	187/8	59/3	19/8	494/2
Asia	435/2	224/1	74/7	15	747
Central America and Mexico	46/5	4/4	6/9	5	62/8
South America	124/1	41/4	70/6	7/3	234/4
Total	831/1	457/7	211/5	47/1	1538/4
Total world	1100	550	235/8	78/6	1964/4
Percent of the world	75/6	83/2	89/7	59/9	78/3

Un appropriate usage of irrigation systems increased the water waste because more than 90% of agricultural crops needs the water and using inappropriate water usage systems the soil destruction have increased that 20% decrease in crop production have occurred especially in 8 country such as china, Indian, Iran, Israel, ordain, euro pea, Nepal, Pakistan, (Drenge, 1990) Also more than1/5 billion mega gram surface soil have erased. (Alhander, 1994; Allison, 1996). One of the other factors in the soil acidification as a new problem that need a defend fertilization project and about $1/7\times10^6$ hectare of irrigated lands have acidified. (Table 2).

Table (2): The destructed irrigated lands resulting soil acidification and inappropriate fertilizer usage in some developing countries:

country	**India**	**China**	**Pakistan**	**Mexico**	**Thailand**	**Uzbekistan**	**Egypt**	**Bangladesh**	**Romani**	**Afghanistan**	**Torkamanestan**	**Tajikistan**
The destructed land resulting acidification	**7**	**6/7**	**4/2**	**1/6**	**1/5**	**2/4**	**0/9**	**1/3**	**0/3**	**1/3**	**1/1**	**0/3**

Desertification in another factor that affect the soil destruction in arid and semi-arid areas. And is a serious problem in developing areas. Soil waste increased to 250 mega-hectares in areas without plant cover and 787and 2576 mega-hectare in respectively the areas with plant cover and rangelands. The soil waste results of water erosion is about 478, 513, 111, 35 mega-hectare (table 3).

Table (3): The desert area development on the basis surveys of (lal, 2000) Glasod (1998) and UNEP91991)

UNEP (1991)		Glasod (1998)	
The type of destructed lands	Area(10^6) hectare	Soil destruction type	Area(10^6) hectare
Irrigated lands	43	Water erossion	478
Irrigated agricultural lands	216	Wind erossion	513
Range lands	757	Chemical destruction	111
The sub group	1016	Physical destruction	35
Area without soil cover	3592	Total	1137
destructed lands	5172	low medium high	489 509 139
destructed percent	69/5	Total	1137

The carbon waste result of other factors such as erosion, acidification and desertification would increase dramatically. The decision- makers and political men in the world not only recognize the desertification factors but also have done activities to their control the appropriate using of land and using effective soil management to reduce land destruction are the main ways. Doing these projects need effective work method providing the tads society cooperation and public and private organization despite this the soil value is about 17/1 trillion dollar annually that has an important role in earth's life with attention to the results to sustainable management of soil resources and avoiding it's desertification, there are two strategy destructed soil and ecosystems restoration and using modern agricultural technologies and improving them.

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Role of Desert Pavements on Plant Establishment, Soil Degradation and Desertification (Case study: Hajaligholi playa, Damghan, Iran)

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Abstract
Desert pavement, a superficial feature from wind erosion widespread throughout arid lands, plays a dynamic role in geomorphic, hydrologic, and ecologic processes. In these regions the plant cover is low or inexistent. Desert pavement is usually covered with large, small, and angular stones. Spatial distribution of stones at surface is reflecting rainfall distribution at land surface. Our objective in this study was to determine the relationship between surface physical characteristics of Desert pavement (meter scale), water movement, subsoil and plant cover. The density and type of cover in land surface are also investigated. For this purpose two different areas (Hajaligholi playa, Damghan) with different geology were selected. In each region, profiles were dogged. In site one, six different profiles dogged and in each profile samples in different horizons (0-10, 10-20, 20-30, 30-40, 40-50cm) were been taken. In site 2, 3 profiles dogged and also in the same horizon samples were been taken. The type and density of vegetation were determined. Finally two sites were been compared. The results showed that strong relationship is between stone cover, soil genesis and plant distribution. Physicochemical properties (particle sorting, stones rates, EC, pH, Gypsum) highly depend on the upland geological characteristics of region. Also, soil structure and salt concentration have strong relationship with stone component. The distribution and density of vegetation show strong linkage with these properties. Also, in sites with desert pavements and dense plant cover, soils are protected and thus, reduce loss of fertile soils and also decrease desertification and wind erosion.
Keywords: Desert pavement, plant**,** desertification, soil properties**,** Hajaligholi playa

Introduction

Desert pavement is a process that occurs by wind erosion in flood plain of arid lands. The age of desert pavement is about 10^5 to 10^4 years old (Mc Fadden et al, 1998, Engel and Sharp, 1985 and Cook et al, 1993). Desert pavement is an important surface process that has high expansion in Iranian arid lands and plays important role in hydrological, ecological and geomorphologic processes. There are several theories for formation of this geomorphologic process. The most important theory express that fine particles and sands are wiped by wind and coarse particles are remained, so, desert pavement is occurred that is a vital factor for next wiping, detachment and protection of particles (fig. 1). Another theory implies that desert pavement formed by expansion and shrinkage of clay minerals beneath them, so, rainfall is absorbed by clay minerals and causes them to expand. Then, when these clay minerals are dried, cracks are created on them. It is possible for this process to transport stones to the surface in arid reigns over time. In desert pavements, fine and coarse stones are round with different size, sharp and flat that change to be varnished because of accumulation of ferric and magnesium oxides that is called "desert varnish". Desert pavements are a result of wind erosion in flood plains that wipe fine particles(silt, clay and sands) and leave coarse particles(gravels and stones)(Wells et al, 1995, Mc Fadden et all, 1987), so, plays vital role in preventing of next wind erosion(Azimzade et al, 1981). Desert pavements are formed in alluvial fans, basaltic flow, pluvial lake beaches and plain terraces (Cook et al, 1993). Desert pavements, whatever they form, have important role in geomorphology, hydrology, soil science and ecosystem process (Wells et al, 1995, Cook et all, 1993).

Figure1. Desert pavements in the region with plant (right) and without plants (left)

Desert pavements in some places include plants that result in changes in water and wind movement and infiltration water into the soil (Abraham & Parson, 1991 and Dunkerley & Brown, 1995). Desert pavements in larger scales are different and changeable view point of surface properties and in some cases has fine to medium gravels.

It is necessary to be considered that studies in these sites are according to nature function assumption and are out of human activities. Although in some cases, human activities such as plant eradicate or overgrazing by animals like sheep, cows or camels, may cause wind erosion and then form desert pavement in long time. In this research tried to study different physical properties about them, so, field works were made. Also, spare plant covers of these pavements were studied. In Iran, precise studies have not been made about desert pavement, just only about wind erosion activities like Azimzade, H.R and Ekhtesasi, M.R. studies (1999). Their results showed that desert pavements are a key factor in controlling wind erosion and lack of them induce wind erosion threshold to be reduced about 50 percent. But extensive researches have been made about desert pavement in United States and other countries such as study of Yvonne A. Wood et al., 2002, that implies surface controls of desert pavement pedological processes and extension of their plant cover. Their results showed that there are some kind of relationships between desert pavement areas and water movement in soil and plant cover. They also showed that there are strong relations between plant cover extension and their properties with soil structure and salt accumulation in it. Another study has been done by Qujianjun et al.(2002), that showed desert pavement disturbance is made by grown plant in Pleistocene period like Pinon Ponderosa. He also implied that desert pavements have a conservative key for subterranean layers. John D. Pelletier et al. (2007) did a research about desert pavement dynamics, numerical modeling and its calibration according to field works data. For calibrating model, they mapped region geology and analyzed desert pavement in the region. The results showed that parent material has a key role in region. P. K. Haff(2001) did a research named “desert pavement of a desert environment” in national park near the death valley in USA and concluded that with possible changes in desert pavement surface, fundamental changes will occur in desert environment.

Materials and methods

Study area

The Study area is located in southern edge of Hajaligholi playa, southestern of Damghan city in Iran, Semnan province. The area end up from south-side to Dolatyar, khers and Torkaman Ghodar mountain, from southwestern-side to Kohpanj and Kuhsorkh, from east-side to Ahond mountain, and from west-side to Dehestan villages (figure 2). The area has lied in longitude 54º 02′ 51″ to 54º 31′ 23″ and latitude 35º 10′ 34″ to 35º 53′ 29″. Mean elevation from sea surface is 3455m. The area is similar to a narrow and wet-bond near the salt lake. The study area according to iso-precipitation map, is located between lines of 120 to 160 mm (mean of 130mm) and the area’s atmosphere temperature with respect of annually isotherm map, is between 19-24, Annually mean evaporation of Damghan city is 2405mm. The rate of sunshine hours is 3450 to 3650 hours. Relative humidity is between 79 % in February month and 40 % in June month at 6:30 A.M., according to 35 yearly means.

Figure 2: The area's location by Google earth ETM$^+$, 2012

After determining the work units by aerial and satellite photos and field works samples had been taken from units. At this pediment area, Stone sizes got smaller from foothill towards low lands. The region is covered by flood plains and most of them are belong to quaternary period. Sediments before this time (Paleozoic and Mesozoic) are in nearly mountains next to the plain. Their lithology includes marls, sandstone and limes with different diameter and Qc ،Qm ،Qs و E_b. At this area, we considered profiles in 2 large sites. Then, we assessed desert pavement forms and size (table 2). After that, we dogged profile in all sites and took samples in different layers (0-10, 10-20, 20-30, 30 -40 and 40-50cm) (samples 1-9 in table 1). Then, samples were transported to Lab and soil factors like ph, gypsum, EC and granolometry (table 3) of them in each layer were determined. Because of low expansion of desert pavement in some section of this area, 3 sites were selected (samples 7-9 in table 1) to be compared with sites with dense desert pavement cover. At last, these two study area got compared viewpoint of physical and chemical properties and desert pavement genesis. Also, stone size, sorting rate and surface cover percent were determined.

Results

At below (table 1, 2 and 3 and figures 3 and 4) are seen rates of ph, gypsum and EC of samples in different depths of soil profile, also stone properties and determining granolometry and, ph, gypsum and EC of soil samples.

Table 1. Rates of ph, gypsum and EC of samples (sample 1, 2 and 9) in soil profile

Samples	*depth*	*Gypsum(meq/100gr)*	*Ph of Soil paste*	*EC(ds/m)*
Sample 1	*0-10*	*0.6*	*5.3*	*3.1*
Sample1	*10-20*	*0.45*	*6.2*	*3.1*
Sample 1	*20-30*	*0.45*	*6.8*	*1.8*
Sample 1	*30-40*	*0.62*	*6.9*	*2.5*
Sample 1	*40-50*	*0.65*	*4.8*	*2*
Sample 2	*0-10*	*0.8*	*5.8*	*4.2*
Sample 2	*10-20*	*0.8*	*6.6*	*3.2*
Sample 2	*20-30*	*0.8*	*6.1*	*3.8*
Sample 2	*30-40*	*0.8*	*8.1*	*4.4*
Sample 2	*40-50*	*1.6*	*6.0*	*6.6*
Sample 9	*0-10*	*0.8*	*6.8*	*4.2*
Sample 9	*10-20*	*1.0*	*4.5*	*6.2*
Sample 9	*20-30*	*1.2*	*6.1*	*5.8*
Sample 9	*30-40*	*0.8*	*6.1*	*4.5*
Sample 9	*40-50*	*1.6*	*5.9*	*6.5*

Table 2. Samples granolometry at regions

Site	*Cover%*	*Main form of stones*	*Stone width(mm)*		
Site 1	*86*	*Semi-Round*	*Minimum*	*Maximum*	*Mean*
Site 2	*78*	*Angular*	*2.4*	*56*	*11*
Site 3	*72*	*Semi-round*	*3*	*56*	*14*
Site 4	*80*	*Semi- round*	*5*	*65*	*12*
Site 5	*69*	*Round*	*7*	*62*	*13*
Site 6	*89*	*Angular*	*8*	*38*	*33*
Site 7	*84*	*Round*	*12*	*58*	*34*
Site 8	*68*	*Round-angular*	*18*	*48*	*38*
Site 9	*79*	*Round*	*12*	*52*	*42*

Table 3. Determining particle size analysis; sample no. 9

Soil on the sieve (gr)	*Soil on the sieve (%)*	*Passing soil(%)*	*Grain diameter (mm)*	*Sieve No.1*
	0.0310			*1"*
68	*0.0564*	*58*	*99*	*(3/4) "*
698	*0.3300*	*1026*	*1120*	*4"*
1214	*0.2345*	*369*	*268.2*	*10"*
653.1	*0.2001*	*128.2*	*315.1*	*40"*
465	*0.0254*	*365*	*459.2*	*100"*
	0.0232			*200"*
	0.0698			*Bottom of each seive*
	0.9704			*total*

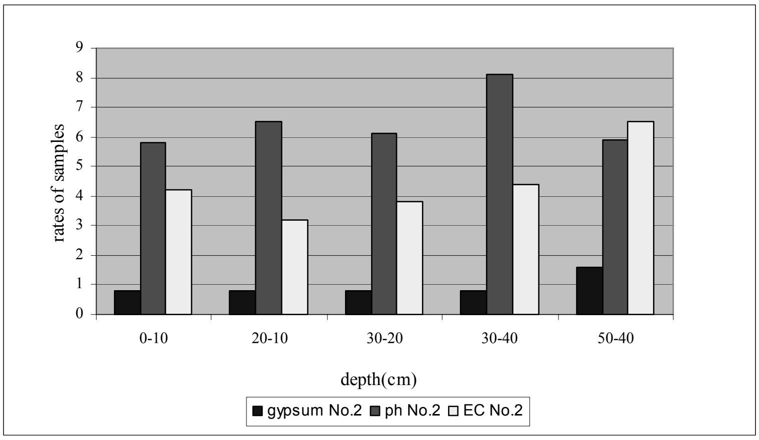

Figure no. 3. Rates of ph, gypsum and EC of soil sample No. 2

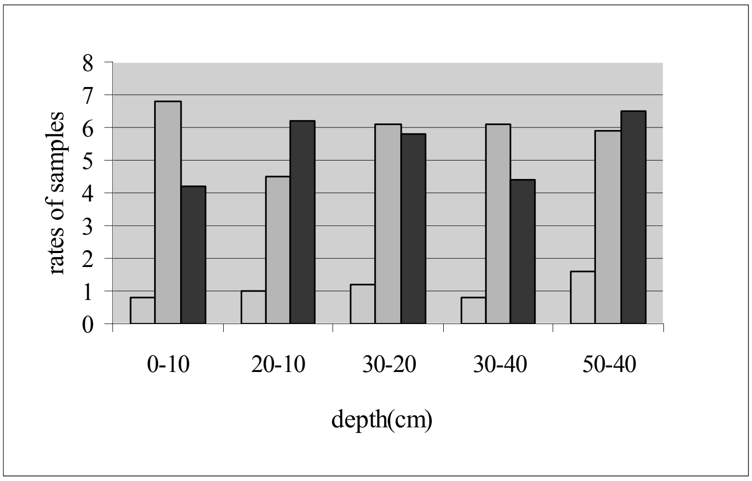

Figure no. 4. Rates of ph, gypsum and EC of soil sample No.9

Discussion and Conclusion

Physical properties of above layers up to 20 centimeters in arid region are very important in determining water local distribution and plant cover with regard to soil, land form and age. Also, bedrock affect on stone kind and form similar to Quade and S.L. Forman, 2002, D. McFadden and J.C. Dohrenwend 1987, Weide John D. Pelletier et al., (2007) results. In site 1, Plants include *Sedlitzia Rosmarinus, Calligonum gomosom, Salsola SP*. And *Haloxylon SP.* Results showed that there are desert pavements with different size, which getting smaller from foothill towards lowlands. Plant density in this region is highly related to desert pavement size, geology and soil genesis. Studied profiles indicate gypsum and $caco_3$ in bellow layers. The results related to this region are seen in table 1, 2 and 3 and figures 3 and 4. Plant cover is related to desert pavement density conversely, that implies surface control of soil available water, which means wherever stone cover was more; plant cover was lower. In site 1, with 4% ephemeral plant cover, stone cover and salt concentration were 55% and 50 respectively. In site 2, with 8% ephemeral plant cover, stone cover and salt concentration were 30% and 40 respectively. In site 2, plants include *Artemisia siberi*, S*edlitzia Rosmarinus and* Haloxylon *SP*. Its desert pavement has better particle sorting against site 1 stones. Similar to site 1, Plant density in this region is highly related to desert pavement size, geology and soil genesis (similar to Quade and S.L. Forman, 2002, D. McFadden and J.C. Dohrenwend 1987, Weide). But in the results, effectiveness of soil genesis was more than them. Also, nodules and gypsum layers were observed (against Wallace, A., E.M. Romney and V.O. Hale 1973). Generally, this status implies soil water control and plant distribution by stone cover (similar to results of Cooke, R.U. 1970. Mc Fadden, L.D., ET al.1998.). Plant density in this region is highly related to desert pavement size, geology and soil genesis (similar to Quade and S.L. Forman, 2002, D. McFadden and J.C. Dohrenwend 1987, Weide). With increasing of stone cover, leaching depth and soil water reduced(similar to Wells, S.G., L, D.L. (ed.) 1985), that increases salt concentration near surface and lower plant cover(according to Yvonne A. Wood et al., 2002, results). Moreover, desert pavement has vital role in controlling wind erosion in the region and increase wind erosion threshold rate. Thus, we must not disturb their structure according to Azimzade, H. and Ekhtesasi,M.R. 2011, Haff, P.K., Warner B.T. 1996, Wood, Y.A., R.C. Graham and S.G. Wells 2005, Valentine, G.A. and Harrington, C.D. 2006).

To summarize, desert pavements have vital role in controlling wind erosion in the region and increase wind erosion threshold rate. Plant cover is related to stone rates conversely. Generally, physical properties of above layers up to 20 centimeters in arid region are very important in determining water local distribution and plant cover with regard to soil, land form and age. Also, results showed that physicochemical properties (like stone rate, particle sorting of particles, EC., ph and gypsum) are highly related to their uplands geology. Similarly, Plant density in this region is highly related to these properties. Also, nodules and gypsum layers were been observed. With increasing of stone cover, leaching depth and soil water reduced, that increases salt concentration near surface and lower plant cover. At last, we must not disturb desert pavement structure and particle sorting, because it is a vital cover for controlling surface soil, different kinds of plants and increasing wind erosion and desertification (loss fertile soils) rates that invade most of Iranian cities like Yazd, Kerman, Damghan, Semnan, Sistan and Balochestan and so on.

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Investigation Soil physical and chemical properties and its relation with carbon dioxide rates variations in saline and Sodic soils (Case Study: Kashan, Iran)

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Abstract
Soil salinity and sodicity are major forms of land degradation in arid and semi-arid regions. Under such conditions, soluble salts accumulate in the soil and negatively affect soil properties such as Carbon dioxide (CO_2) rates and crop productivity. Soil respiration is the total efflux of Carbon dioxide produced from soil metabolic processes, mainly microbial decomposition of soil organic matter and root respiration. Carbon dioxide rates variations in soils is controlled by the input rate of organic material and the rate of decomposition which in turn are affected by temperature, moisture and soil factors. Few researches have been done about the relationship between soil properties and Carbon dioxide emission in salt-affected soils. In this experiment, we chose two sites; non-salt-affected and salt-affected soils (depth of 0-35 cm). Then we assessed electrical conductivity (EC) and Sodium adsorption ratio (SAR) in each site and Carbon dioxide release was measured over 70 days at constant temperature and soil water content. Differences in two sites were a function of differences in soil texture, soil organic matter (SOM) and also EC and ESP. according to regression analysis by SPSS software, Cumulative Carbon dioxide emission rates was negatively correlated with EC in saline and sodic soils (R^2 = 0.6) and bulk density and clay percent in non-salt-affected soils. In each site, cumulative Carbon dioxide emission was significantly positively related to the content of soil organic matter (SOM). The results showed that in salt-affected soils, EC and ESP and clay percent were the main factors influencing soil CO2 emission rates, but in non-salt-affected soils, main factors were clay percent and bulk density.
Key words: Carbon dioxide rates, regression analysis, Salt-affected soils, soil factors, Kashan, Iran

Introduction
Soil salinity and alkalinity (sodicity) are major forms of land degradation in arid and semi-arid regions where precipitation is too low to maintain a regular percolation of rain water through the entire crop root zone of the soil. Under such conditions, soluble salts accumulate in the soil and negatively affect soil properties and crop productivity (Rengasamy, 2010). Decrease osmotic potential, thus inducing osmotic stress for microorganisms and then reducing their metabolic activity. Soil respiration is the total efflux of CO2 produced from soil metabolic processes, mainly microbial decomposition of soil organic matter and root respiration (Singh and Gupta, 1977). Soil microbial respiration from decomposition of organic matter constitutes approximately 50% of soil CO2 emission (Rastogi et al., 2002). The measurement of CO2 emission from the soils is a sensitive indicator of availability of soil C to decomposition (Al-Kaisi and Yin, 2005). It is important to quantify the effect of physical and chemical soil properties to accurately predict CO2 release and understand SOM turnover in a landscape. The impact of temperature, water and clay on CO2 emissions are well-studied in non-salt-affected soils, but less is known about the relationship between soil properties and CO2 emission in salt-affected landscapes. High EC causes osmotic stress and has been shown to reduce soil microbial activity (Pathak and Rao, 1998), but the impact of alkalinity or saline alkalinity on microbial activity is unclear with some studies showing no effect. Many of these studies have been carried out in salt amended soils that may not be representative of the ionic composition of salt-affected soils in the field (McClung and Frankenberger, 1987).

Materials and methods
The Study area is located in southern edge of salt lake, at 45 kilometer of north-eastern of Kashan city in Isfahan province. The area end up from south-side to sand lands, Maranjab caravansary, Koshko field and Yakhb mountain, from north-side to salt lake, from east-side to Abrizan mountain, Talbour and Sephidab and from west-side to villages, farms and Siahkouh, Sar, Takht Bozorg and Anabeneh altitudes(figure No.1). The area has lied in longitude 51º 45′ 51″ to 51º 58′ 46″

and latitude 34º 17′ 34″ to 34º 20′ 29″ (14,15 and 16). According to field works, the study area is 5422.448 ha. Mean elevation from sea surface is 975m. The area is similar to a narrow and wet-bond near the Salt Lake. The study area has 110mm precipitation and temperature of 20˚C. Annually mean evaporation of Kashan city is 2205.5mm.

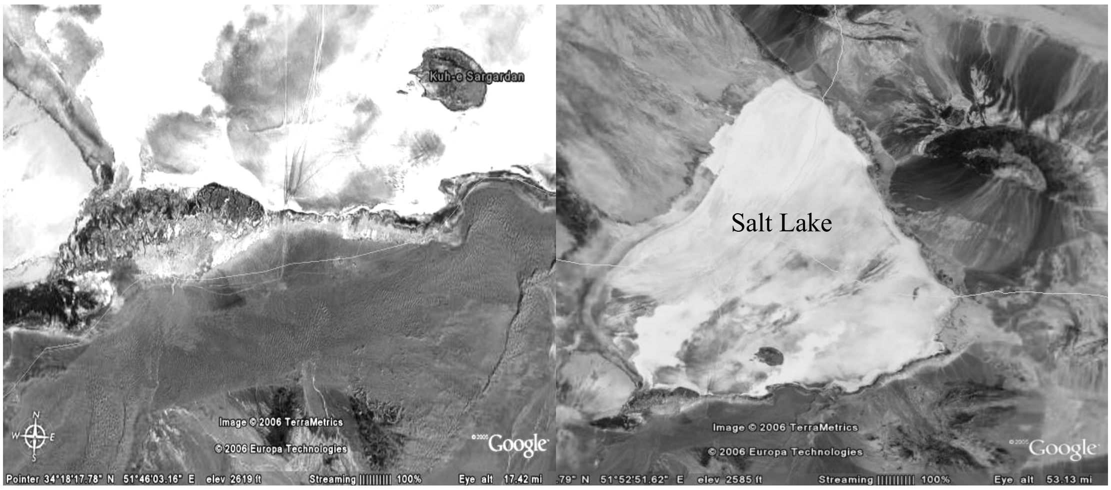

Figure No.1: The area's location (south of Salt Lake) by Google earth ETM^+, 2012

Two sites were used for collection of soil samples. The climate at site 1 is tropical and the mean winter temperature is 14˚C and the mean summer temperature is 34˚C. site 2 has a dry climate and the average winter temperature is 16˚C and the average summer temperature is 31˚C. Using IRS satellite data (spatial resolution 23.5 m), various physiographic units and land use classes were delineated. On the basis of physiography and land use, 100 and 130 salt-affected and non-salt-affected soils were collected from two sites, respectively, from 0 to 0.30 m depth. The soils were passed through a 2 mm sieve and stored air-dry. Soil characterization Soil pH and EC were measured in a 1:5 soil: water suspension after 1 h end-over e end shaking at 25˚C. To determine the sodium adsorption ratio (SAR), Ca and Mg were measured in a 1:5 soil: water extracts using atomic absorption spectrophotometer; Na was measured in the same extract using flame photometer and SAR 1:5 were calculated by the following equation:
$SAR=Na/ (Ca+Mg)^{0.5}$. Water holding capacity (WHC) was measured using a sintered glass funnel connected to a 100 cm water column. Soil was placed in rings in the sintered glass funnel, thoroughly wetted and allowed to drain for 48 h. Dry weight of the soil was determined after oven drying at 105˚C for 24 h. Bulk density was measured by the clod method before sieving the soil (Blake, 1965). Particle size distribution, total organic C (TOC), particulate organic carbon (POC) was estimated by mid infrared (MIR) spectroscopy on tungsten-milled subsample of the air dried soil (Janik et al., 1998; Janik et al., 2007). Humus-C was calculated as TOC minus POC. To verify the reliability of the MIR predictions for SOC pools in the soils used in this study, POC content were determined as described by Skjemstad et al. (2004). The soils were classified into saline, sodic and saline sodic based on EC and SAR as per the US Salinity Laboratory (Richards, 1954) after converting EC1:5 to ECe (Shaw et al., 1987) and SAR1:5 to SARe (Sodium adsorption ratio of saturated extract, Rengasamy et al., 1984. To ensure optimal moisture conditions for organic matter decomposition, a preliminary study was carried out to investigate the influence of WHC on respiration in the soils of different texture. For 20 soils covering the range of textures found in the study areas, WHC was adjusted between 50 and 85% at 5% intervals and CO2 emission of soils amended with 3 g glucose C per kg soil was measured over 7 days. The maximal respiration was achieved at 80% of WHC for soils with less than 12% clay, at 60% of WHC for soils with 12-20% clay, at 50% of WHC for soils with 20-50% clay and at 50% of WHC for soils with more than 45% clay. The soils used in the main experiment were incubated at the WHC that resulted in maximum respiration according to their texture. Respiration was measured by quantifying headspace CO2 concentrations within each jar using a Servomex 1450 infra-red gas analyzer (Servomex, UK).

Carbon dioxide was measured repeatedly for each sample over the duration of the experiment. For each measurement period, an initial measurement of the CO2 concentration in the headspace was taken immediately after sealing the jars. The closed jars were then incubated for a defined duration and then a second measurement of the CO2 concentration in the headspace was taken. Linear regression was used to define the relationship between CO2 concentration and detector response. Stepwise regression analysis was used to identify the main factors affecting CO2 emission in non-salt-affected, saline and saline-sodic soils separately. The regression analysis was performed by SPSS Statistical Software 17.0.

3. Results

Soils site 1 were characterized by pH values >7.5 and low to high salinity (EC1:5 from 1 to 9 dS m_1) and ranged from being non-sodic to saline-sodic (SAR from 0.15 to 30) (Table 1). The clay content varied from 46 to 348 g kg_1 with a median value of 180 g/kg. The median value of TOC was 12 g/kg. The particulate organic carbon content varied from 0.08 to 14.3 g/kg, char-C from 0.01 to 1.2 g/kg and humus-C from 1.1 to 8.9 g/kg. The cumulative CO2-C emission from soils was 4 mg/g1 soil. In site 2, the pH of soils was >7.1. Soils were non-saline to highly saline and ranged from being non-sodic to saline sodic (Table 1). The texture was finer. Clay content varied between 135 and 561 g kg_1. Char-C (between 0.01 and 2.2 g/ kg) and humus-C (from 1.1 to 10.3 g/kg), but the content of POC was lower, varying from 2.3 to 11.3 g/kg. The average cumulative CO2-C emission soils were higher. Relationships between soil properties and CO2 emission in site 1, was 25% of the observed variation in cumulative CO2-C emission was explained by negative relationships with clay and EC, whereas in site 2, 20% of the variation in cumulative CO2-C was explained by a negative relationship with EC alone. The regression analysis of non-salt-affected soils of site 1 indicated that cumulative CO2-C emission was significantly positively affected by POC whereas non-salt-affected soils of site 2, a negative correlation with clay explained 29% of the variance.

Table 1: soil properties and soil CO2 emission from soils in two sites

soil propeties	units	Site 1 Mean	site 2 mean
Bulk density	Mg/kg	1.8	1.3
PH	-	9.1	8.6
EC1:5	dS /m	1.7	1.3
SAR	-	4.5	5.1
Sand	g/ kg	610	482
Clay	g/ kg	180	350
Silt	g/ kg	270	280
Particulate organic carbon	g /kg	6.5	1.1
Char-C	g /kg	0.75	3.1
Humus-C	g /kg	5.1	35
Total organic carbon	g/ kg	12	37

For saline soils from both sites, the negative influence of EC explained 60% of the variance (Fig. 2 and 3).

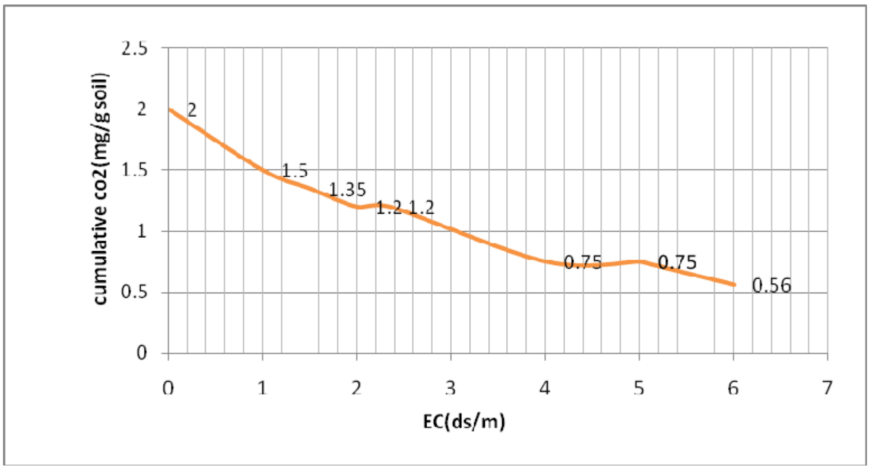

Fig.2. Relationship between EC and cumulative CO2-C emission from soils in site 1

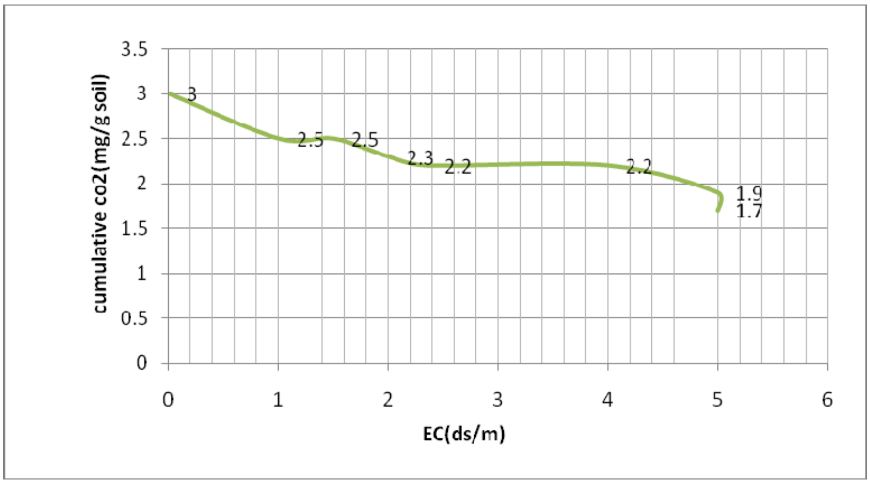

Fig.3. Relationship between EC and cumulative CO2-C emission from soils in site 2

Discussion and conclusion

The differences in soil properties between two sites (Table 1) can be explained by differences in soil age, bedrock, climate and cropping history. In site 1, soils are only 1-2 m deep, whereas, in site 2, soils are very deep. The lower organic C in site 1 can be explained by the higher temperature and soil water content (due to irrigation) compared to site 2, as these factors increase decomposition rate of organic matter. Additionally, the SOC content at site 1 is decreased by the high cropping intensity and management practices like tillage and removal of most harvest residues. The char-C content was higher in site 2, than in site 1, because of the long history of frequent burning of vegetation in the dry regions of site 1(Kianian et al, 2007). The MDS plots of soils of two sites (Fig.2 and 3) showed that soils could be separated based on soil texture (clay, sand), SOC pools (POC, humus-C) and also EC. The importance of EC was expected because of inclusion of saline soils (maximum EC1:5 were 3.4 dS/m for site 1 and 3.2 dS/m for site 2, Table 1). The observed patterns were not the result of differences in SAR, probably because only saline or saline-sodic soils were used in this study; none of the soils were sodic as per the classification of the US Salinity Laboratory (Richards, 1954). The standardized regression coefficient between EC and CO2 emission from soils in site 2 was higher than in soils in site 1. This may be due to the limited C availability in soils as it has been shown in previous studies with non-saline soils, C availability is the main limiting factor for microbial growth and activity (De Nobili et al., 2001; Mondini et al.,

2006; Hoyle et al., 2008). Moreover, active microorganisms may be more sensitive to salinity as it has been suggested in relation to sensitivity to drying and rewetting stress (Butterly et al., 2009).
To study the effect of soil physical and soil chemical properties on CO2 emission, the soils in the present study were maintained at constant soil water content and temperature as these factors can have a major influence on CO2 emission from soils. In our study, CO2 emission was negatively correlated with clay and positively related to SOC pools soils of two sites. Binding of SOM to clay decreases the accessibility of SOM to soil microorganisms (Hassink, 1997; Baldock and Skjemstad, 2000; Krull et al., 2003), resulting in decreased CO2 emission from clay-rich soils (Franzluebbers et al., 1996). A significant negative relationship between bulk density and CO2 emission can be explained by a smaller proportion of macrospores to micro-pores in soils with high bulk density that can limit fluid and gas transport and thereby microbial activity (Pengthamkeerati et al., 2005). De Neve and Hofman (2000) also observed a decrease in soil CO2 emission with increasing bulk density. Overall, CO2 release in salt-affected landscapes is affected by C availability (size of C pools), clay content and EC. A negative effect of bulk density on CO2 release suggests that CO2 emission is not only affected by biological and chemical properties of the soil but also by physical properties. Electrical conductivity has a negative impact on CO2 release in soils of two sites, which shows the effect of EC on CO2 release irrespective of climate and origin of salinity. Therefore, EC needs to be taken into account when estimating CO2 release in salt-affected landscapes.

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Studying Soil Physical and Chemical Properties on Plants Production Probability In Arid Region (Case study: Kashan, Iran)

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Abstract

Productive capacity or probable productions are useful in determining the suitability of soils for agricultural usage. Attempts have been made to key the production of agricultural crops or pasture to limited numbers of soil properties. An approach is described for predicting yields of wheat and cotton by some distinct properties of soils in lands with high level of management and agricultural practices. Statistical models were calibrated for the properties of the soils and the estimated yields of the two crops in 14 soils representing 3 great groups. The procedure includes analyses by multiple regressions (by SPSS software). Some Soil properties selected were: useful depth, clay and loam contents, water table, carbonate (CO_3) and bicarbonate (HCO_3) contents, electrical conductivity (EC), exchangeable sodium percent (ESP) and cation exchange capacity (CEC). Amongst Above properties, four properties, i.e. useful depth, EC and ESP and depth of water table, had important effects on yields of three crops.

Key words: Production estimation, Soil properties, land management, Kashan, Iran

Introduction

Productive capacity or expectable yields are useful in determining the suitability of any soil for agricultural use. Consequently, estimates have been made of the productivity of individual kinds of soils in many places. Attempts have been made to key the yields of crops or pasture to limited numbers of soil properties (Storie, 1950; Carstea, 1964; Sys, 1964; De la Rosa et al., 1977). Other approaches have relied on crop yields from identified soils in farm fields (Simonson, 1938; OdeU, 1958). With available computer techniques for storing and retrieving information, it should be possible, as suggested by Cline (1977), to prepare both more and better estimates of expectable yields from soils. This paper describes an approach for predicting yields of wheat, corn and cotton on the basis of selected soil properties. In this approach, statistical models were first designed to relate the yields of three crops to selected properties of 35 soils of Kashan. Correlations and multiple regression analyses were employed to investigate the relative contributions of the selected soil properties. Similar techniques were also applied to estimate optimum expressions of two properties, useful depth and depth to hydromorphic features, for maximum yields of the three crops.

Materials and methods

Study area

The Study area is located in southern edge of salt lake, at 45 kilometer of north-eastern of Kashan city in Isfahan province. The area end up from south-side to sand lands, Maranjab caravansary, Koshko field and Yakhb mountain, from north-side to salt lake, from east-side to Abrizan mountain, Talbour and Sephidab and from west-side to villages, farms and Siahkouh, Sar, Takht Bozorg and Anabeneh altitudes(figure No.1). The area has lied in longitude 51º 45′ 51″ to 51º 58′ 46″ and latitude 34º 17′ 34″ to 34º 20′ 29″ (14, 15 and 16). According to field works, the study area is 5422.448 ha. Mean elevation from sea surface is 975m. The area is similar to a narrow and wet-bond near the Salt Lake. The study area has 110mm precipitation and temperature of 20°C. annually mean evaporation of Kashan city is 2205.5mm. 20 cultivated soils were studied. The study area was 35,000 ha.

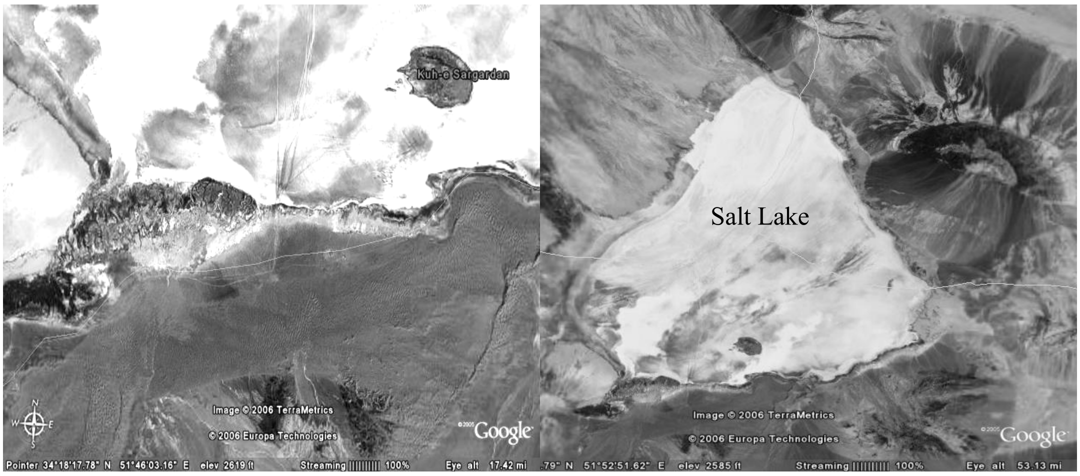

Figure 1. The area's location (south of Salt Lake) by Google earth ETM^+, 2012

The individual soils studied constituted entire fields. In sampling the soils, a single site was chosen to represent each of the 20 types. The soil characterization was made during a soil survey. The 20 soils were classified in the following great groups: Haploxeralfs (3), Rhodoxeralfs (3), Xerofluvents (7), Xeroch','epts (3), and Chromoxererts (9), as described in "Soil Taxonomy" (Soil Survey Staff, 1975). Useful depth was considered to be the total thickness of the soil profile providing a favorable environment for growth of roots. For the soils studied, the lower limits of useful depth were an impervious argillic material (BT horizon), a petrocalcic horizon (Cca) or a gravel layer. Depth to hydromorphic features was established as the depth between the soil surface and the horizon with many black iron-manganese nodules (De la Rosa et al., 1977). Clay content was determined by the hydrometer method (Bouyoucos, 1962). Carbonate content was measured by a volumetric method. Salinity was determined by the conductivity of a saturation extract. Sodium saturation (exchangeable-sodium percentage) was calculated by dividing exchangeable sodium by cation exchange capacity. Cation exchange capacity was measured by the NH_4Ac at pH 7.0 and leaching tube method. Exchangeable sodium was measured by flame photometry on the leachate (Soil Survey Staff, 1972). A control section of the soil profile was selected for taking soil samples for chemical determinations. It was established as a vertical section between 20 and 50 cm, between 25 and the limit of useful depth when this limit was between 20 and 50 cm or in any part above the limit of useful depth if this depth was less than 25 cm. Duplicate samples were taken to represent the control section of each soil profile, and duplicate chemical measurements were also made. Information on yields of wheat *(Triticum aestivum* L.) and cotton *(Gossypium hirsutum* L.) for the soils investigated was provided by farmers, soil scientists and agronomists. Estimated average yields were based on actual records so as to correspond to production obtained in recent years under a high level of management. The high level of management included the following practices: rainfall is conserved effectively; a surface drainage system is installed when needed; suitable quality and quantity of irrigation water are used; irrigation is timed to meet the needs of the soil and crop; irrigation is by furrows; tillage is timely; insect, disease and weed control measures are used consistently; fertilizers (N, P_2O_5, K_2O) are applied according to soil tests and crop needs; adapted crop varieties are used at recommended seeding rates; and crops included in the rotations are normally wheat, corn, cotton, sugar beets and potatoes. The crop yield or response Y was analysed as a function of the type:

$$Y=\varphi (x_l, x_2, ..., x_n) +e$$

Where, e measures the residual. As the mathematical form of φ is not known, this function can be approximated satisfactorily, within the experimental region, by a polynomial (Cochran and Cox, 1962). Thus for each crop, the following general polynomial model was used:

$$y = b_0 + \underset{1 \leq i \leq n}{£} b_i X_i + \underset{1 \leq i < j \leq n}{£} b_{ij} X_i X_j$$

where y represents the predicted yield, and b-values are the intercept term and partial coefficients for the independent variables: useful depth (X_1), clay Content (X_2), depth to hydromorphic features (X_3), carbonate content (X_4), salinity (X_5), sodium saturation (X_6) and cation exchange capacity (X_7), and their interactions of second order. Squared terms were not included in the general model for reasons of simplicity. Quadratic polynomials were also fitted. Their general form was:

$$y = b_0 + b_l X_i + b_2 X_j + b_3 X_i^{\,2} + b4 X_i^{\,2} + b_5 X_i X_j$$

These were limited to the two factors (useful depth and depth to hydromorphic features) which had the highest influence on the crop yields as shown in the correlation analysis. The calibration of these polynomial models was treated statistically as a particular case of multiple regressions. Correlation and multiple regression analyses were performed using the Biomedical Computer Programs, On the basis of the quadratic models; a mathematical procedure was followed in order to find a combination of X-variables to maximize predicted yields. This procedure was: by taking the first derivative with respect to each independent variable, setting it equal to zero and then solving a system of simultaneous equations.

3. Results and discussion

Ranges and mean values of useful depth, clay content, depth to hydromorphic features, carbonate content, salinity, sodium saturation, cation exchange capacity, wheat yield and cotton yield for the 20 soils investigated are reported in Table I. For each soil property, the scatter of the data was quite wide. Coefficients of variation ($\pm 1\sigma \times 100/\bar{M}$) ranged from 42 to 160%.

Table1. Ranges, means ($\bar{M}$) and standard deviations (σ) for selected properties of the soils investigated and for yields of wheat and cotton

Variables	Range	$\bar{M} \pm \sigma$
Salinity (mmhos/cm)	2-6	3.1±2.4
Sodium saturation (%)	0.5-9.2	3.2±2.6
Cation exchange capacity (mequiv/100 g)	7.2-52	30±15
Depth to hydromorphic features (cm)	20-115	80±35
Carbonate content (%)	0.5-26	6.1±9.2
Useful depth (cm)	30-110	78±20
Clay content (%)	15-70	40±20
Wheat yield (kg/ha)	1600-6200	4200±1200
Cotton yield (kg/ha)	1700-4200	3000±850

n=25

Simple correlation coefficients (r) between the paired soil factors were calculated and these are shown in matrix form in Table 2. Correlation of wheat and cotton yields with X-variables gave similar ranges of r-values. The influence of useful depth and depth to hydromorphic features, as indicated by highest r-values, are the most important for yields of the three crops. Clay content in all cases was, however, slightly correlated ($0.05 \leq r \leq 0.25$) with the Y-variable. Among X-variables, useful depth with depth to hydromorphic features, and clay content with salinity and cation exchange capacity showed the highest coefficients of correlation (r=0.70** and 0.85**, respectively). The correlation data provided a convenient starting point in estimating the contribution of the X-variables to the explanation of crop yields.

Table 2. Correlation matrix showing correlations among selected variables

Var. *[1]	Simple correlation coefficient (r)								
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	Y_1	Y_2
X_1		0.18	0.72*	0.35	0.32	0.41	0.21	0.65**	0.52*
X_2			0.12	0.12	0.25**	0.35**	0.65*	0.12	0.31
X_3				0.35*	0.23	0.31	0.31	0.23*	0.55**
X_4					0.35	0.25*	0.33**	0.35*	0.23**
X_5						0.12	0.51**	0.21	0.41
X_6							0.34*	0.25	0.23
X_7								0.13	0.24

*[1]X_1 = useful depth; X_2: = clay content; X_3 = depth to hydromorphic features; X_4 = carbonate Content; X_5 = salinity; X_6 = 'sodium saturation; X_7 = cation exchange capacity; Y_1 = wheat Yield; and Y_2 = cotton yield.
* = significant at the 0.05 level. ** =significant at the 0.01 level.

In the multiple regression analysis, the general model type was selected after taking into account the main effects of the X-variables that were considered and the major interactions of second order. This approach was chosen for reasons of simplicity. For wheat yields, the numerical computation method showed that the variations observed were best accounted for (R^2 = 0.82) by the equation. Although simple correlation analysis showed that carbonate contents were significantly correlated with cotton yields, multiple regression analysis showed that this X-variable had no important effect. For cotton yields, the R^2value showed that the equation accounted for 86% of the observed variation. Although simple correlation analysis showed that carbonate contents were significantly correlated with corn yields (Table II), multiple regression analysis showed that this X-variable had no important effect. For cotton yields, the R^2value showed that the equation accounted for 75% of the observed variation. In this case multiple regression analysis was made with clay content in the model although its correlation with cotton yield was very low (Table 2). The significance of the partial mean squares for the independent variables against deviation from regression mean square was tested (Table 3). The F-values for useful depth (F1) were significant (1or 5% level) except for the cotton model. The F-values for depth to hydromorphic features (F: in wheat and F3 in the cotton model) were also significant (1 or 5% level). The interactions of sodium saturation with cation exchange capacity and of salinity with cation exchange capacity presented F-values significant (1 or 5% level) in the wheat and cotton models (F_6). Quadratic polynomial equations for wheat and cotton yields accounted for 45-62% of the total variability of yields of these crops for the samples in the study. Results 6f tests of significance of partial regression coefficients for the quadratic equations are shown in Table 3. In most cases, the F-values were lower than for terms of general models. On the basis of quadratic equations, adequate combinations of levels of X-variable to maximize wheat and cotton yields were mathematically calculated (Table 4). These limits of useful depth and depth to hydromorphic features could be considered as minimum depths necessary for maximum yields in the region.

Table3. Results of tests of significance for regression coefficients of the polynomial equations

Crop	Results of tests of significance*1					
	F $_1$	***F*** $_2$	***F***$_3$	***F*** $_4$	***F*** $_5$	***F***$_6$	***X***$_7$
General models							
Wheat	3.35**	3.2*	2.25**	2.5	4.2 **	3.5
Cotton	1.23	2.4	3.65**	2.1	2.4	3.6
Quadratic model							
Wheat	1.2	2.65*	1.6	2.5	3.2 *	0.5
Cotton	1.4	3.6*	2.45*	1.2	0.6	0.8

*1 F_i are F-values for the test of the partial mean squares for the X-variables Against deviation from regression mean squares.
* Significant at the 0.05 level. ** Significant at the 0.01 level.

Table4. Estimated minimum levels of two factors for maximum yields of the two crops, Calculated from the quadratic models

Variable	Minimum levels	
	Wheat	cotton
Useful depth (cm)	65	142
Depth to hydromorphic features (cm)	115	124

The results of the study indicate that statistical models may be used to predict the relative productivity of the soils investigated. Multiple regression analysis showed that the independent variables considered and their interactions accounted for a great part of the variation in wheat, corn and cotton yields.

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Determination of Soil Quality by Land Evaluation with the aim of sustainable development (Case study: Southern Lands of Salt lake, Kashan, Iran)

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Abstract

The term "quality" has a relative meaning. This is expressed by the ISO definition: "The totality of features and characteristics of a system that bear on its ability to satisfy stated or implied needs". Soil quality evaluation is the process of predicting the capacity of a soil to function. Due to the many possible soil functions, simple measuring of an individual soil parameter is not sufficient. These soil-quality parameters or indicators are grouped in physical, chemical and biological components. Land evaluation, which tries to predict land behavior for each particular use, is not the same as soil-quality assessment, basically because the biological parameters of the soil are not considered by land evaluation. Kashan city review of soil quality evaluation and monitoring is presented in this paper, focusing on the possibilities of applying the accumulated knowledge of past studies of land evaluation to facilitate the monumental task of relating soil quality indicators to the various soil functions.

Key words: Land evaluation, soil qualities, sustainable development, Salt Lake, Iran

Introduction

Recently there was a change in the general perception of the importance of soil as a non renewable resource that if used or managed inappropriately could be lost in a short period of time, with very limited opportunity for regeneration. The perceptual change is due to the significant decline in soil quality that has occurred in many places through adverse changes in its physical, chemical and biological properties and contamination by inorganic and organic chemicals. Agricultural practices and management systems have been generally adopted without recognizing their consequences on soil conservation and environmental quality, and therefore a significant decline in agricultural soil quality has occurred worldwide. Several international studies have explored the potential for agricultural production and associated environmental issues, among them soil degradation (Bouma, 1999). In the European Union (EU), a thematic strategy for soil protection is currently under development. First of all, environmental measures will be proposed to prevent soil degradation, soil-monitoring legislation will be also proposed, and recommendations for actions will be formulated. An adequate EU soil policy will provide an environmental pillar for sustainable development, enabling national and local decision makers to protect their soils within a harmonized European framework (CEC, 2002). Within this general context, there has been an increased demand to establish criteria to determine soil quality and to develop indices that may be used to rank and compare the quality of soils at different locations or at the same location through time (Nortcliff, 2002). Soil quality has recently been defined as ‘‘the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation’’ (Karlen et al., 1997). When examined as part of an ecosystem, soil-quality assessment is considered an effective method for evaluating the environmental sustainability of land use and management activities. However, the process of evaluating soil is not new, and agro-ecological land evaluation has much to offer in this sense. Land suitability is defined in land evaluation as the fitness of a given land unit for a specified type of land use. In a more operational sense, suitability expresses how well the biophysical potentialities and limitations of the land unit matches the requirements of the land use type (FAO, 1976). Therefore, new investigations must obviously be based on a solid understanding of the past studies. There is a need to investigate coordinated and multidisciplinary approaches to assess the quality of soil, Evaluating their long-term potential and limitations and monitoring the short-term changes in response to use and management. The objectives of this paper are: (1) to compare the terms and concepts of land evaluation and soil quality evaluation; (2) to describe the different types of soil quality indicators and soil functions.

Materials and methods

Study area

The Study area is located in southern edge of salt lake, at 45 kilometer of north-eastern of Kashan city in Isfahan province. The area end up from south-side to sand lands, Maranjab caravansary, Koshko field and Yakhb mountain, from north-side to salt lake, from east-side to Abrizan mountain, Talbour and Sephidab and from west-side to villages, farms and Siahkouh, Sar, Takht Bozorg and Anabeneh altitudes(figure No.1). The area has lied in longitude 51º 45′ 51″ to 51º 58′ 46″ and latitude 34º 17′ 34″ to 34º 20′ 29″ (14, 15 and 16). According to field works, the study area is 5422.448 ha. Mean elevation from sea surface is 975m. The area is similar to a narrow and wet-bond near the Salt Lake. The study area has 110mm precipitation and temperature of 20°C meanly. annually mean evaporation of Kashan city is 2205.5mm (Kianian, M.kia, 2007). At this paper we tried to compare the terms and concepts of land evaluation and soil quality evaluation and describe the different types of soil quality indicators and soil functions.

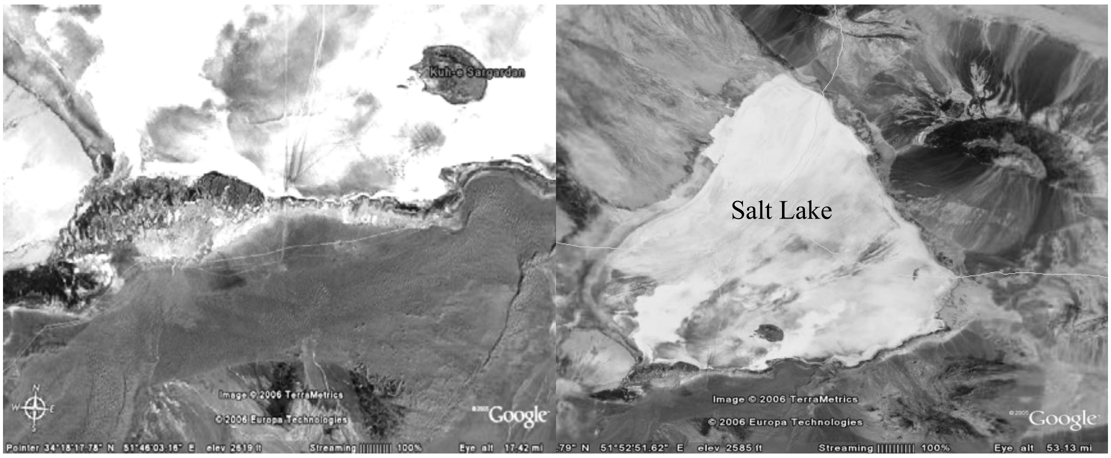

Figure 1. The area's location (south of Kashan Salt Lake) by Google earth ETM$^+$, 2012

Results and discussion

Soil-quality evaluation tries to predict the natural ability of each soil to function. However, land evaluation is not the same as soil-quality assessment, basically because the biological parameters of the soil are not considered in land evaluation. Land evaluation refers not only to soil, but also to the combined resources of soil, climate and crop/management. However, land evaluation has traditionally been 'pedocentric', i.e. emphasizing the soil resource and being carried out by soil scientists (Rossiter, 1996). Table 1 shows the relation between the major terms used in land evaluation and their corresponding terms in soil-quality evaluation. Land evaluation was defined as 'the process of assessment of land performance when used for specified purposes, involving the execution and interpretation of surveys and studies of land use, vegetation, landforms, soils, climate and other aspects of land in order to identify and make a comparison of promising kinds of land use in terms applicable to the objectives of the evaluation' (FAO, 1976). Soil surveys are the building blocks of the Comprehensive dataset needed to drive land evaluation. Soil surveys and soil taxonomy systems are used to define with precision specific soil types. The land-evaluation analysis focuses on different purposes, which can be grouped in two main classes: land suitability or productivity, and land vulnerability or degradation approaches. The traditional scheme in land-evaluation analysis involves the following main stages:

1. Selection of land attributes: land characteristics and associated land qualities;
2. Definition of relevant land-use requirements or limitations: land-use response or degradation level;
3. Matching of land attributes with land use requirements: identifying cause-effect relationships through narrative statements, matching tables, decision trees, response curves, rating indexes, weighting factors, or comprehensive models; and
4. Validation of the developed algorithms in other representative areas.

Table 1: Relation between main terms used in land evaluation and their corresponding terms in soil-quality evaluation in the region

Land evaluation	Soil-quality evaluation
Land suitability/vulnerability	Soil quality
Land qualities (LQs)	Soil functions
Land characteristics (LCs)	Soil quality indicators
Land-use requirements (LURs)	Desired values (critical limits)
Observational information	monitoring mode
Morphological, physical and chemical soil components	Physical, chemical and biological soil components
LCs vs. LURs comparison: narrative statements, matching	Desired values definition: simple ranges
Land productivity/degradation classes	Soil quality/degradation indexes
Potential users: land managers and decision makers	otential users: land managers and decision makers

Table 2 shows a list of the main input soil characteristics used in the land-evaluation analysis. These are principally concerned with the physical arrangement of the solid particles and pores. A large list of soil chemical attributes is also included. Additionally, a set of visible or observed attributes is considered, with special reference to the soil degradation processes such as decline in soil productivity, water erosion or subsoil compaction. Many of the visible, physical and chemical soil attributes, which are the main input land characteristics in land evaluation, are very fixed and permanent in time. The land-evaluation process is developed on the basis of land characteristics, and uses land qualities as an intermediate between land characteristics and land suitability. Land characteristics (Table 2) are a simple attributes of the land that can be directly measured or estimated in a routine survey.

Table 2: Main soil physic-chemical characteristics considered in land evaluation in the region

Attributes	Soil parameter
Visible attributes	Poor plant growth
	Surface runoff
	Surface ponding of water
	Form of rills
	Exposure of subsoil
	Subsoil compaction
Chemical attributes	Clay content
	Color
	Reaction
	Organic matter content
	Carbonate content
	Electrical conductivity
	Sodium saturation
	Cation exchange capacity
	Status of plant nutrients
	Toxic elements
Physical attributes	Soil texture
	Bulk density
	Porosity
	Aggregate strength and stability
	Soil crusting
	Soil compaction
	Drainage
	Water retention
	Infiltration
	Hydraulic conductivity
	Soil depth
	Stoniness

Land quality is a complex attribute of land, which acts in a manner distinct from the actions of other land qualities in its influence on the suitability of land for a specified kind of use. Table 3 presents the main land qualities or functions considered in land evaluation. The comparison or matching stage forms the basis for assessing the suitability of the land for a particular use. This interpretation process is often difficult and subjective because of a lack of knowledge of the land performance.

Table 3: Main land qualities considered in land evaluation in the region

Evaluation method	Land qualities
Land degradation	Runoff potential Soil erodibility Soil structure Cover protection Subsoil compaction Soil workability Leaching potential Toxic absorption and mobility Pesticides degradation
Land productivity	Crop growth Plant water-use efficiency Water- and air-filled pore space Nutrient availability Plant root penetration Water infiltration

Current progress in information technology is making possible the application of many different modeling techniques to the most complex systems (De la Rosa and Van Diepen, 2003). In land evaluation, empirical-based modeling has moved on from simple qualitative approaches to others, which are more sophisticated and based on artificial intelligence techniques. Additionally, process-based modeling, which is deterministic and based on an understanding of the actual mechanisms, has been incorporated into land evaluation (Van Lanen, 1991; Rossiter, 2003). Predictions of land performance, no matter how soundly based, are only useful if they are used by decision makers, including individual land users, groups or governments to make better land-use decisions (Rossiter, 1996). Any evaluations of the quality of the soils must consider the multiple soils uses (e.g. agricultural production, forest, rangeland, nature conservation, recreation or urban development). However, the most widely accepted concept of soil quality and the most significant in a global context is referred to agro-ecosystems. As a result, each soil has a natural ability to perform a specific function. In soil quality evaluation, the two main questions that must be answered are:

a. How does the soil function?

b. what indicators are appropriate for making the evaluation?

After answering those questions, a range of parameter values that indicate whether a soil is functioning at full potential can be calculated using landscape characteristics, knowledge of pedogenesis and a more complete understanding of the dynamic processes occurring within the soil. Depending upon the nature of the soil function under consideration, the selection of soil indicators will vary. These soil attributes can be classified in three broad grouping: physical, chemical or biological indicators. The physical and chemical attributes used in soil quality evaluation are similar to those used in land evaluation (Table2).

Conclusion

Evaluating and monitoring soil quality is a complex task. It has become an important activity, because of the need to protect soil and its ability to sustain its functions. The soil-quality evaluation is considered a prerequisite for the agro-ecological sustainability of soil use and management. Depending upon the nature of the soil function under consideration in soil-quality evaluation, the selection of soil indicators will vary. These soil attributes can be classified in three broad groupings: physical, chemical or biological indicators. Most of the soil physical and chemical parameters, which are the main input land characteristics in land evaluation, are very fixed and permanent in time. However, the soil biological parameters are most variable and sensitive to management practices. Soil-quality evaluation and agro-ecological land evaluation have many elements in common, and an approach is proposed that analyses soil physico-chemical indicators and soil biological indicators separately. For example, a soil physico-chemical quality index for each agro-ecological zone can be facilitated by the application of the different land-evaluation models of MicroLEIS DSS. Case studies in the different agro-ecological zones should be conducted on soil biological quality evaluation and monitoring, in order to provide detailed information on the effectiveness of the farming system, land-use practices, technologies and policies on soil protection.

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Recultivation of disturbed lands in Siberia

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Abstract

Recultivation technologies used for regeneration of man-disturbed lands in Siberia are diverse enough. It is connected with diversity of natural and climatic conditions in Siberia, kinds of disturbances and different aims of recultivation works. As the basic deposits of minerals are found in the centre of Eurasian continent, sharply continental climate with prolonged winter and short hot summer prevails here practically at the whole territory. However, specific features of the relief and mountain ranges of Siberia cause nonuniform redistribution of heat and precipitation and formation of latitudinal and vertical zonality. Therefore, the whole set of landscapes from strongly swamped territories to semi-deserts are presented at the territory of Siberia. In restoring of damaged territories its own direction of recultivation is chosen in every natural and climatic zone. At the same time the ways and directions of recultivation are determined by mining technology and specific features of climatic indices. The efficiency of restoration of disturbed lands depends on degree of use of character of local resources of recultivation. Last years the basic directions of restoration of disturbed territories in Siberia are forest and sanitary-and-hygienic ones. In this connection, plant cover is very often created on man-caused substrate, without formation of root layer to be favorable for development of plant cover and soil-forming processes. Therefore, soil-environmental efficiency of recultivation works is low and slightly different from natural restoration of disturbed territories. In order to increase efficiency of recultivation works and accelerate restoration of soil cover on damaged territories, the single-minded creation of root layer is necessary when fertile soil layers and potentially fertile rocks are used.

Keywords

Man-disturbed lands, recultivation, soil-environmental efficiency

Introduction

Now the level of man-caused influence on natural complexes constantly grows in Siberia. It is caused by always increasing volumes of extraction and processing of natural resources in this territory where the basic stocks of some kinds of minerals of Russia are concentrated.

The total area of the Siberian Federal district (SFD) exceeds 5 mln. sq km. that makes up almost the third part of the whole territory of Russia. The forests occupy about 60 % of territory of Siberia, whereas the territory used in agriculture amounts to 11 %. Severe environmental conditions impede active development of the territory of Siberia; therefore the density of population at this territory is left the least in Russia. Nevertheless, there are the regions at the territory of SED which are rather actively developed industrially. Kuznetsk Basin is one of such regions.

The basic supplies of coal are concentrated in Kuznetsk Basin. Now the coal production exceeds here 180 mln tons a year (Statistical collection. Regions …, 2009). The conditioned supplies of coal exceed in Kuznetsk Basin all world's supplies of oil and natural gas more than 7 times (converting into conditioned fuel) and make up 693 billion tons including 207 billion tons of coking coals.

At the same time, the exploitation of coal-fields influences essentially on formation of environmental situation in the region. With the beginning of intensive exploitation of mineral deposits the area disturbed by open and underground way of coal production amounted according to various data from 60 to 110 thou ha; thus, the total area of disturbed lands makes up more than 1 % of the territory of Kuznetsk Basin. The exploitation of coal-fields is mainly performed by open way that leads to destruction of the ecosystem as a whole (Potapov, etc., 2005). But for all that the most significant changes take place in land fund. The soil cover is practically destroyed, new relief is formed, river hydrology changes, atmosphere is polluted and the like. Therefore, a set of works directed to restoration of destroyed ecosystems is necessary to be carried out in order to improve environmental situation in the region in question.

Materials and Methods

According to state standard GOST 17.5.1.01-83, in Russia the 6 basic directions of recultivation are distinguished such as agricultural, forest, hydroeconomic, recreational, sanitary and hygienic and building. All these directions are subdivided into species according to the purpose of recultivation. For example, agricultural recultivation can be performed in order to rehabilitate the ploughland or only create meadows or gardens, etc. At the same time different directions of recultivation can be combined and supplemented within one object. Hydroeconomic and forest directions may include recreational measures as well.

During the whole period of exploitation of minerals the area of disturbed lands as large as more than 30 thousand hectare was recultivated, it makes up about the third part of the whole damaged territory. The basic direction of recultivation in Kuznetsk Basin is the forest recultivation with planting pine and sea-buckthorn. Lately the flooded open-cast mines and hydro dumps are considered as recultivation areas.

The conducted works have shown the possibility for creation of artificial phytocenoses at disturbed areas. During performance of these and subsequent works on recultivation the classification of disturbed territories was worked out. This classification takes into account the formed relief and suitability of rocks to biological recultivation. Principal ways and methods of rehabilitation of soil and vegetative cover on the disturbed lands have been tested as well (Trofimov, Ovchinnikov, 1970). The disturbed areas are very diverse and more generally can be divided by relief forms into denudational and accumulative ones. Different cavities of open-cast mines, subsidences, trenches are considered as denudation's forms. Waste materials of different shape and formed by different rocks as well as bulks, embankments and dams can be ascribed to accumulative forms.

According to suitability to biological recultivation the overburden and accommodating rocks and other stored waste products were divided into three groups such as suitable, of little use, and unsuitable ones. Fertile soil layer (FSL) and potentially fertile rocks (PFR) (loamy sands, sandy loams and clays) are considered as being rocks suitable for biological recultivation. These rocks make a basis of lithogenous resources of recultivation in Kuznetsk Basin (Ragim-zade, 1977). Sandstones, siltstones and mudstones are considered as being the rocks of little use. These rocks can be recultivated only after improvement of their physical and agrochemical properties. The rocks with very unfavorable chemical and physical properties for plants are classified as being unsuitable for recultivation. The waste products of iron-ore production, heavy saline, rocky materials etc. can be included into this group.

According to GOST 17.5.1.01-83 the recultivation of the disturbed lands is understood as a set of works directed to rehabilitation of productivity and national economic value of these lands as well as to improvement of the environment. Formulating the definition of recultivation at that time the scientists tried to reflect all main objectives and problems of recultivation but by no means determined the ways or mechanism how to realize it; furthermore, they could not estimate the efficiency of recultivation works. Therefore, for a long time and in many cases the efficiency of recultivation was estimated by the fact if grows or does not grow grass or forest. Nowadays it can be established that the level of rehabilitation of soils and soil-environmental functions should be estimated first of all.

The soil as a basis of any above-ground ecosystem plays a broad spectrum of regulating and stabilizing roles in biosphere. Finally, soil-environmental conditions exactly determine the quality of our vital space. Therefore, the destruction of soil cover during exploitation of minerals at vast areas leads to reduction of favorable vital space and deterioration of the whole complex of environmental indices. In order to change this situation it is necessary to turn to recultivation technologies directed to rehabilitation of soils, root-inhabited layer and creation of habitats in accordance with the purpose of recultivation. But for all that it is important to estimate evenly the efficiency of recultivation works, because the prospects of rehabilitation of the damaged areas will depend on it.

A method of qualitative estimation of efficiency of recultivation works was worked out in the Laboratory of Soil Recultivation of ISSA SB RAS; it is based on the methods of soil rating (Gadzhiev, Kurachev, Androkhanov, 2001). The principles of this estimation consist in recognition of individual specificity of every man-caused landscape and comparison of the properties of the created soils at the territory under recultivation with basic types of soils spread at adjacent territories. Such approach permits to estimate evenly the level of rehabilitation of fertility and determine the ways for further use of the recultivated lands. It was ascertained at the same time that technology of formation of dumping ground or formation of man-caused landscape was the leading factor which determines the efficiency of recultivation. That is to say that basic properties and parameters of the landscape (relief, composition of the rocks) are formed at technogenic (man-caused) stage; these properties and parameters can impede the creation of the conditions for successful rehabilitation of the disturbed lands or favor to them. The greatest level of soil-environmental efficiency of recultivation is reached when PFR and FSL are placed surface layers of man-caused landscapes.

Results and Discussion

Considerable quantity of restoration technologies directed to rehabilitation of disturbed lands is now developed and put into practice in Siberia. It is connected with the fact that practically in all regions there are disturbed territories and consequently the urgency of the works on soils rehabilitation are beyond any doubt. According to standard documents these works are necessary to be carried out when dealing with disturbance of soil cover. As a rule, there are the projects of land restoration at the enterprises which conduct the exploitation of mineral deposits or building works which lead to disturbance of soils. Such projects provide for works on soil rehabilitation. The use of one or another technology should be caused by natural and climatic conditions of the territory under rehabilitation, on the one hand, and by degree of disturbance or destruction of natural landscapes, on the other hand.

The kinds of recultivation and its directions should be defined by the purpose, that is to say what wants the customer of works to restore at disturbed territories. Unfortunately, last years in most cases the recultivation works consist practically in greening of disturbed territories and namely do not provide for restoration of the same landscapes and soils which have been disturbed. And after all at the beginning of formation scientific and practical direction of recultivation the principal object of recultivation was assumed in restoration of earlier existing lands (Scientific and technical 1978; Revel P, Revel Ch., 1995). Abroad in many countries such an approach remains until now (Kaar, Kiviste, 2010). But for all that the efficiency of recultivation is estimated by similarity of the disturbed lands and their productivity of earlier existing soils and landscapes.

In practice, in most cases, all recultivation technologies which are used in Siberia can be divided into great groups such as recultivation by temporary scheme and radical recultivation applied by permanent scheme. The purposes of recultivation of the first type are limited by necessity of fastening of the surface, its greening and reduction of negative influence on surrounding territories. It is clear that soil-ecological efficiency of such recultivation is usually not high and not infrequently it will take some decade for achievement of level of efficiency of 30-40 %, and in most cases this efficiency does not differ markedly from that at natural overgrowing. When radical high-tech recultivation is applied, soil-like formations arise, i.e. technozems. In this case maximum efficiency can be reached during 2-3 years. Any economic use of recultivation tracts by temporary scheme is not assumed without creation of root-inhabited layer, but it is impossible with some exception. For this reason such recultivated lands should not be basically transmitted to the land-user.

In case of radical recultivation the purposes become permanent, they are directed to receipt of prolonged concrete not only environmental but also economic effect. It was established that high soil-environmental effect could not be mostly obtained in Siberia without application of PFR and FSLr. Therefore, in case of recultivation of the second type one should not bring everything to so called biological recultivation. Biological development in such projects is no more than reclamative stage. The tracts recultivated by radical permanent schemes can be used depending on obtained efficiency for different purposes including agricultural ones. For this reason they should be transmitted to the land-user.

As it has been mentioned above, in case of radical recultivation soil-like formations arise, i.e, technozems, and artificial root-inhabited layer is created which favors to sustainable development and rehabilitation of the whole complex of biocenoses. More generally the technozems are as artificially created surface horizons with different level of restoration of fertility and soil-environmental functions. The properties and regimes of technozems are formed meaningly and purposefully as a result of application of one or another technology of recultivation. But for all that the formation of favorable edaphic conditions in root-inhabited layer and acceleration of soil-forming processes is the main purpose for creation of technozems. Depending on the reached level of fertility and rehabilitation of soil functions the recultivated plots can be used both for receiving of agricultural production and making recreational zones, etc.

Unfortunately, the area no more than thousand ha was recultivated in Kuznetsk Basin by such a technology. It is explained by high value of accomplishment of such recultivation works. As recultivation inputs are reflected on prime cost of output the enterprises cannot concede to reduction of profitability of the works. Therefore, the simplest and the cheapest ways of recultivation are chosen, and sometimes no measure is carried out for rehabilitation of the disturbed lands.

In any case the piles overgrow gradually to a greater or lesser extent. The process of overgrowing is accelerated if perennial grasses or arboreal plants are cultivated, but as it was evidenced by latest researches the mere greening of the piles often cannot fundamentally limit negative influence of man-caused landscapes. Such a recultivation proves to be one-sided as solely component of ecosystem is rapidly restored. Therefore, a specific disbalance becomes apparent. But for all that one should not forget that the soil is a basis of any over-ground ecosystem. For this reason the created artificial plantings prove to be unsustainable and degrade rapidly under effect of unfavorable factors such as incorrect exploitation, drought, fires etc. As a result, the recultivated soils return to initial state, i.e. to man-caused desert. The mere greening of the disturbed lands does not permit in the most cases to rehabilitate disturbed territories for a long period; in case of such a recultivation man-caused landscapes will practically keep technogenesis for ever and will be as ecological field (wedge) incorporated into the system of natural landscapes with specific properties and regimes of functioning (Androkhanov, Kurache, 2010). Because of complicated economic state of many extractive enterprises of Kuznetsk Basin many regulations of normative documents concerning recultivation are not implemented, it leads to appearance of disturbed areas which rehabilitate naturally for a long time interval. The inspection of the disturbed lands conducted at present time permitted to estimate the capacity of man-caused landscapes to favor to development of soil-forming processes and soil rehabilitation or impede them.

The performed researches show that soil-environmental state of man-caused landscape defines entirely the character, rate and direction of soil formation. At the same time, it becomes evident that natural rehabilitation of the disturbed lands will merely result in overwhelming majority of cases in restoring intrazonal soils and landscapes which are not peculiar to natural and climatic conditions of Kuznetsk Basin. If traditional technology of exploitation of coal-fields and recultivation directed only to greening are kept unfavorable environmental situation will further become worse.

In order to increase in efficiency of rehabilitation of the disturbed territories and improve their soil-environmental state one should turn to selective technology of pile formation which permits to place on the surface of piles the rocks favorable for rehabilitation of the whole complex of biocenoses. It is also necessary to turn to combined technology of exploitation at coal-fields where technical specifications permit. It will allow diminishing the depth of open-cast mine and overburden amount stored in exterior piles. Therefore, the total area of the disturbed lands and removal to the surface of hypogene rocks which are the most unfavorable for recultivation are reduced.

At present time the most complicated situation arises in Siberia in connection with introduction of modern high-performance technologies into practice. At contemporary stage it is necessary to elaborate the mechanism of efficient technologies of recultivation which would functionate stably and take into account not total recultivated area but quality under recultivation. For that serious change is required to the approaches of recultivation technology as a such. Finally, in executing recultivation measures it necessary to take properly into account the complexity of the problem of recultivation because when rehabilitating solely component of ecosystem, i.e. plant cover, it is impossible to improve essentially environmental situation on the disturbed territories. In order to change environmental situation in industrial regions one should turn to the practice of realization of radical recultivation with creation of soil substrates which are capable to maintain surely and for a long time natural rehabilitation of the disturbed ecosystems of Siberia.

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Analyzing Relationships between Land Use Change and Land Potential: A Case Study of Bornova, İzmir

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Abstract

The study has been realized in Bornova district of İzmir, Turkey, to analyse the relationships between land use change and land potential by using remote sensing and geographical information systems technologies. LU change information was derived from 30 m resolution Landsat images. The changes were analysed for the years 1984 and 2009 considering five LU types: artificial surfaces, agriculture, forest, shrub and herbaceous vegetation, water, and others. Land potential for Bornova district was determined by using multicriteria decision support system which based on the evaluation of interactions between land characteristics of the study area and prescribed LU types. The results of the LU change matrix revealed that artificial surfaces sprawled mostly on others, shrub and herbaceous vegetation, and agriculturel LU types. The results also put forward that the existent amount of forest land is three times less than the area which is suitable for afforestation. Consequently, it is possible to say that LU has changed dramatically during past 25 years, and lands of the study area are not used considering its potential. To solve this problem, ecological landscape planning approach should be considered during development procedure of regional LU plans, and change detection studies should be realized periodically to prevent rapid and uncontrolled expansion of urban on other LU types.

Keywords: Land potential, land use change, remote sensing, GIS, Bornova.

1. Introduction

Land use (LU) change shapes out the structure and the sustainability of the landscapes and ecosystems, and generally LU changes result with use of land in unsuitable form (Lambin et al., 2001; Nurlu and Erdem, 2001; Wang et al., 2006; Hu et al., 2008; Barut et al., 2011). LU changes mostly appear as the development of urban areas on wetlands, sand dunes, forests, prime farmlands, and on the other hand, sometimes agricultural activities can cause loss of natural habitats (Davis ve Froend, 1999; Kesgin and Nurlu, 2009; Lu ve ark., 2011).

The aim of this study is to analyse the relationships between land use change and land potential by using remote sensing and geographical information systems technologies, in Bornova district of İzmir, Turkey. It is also aimed at producing proposals to prevent the negative effects of LU changes on natural landscape and ecosystems, ant to put forward the importance of land use plans prepared considering ecological approaches.

2. Materials and Methods

The study was performed in Bornova district, İzmir, which has an area of 214 km^2. Land use (LU) information was derived from 30 m resolution Landsat images acquired in 1984 and 2009. The satellite images were classified using supervised classification with maximum likelihood classifier. Classification was made upon the evaluations of ground control points of LU classes and reflection values of satellite images. A post-classification change detection method was employed to detect and monitor LU change. The changes were analysed considering five land use types: artificial surfaces, agriculture, forest, shrub and herbaceous vegetation, water, and others.

LU potential of Bornova district was analysed by using multicriteria decision support system which based on the evaluation of interactions between natural land characteristics of the study area and prescribed LU types: urbanization (urban - industry), agriculture, afforestation and conservation. Some information on soil, geology, forest etc were assessed to analyse the LU potential. First, 1:25000 sacele maps which reflect general structure of the study area were on screen digitized according to UTM coordinate system. Then, all the digitized maps were evaluated numerically considering their importance for prescribed LU types. The numbers between “0 - Unsuitable and 10

- Suitable" were used to reflect the degree of the importance of each land character (geology, soil, etc). Finally, numerically evaluated maps were overlapped to produce LU potential map.
During the image classification, change analysis, digitization, and mapping studies Erdas Imagine, Idrisi Selva and ArcGIS softwares have been used.

3. Results and Discussion

Change analysis put forward that LU types converted to others in 8881.05 ha of land. It means, 41% of the Bornova district has changed during 25 years period, between 1984 and 2009 (Figure 1). The biggest change has occurred in artificial surfaces with the rate of 254%. It was 1747.98 ha, but increased to 6188.49 ha; it grew up by almost 3 times. Agricultural areas had the second biggest change rate with 63.26%. It was 1099.62 ha, but decreased to 404.01 ha. On the other hand, according to LU change matrix artificial surfaces sprawled mostly on others (3329.64 ha), shrub and herbaceous vegetation (774.81 ha), and agriculture (315.72 ha) LU types (from, Nurlu et al., 2011).

Table 1. Land use in 1984 and 2009

Land Use Types	Years (ha)		Change	
	1984	2009	ha	%
Artificial surfaces	1747.98	6188.49	4440.51	254.04
Agricultural areas	1099.62	404.01	-695.61	63.26
Forests	3254.04	2986.29	-267.75	8.23
Shrub and herbaceous vegetation	6772.5	5842.62	-929.88	13.73
Water	666	660.87	-5.13	0.77
Others	7901.28	5359.14	-2542.14	32.17
	21441.42	21441.42	8881.05	41

LU potential of Bornova district was analysed for urbanization, agriculture, afforestation, and conservation. The result of the analysis showed that 46% of the area was suitable for afforestation while the areas suitable for conservation, agriculture and urbanization were 30, 14.2, and 9.8%, respectively (Table 2).

Table 2. Land use suitability

Land Use Types	Area	
	ha	%
Afforestation	9863.2	46.0
Conservation	6425.4	30.0
Agriculture	3048.4	14.2
Urban	2102.6	9.8

The results revealed that lands of Bornova district were generally not used pursuant to LU potential. For example, 14% of the land consists of forests in present form while 46% of the land was suitable for afforestation studies. Similarly, 2% of the area is used for agricultural acivities in 2009 while 14% was suitable for it. On the other hand, urban area covers almost 30% of the study area while the rate of suitable land was only 10%.
According to results belong to LU change analysis and LU potential, it is possible to say that LU types have changed dramatically during past 25 years, and lands of the study area are not used pursuant to its potential. To solve this land use problem, ecological landscape planning approach should be considered during development procedure of regional LU plans, and change detection

studies should be realized periodically to prevent rapid and uncontrolled expansion of urban on other land use types.

Acknowledgements

The authors gratefully acknowledge the scientific research grant (ÇAYDAG 109Y210) of the Scientific and Technological Research Council of Turkey (TÜBİTAK).

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Heavy Metals and Land Degredation-an Example Aliağa/İzmir

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Abstract
Soil is one of the most important natural sources and most important factors of life. Unfortunately, soil pollution has reached serious proportions so it has become an important environmental issue. Although there are many chemical and physical techniques for remediation of contaminated soil, phytoremediation has come forward due to easy and inexpensive. Also, phytoremediation of soil that contaminated with organic matters and heavy metals is eco-friendly. In this study, it was investigated rehabilitation of soil polluted with heavy metals by plants and it was researched advantages and disadvantages of phytoremediation.
Keywords: heavy metal, phytoremediation,

Introduction
Soil pollution, a very important environmental problem, has been attracting considerable public attention over the last decades. As a matter of fact, increasingly widespread pollution has caused vast areas of land to become non-arable and hazardous for both wildlife and human populations (Garbisu and Alkorta, 2001). Controlled and uncontrolled disposal of waste, accidental and process spillage, mining and smelting of metalliferous ores, sewage sludge application to agricultural soils are responsible for the migration of contaminants into non-contaminated sites as dust or leachate and contribute towards contamination of our ecosystem. A wide range of inorganic and organic compounds cause contamination, these include heavy metals, combustible and putriscible substances, hazardous wastes, explosives and petroleum products. Major component of inorganic contaminates are heavy metals (Ghosh and Singh, 2005). Heavy metals are important environmental pollutants and many of them are toxic even at very low concentrations (Memon et al., 2001).

High concentrations of heavy metals in soil can negatively affect crop growth, as these metals interfere with metabolic functions in plants, including physiological and biochemical processes, inhibition of photosynthesis, and respiration and degeneration of main cell organelles, even leading to death of plants Soil contamination with heavy metals may also cause changes in the composition of soil microbial community, adversely affecting soil characteristics (Lone et al., 2008). Toxic metal contamination of soil, aqueous waste streams and groundwater poses a major environmental and human health problem, which is still in need of an effective and affordable technological solution. In spite of the ever-growing number of toxic metal-contaminated sites, the most commonly used methods of dealing with heavy metal pollution are still either the extremely costly process of removal and burial or simply isolation of the contaminated sites (Memon et al., 2001). Currently, conventional remediation methods (capping, excavation, soil washing, thermal treatment) of heavy metal contaminated soils are expensive and environmentally destructive. Also, Conventional technologies involve the removal of metals from polluted soils by transportation to laboratories, soil washing with chemicals to remove metals, and finally replacing the soil at its original location or disposing of it as hazardous waste. This decontamination strategy is an ex situ approach and can be very expensive and damaging to the soil structure and ecology (Jadia and Fulekar, 2008). The idea of using rare plants called phytoremediation that hyperaccumulate metals to selectively remove and recycle excessive soil metals was introduced in 1983, gained public exposure in 1990 and has increasingly been examined as a potential practical and more cost-effective technology then the soil replacement, solidification and washing strategies presently used (Chaney et al., 1997).

Phytoremediation is defined as the use of plants to remove pollutants from the environment or to render them harmless (Pulford and Watson, 2003). Phytoremediation is also referred as bioremediation, botanical remediation and green remediation (EPA, 2000). The most important advantage of phytoremediation is that a variety of organic and inorganic compounds are amenable to the phytoremediation process (Henry, 2000). There is wide range of organic and inorganic pollutant that were removed from environment by phytoremediation. Some pollutants that can be taken from soil by plants are elements (Ag, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Zn), metalloids (As, Se), radionucleids (90Sr, 137Cs, 239Pu, 238U, 234U), non-metal (B) and other organic compound as pesticide (EPA, 2000), (see table.1). Phytoremediation can be used either as an in situ or ex situ application. In situ applications are frequently considered because minimizes disturbance of the soil and surrounding environment and reduce the spread of contamination via air and waterborne wastes (Henry, 2000). This environmentally friendly, costeffective and plant-based technology is expected to have significant economic, aesthetic, and technical advantages over traditional engineering techniques (Chen et al., 2004). Phytoremediation does not require expensive equipment or highly-specialized personnel, and it is relatively easy to implement. However, the greatest advantage of phytoremediation is its low cost compared to conventional clean-up technologies. For example, the cost of cleaning up one acre of sandy loam soil with a contamination depth of 50 cm with plants was estimated at $60,000-$100,000 compared to $400,000 for the conventional excavation and disposal method. It is far less disruptive to the environment (Henry, 2000).

Table 1*. Organic and inorganic matter amenable to the phytoremediation process

Organics	Inorganics
Chlorinated Solvents TCE, PCE, MTBE, carbon, tetrachloride	Metals B,Cd, Co, Cr, Cu, Hg, Ni, Pb, Zn
Explosive TNT, DNT, RDX and other nitroaromatics	Radionuclides Cs, ^{3}H, Sr, U
Pesticides Atrazine, bentazon and other chlorinated and nitroaromatic chemicals	Others As, Na, NO_3, NH_4, PO_3, perchlorate(ClO_3)
Wood Preserving Chemicals PCP and other PAHs	

* (Henry, 2000)

In contrast to its many positive aspects, phytoremediation does have a few disadvantages and limitations (Henry, 2000). The disadvantage most frequently cited for soil bioremediation processes is they are often very slow processes, thus it may take several years or longer to clean up a hazardous waste site and frequently desired end points may not be achieved (Sing and Ward, 2004). It is restricted to the rooting depth of remediative plants (Henry, 2000). Formation of vegetation may be limited by extremes of environmental toxicity (Macek, et al., 2000). The use of invasive, nonnative species can affect biodiversity. The consumption of contaminated plants by wildlife is also of concern. Harvested plant biomass produced from the process of phytoextraction may be classified as a RCRA hazardous waste, therefore subject to proper handling and disposal. Unfavorable climate is another important consideration because it can limit plant growth and phytomass production, thus decreasing process efficiency (Henry, 2000).

There are five main subgroup of phtyoremediation (Pulford and Watson, 2004).

- **Phtyoextraction;** involves extraction of metals by plant roofs and translocation thereof the shoot. The use of pollutant-accumulating plants to remove metals or organics from soil by concentrating them in the harvestable parts (Macek et al., 2000). It is the best approach to remove the contamination primarily from soil and isolate it without destroying the soil structure and fertility. It is also referred as phytoaccumulation (Ghosh and Singh, 2005)
- **Phytodegredation or phytotransformation**; uptake of organic contaminants from soil, sediments or water and subsequently their transformation to more stable, less toxic or less mobile form. Metal chromium can be reduced from hexavalent to triavalent chromium which is a less mobile and non-carcinogenic form (Vidali, 2001).
- **Rhizofiltration;** the use of plant roots to absorb and adsorb pollutants, mainly metals, from water and aqueous waste stream (Macek et al., 2000).

- **Phytostabilization** the use of plants to reduce the bioavailability of pollutants in the environment or immobilization and reduction in the mobility and bioavailability of contaminants by plant roots and their associated microbes (Macek et al., 2000).
- **Phytovolatilisation,** volatilization of contaminants by plants from the soil into the atmosphere (Khan, 2005).

Plants characteristics and metal uptake

The most suitable plant used for phytoremediation can survive even at high concentrations of heavy metal in soil and has strong and profuse root system. Also; the ideal plant should have some other characteristics, for instance; accumulate high levels of metal in its harvestable parts, rapid growth rate and have the potential to produce a high biomass in the field (Garbisu and Alkorta, 2000)**.** Metal hyperaccumulating plants, endemic to metalliferous substrates, have an extraordinary capacity for heavy metal accumulation. The criteria for defining Co, Cu, Ni and Pb hyperaccumulators is 1000 $\mu g\ g^{-1}$ in the shoot dry matter, whereas for Mn and Zn the threshold is 10,000 $\mu g\ g^{-1}$, and for Cd 100 $\mu g\ g^{-1}$. However, hyperaccumulating plants are relatively rare and many are of small biomass and have a slow growth rate (Lazaro et al., 2006).

Metal uptake by plants depends upon metal bioavailability in the soil, and particularly on the supply from less plant-available fractions(Lazaro et al., 2006). Plants have developed three basic strategies for growing on contaminated and metalliferous soils. First group metal excluders plants effectively prevent metal from entering their aerial parts over a broad range of metal concentrations in the soil; however, they can still contain large amounts of metals in their roots. Second group Metal indicators plants accumulate metals in their above-ground tissues and the metal levels in the tissues of these plants generally reflect metal levels in the soil. Last group accumulator plant species (hyperaccumulators) can concentrate metals in their above-ground tissues to levels far exceeding those present in the soil or in the non-accumulating species growing nearby (Memon et al., 2001). The hyperaccumulation of heavy metal depends on plant species, soil conditions(pH, organic matter content, cation exchange capacity) and types of heavy metal over 500 plant species comprising of 101 families have been reported hyperaccumulator: Asteraceae, Brassicaceae, Caryophyllaceae, Cyperaceae, Cunouniaceae, Fabaceae, Flacourtiaceae, Lamiaceae, Poaceae, Violaceae and Euphobiaceae (Sarma, 2011). On the other hand; fast growing trees (Salix, Populus) and high biomass producing crops (Brassica, Helianthus) have also been shown to have potential uses in phytoextraction, since higher biomass yields can compensate for a lower metal accumulation (Lazaro et al., 2006). *Populus tremula*, used for remediating Pb contaminated soil and *Brassica juncea, Helianthusannuus* also used for metals uptake from soil. (McCutcheon&Schnoor, 2003). Dominguez et al.(2008), studied that *Quercus ilex, Populus alba, Olea europea* potential of phytoremediation and reported that Populus alba leaves accumulated Cd and Zn well above normal ranges. Dominguez et al., (2011) studied also *Quercus ilex* and *Pistacia lentiscus* for absorbtion of Cd and Tl from soil. Mastic plants were more sensitive to Tl and Cd than oak plants. Holm oak showed a higher tolerance for Cd than for Tl, and a higher resistance to both metals than mastic shrub, due to a high capacity for Cd retention at the root level Holm oak shows a high capacity to retain Cd in the roots. The other study of Dominguez et al.,(2009) showed that Quercus ilex roots could accumulate up to 7 g $kg-^{1}$. Jimenez et al. (2012)., studied with *Myrtus communis* in arsenic including pots at the acidic conditions and results showed that *Myrtus communis* extracted 50% As; also soil health increased. Prasad and Freitas, 2000 investigated advantages and potential of *Quercus ilex* for phytoremediation so it was proved root biomass of *Q.ilex* had the capacity for complexing Ni and Cd, Pb, Cu, Cr.

Table 2. Some species used for phytoremediation

Species	Contaminant	Process	Reference
Quercus ilex	Ni, Cd, Pb, Cu,	Complexing	Prasad and Freitas, 2000
Populus alba	Cd, Zn	Accumulation	Dominguez et al.,2008
Myrtus	As	Accumulation	Jimenez et al., 2012
Populus tremula	Pb	Accumulation	McCutcheon&Schnoor, 2003
Quercus ilex	Cd	Rhizofiltration, Phytostabilization	Dominguez et al.,2011 (Dominguez et al.,2009 resp.)

Aliağa

Aliağa, one of the district of İzmir is in the Aegean coastal area. The district is located between 38°56' north 37° south latitude and 26°53' west-27°10' east longitude. Mediterranean climate is dominant in the district. Thus, vegetation of the district is composed of *Pinus brutia*(red pine), *Quercus coccifera* and *Olea europea var. Silvestris* and also involves shrubs. Some species of shrubs in the area are holm oak (*Quercus ilex*), mastic (*Pistacia lentiscus*), mock privet (Phillyrea latifolia), Broom Absolute katır tırnağı (*Spartium junceum*), Storax (*Sytrax officinalis),* Killarney Strawberry Tree (*Arbutus unedo*), bay leaf (*Laurus nobilis*), juniper tar (*Juniperus oxyicedrus* var. *macrocarpa*), asparagus kuşkonmaz (*Asparagus acutifolius*), rowanberry üvez (*Sorbus gracea*), myrtle mersin (*Myrtus communis*), burdock çakır dikeni (*Sarcopoterium spinosum*) (Ersoy,2008).

Trace element levels in soils have increased in many soils since the beginning of the human industrial activity (Jimenez, 2011). Aliağa has been subjected to extensive industrial development. There are iron-steel factories, coal storage yards, fuel storage yards, fertilizer factory, natural gas power plant, electrical substation, small industrial areas and shipbreaking area which cause heavy metal pollution. The population increased ten times in Aliaga due to the developments of petrochemical industry (Esen et al.,, 2010). One of the major shipbreaking area is in Aliağa where 2.8% by number and 1.1% by tonnage of the world's global fleet scrapped per year, was scrapped during 1994-2002 period. Heavy metals are one of the subclasses which are produced by shipbreaking process (Neşer, 2006). Heavy metal pollution of Aliağa soil was investigated by Sponza and Karaoğlu 2002. The mean concentrations of heavy metals measured at different distances from the metal industry in 1992 (Henden et al., 1997) and 1997 (Sponza and Karaoğlu, 2002) were compared. The analysis results showed that some heavy-metal levels increased significantly during the years, since 1992 up to 1997. Pb concentrations increased from 61 to 112–200 ppm at a distance of 250 and 750 m from the metal industry in last 5 years. The heavy-metal analysis carried out in 1997 showed that Cr and Ni concentrations increased excessively in last 5 years. Cr and Ni concentrations increased from 3.7 and 22 ppm to 538 and to 85 ppm in 5 years. Fe and Zn concentrations also increased up to 4000 and 3000 ppm from 1673 and 215 ppm, respectively, in very close distance to the metal industry with the year. The mentioned heavy metals were measured to be 1830 and 155 ppm at 250 m away from the industry. The results of this study clearly show that the area studied is heavily polluted. The concentration of Pb, Cd, Zn, Cr, Mn, and Fe in the plants, soil, and air were found to exceed the limit concentrations within 2.5 km to the steel plant between 1996 and 1997. The heavy-metal measurements showed that the study area is very polluted. Furthermore, the pollution level in this region is much higher than polluted soils surrounding in similar industrial areas in Poland, USA, and UK. (Sponza and Karaoğlu, 2002).

Results and Discussion

Until 1960, Aliağa which was a small agriculture and fisherman's town, gradually grew into a sizable industrial shifts. Enormouos air, soil and inland water pollution problems prevail at Aliağa because of the types, technologies, and production capacities of the industrail premises. Heavy metal concentrations in soil is very high. And Aliağa is very pollutant area (Müezzinoğlu, 2000). Henden, et al. (1997) and Sponza and Karaoğlu, (2002) studied in this area and showed that significant levels of heavy metals such as Fe, Ti, Mn, Cr, Ni, Cu, Pb, and Zn were found in the vicinity near the metal industry area in soil. Due to the toxic effects of heavy-metal contamination, remediation process for this area must be begun. In this point; phytomanagement is the use of vegetation and soil amendments to reduce the environmental risk posed by contaminated sites (Dominguez, 2008). Phytoremediation can be a good alternative technique. For Aliağa, the most important advantage of phytoremediation is environmentally friendly and costeffective. As well as; shrubs, especially *Q, ilex* and *M. Communis* are members of Aliağa vegetation and used for phytoremediation previously (Jimenez et al. 2012, Prasad and Freitas 2000). The ideal plant for remediation shouldn't danger biodiversity so these species can be alternative for Aliağa phytoremediation. However; phytoremediation is very complex and slow process. As with the phytomanagement of other trace element-contaminated sites, the success of this programme depends on the combination of suitable soil amendments and well-chosen plant species that tolerate the local conditions, including the elevated concentrations of trace elements (Dominguez, 2008). For that reason; it should be considered all conditions of soil (pH, acidity, humidity,exc.). As a result, it is recommended that the potential of phytoremediation should be investigated.

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Analysing effects of land use change on vegetation cover and agricultural areas: a case study of Izmir

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Abstract

Within this study, the effects of rapid land use (LU) change was assessed in Izmir. Four districts; Güzelbahçe, Narlıdere, Karabağlar and Balçova were selected as study area. LU changes were analysed with the help of Landsat images acquired in 1984 and 2009. Six LU types were considered during image classification process; artificial surfaces, agricultural areas, forests, shrub and herbaceous vegetation, water bodies, and others. A change matrix was also composed to put forward the conversin of LU types from one to another. The results displayed that LU types in the study area were changed in 9230 ha area during 25 years period. Artificial surfaces have increased by more than 4 times, while agricultural areas has decreased with the rate of 43%. Artificial surfaces expanded mostly on others (2925 ha), agricultural (601 ha), and shrub and herbaceous vegetation (465 ha) LU types. On the other hand, agricultural areas occupied 330 ha of land from others, shrub and herbaceous vegetation, and forests LU types, while it lost 1114 ha of land due to growth of artificial surfaces, forests, shrub and herbaceous vegetation. It is possible to say that ongoing LU change trend will continue increasingly due especially to growth of urban population, and, loss of agricultural and natural aeas will also increase. To prevent the mentioned destructions, ecological land use plans should be developed and put into practice together with the regional and local conservation leislations which will be prepared by local authorities and the universities.

Keywords: Land use change, remote sensing, Izmir.

1. Introduction

Urban systems are in the center of complicated and dynamic land use change processes, with their growing and competitive structures based on intense economic and human activities. These properties with rapid population growth make urban areas able to rapidly sprawl in the form of encroachment first to their immediate surrounding lands. (Doygun, 2009). Landscape change associated with urbanization has been significant during the last half century and is expected to continue through the next decades (Alberti et al., 2007).

The rapid and often uncontrolled growth of the urbanized areas brings about numerous changes in the structure and functioning of landscape (Solon, 2009). Due to their spatial proximity to urban areas, agricultural lands are the first ones affected adversely from the urban sprawl (Doygun, 20009). Turkey has also been subject to land transformations into urban-industrial land uses, especially with the loss of fertile agricultural lands to urbanization (Evrendilek and Doygun, 2000; Eşbah, 2007; Doygun et al., 2008).

The aim of this study is to analyse the environmental effects of land use (LU) change by using remote sensing technologies, in Güzelbahçe, Narlıdere, Karabağlar and Balçova districts of İzmir, Turkey. It is also aimed at producing proposals to prevent the environmental effects of LU changes on ecosystems.

2. Materials and Methods

With 255 km^2 (25500 ha) of land, the study area consists four districts of Izmir: Güzelbahçe, Narlıdere, Karabağlar and Balçova. 1984 and 2009 land use (LU) information were derived from Landsat TM and ETM images. The images were classified using supervised classification with maximum likelihood classifier, and classification was made upon the evaluations of ground control points of LU classes and reflection values of images. A post-classification change detection method was employed to detect and monitor LU change considering six land use types: artificial surfaces, agriculture, forest, shrub and herbaceous vegetation, water, and others.

Areas of the LU types was calculated for the years 1984 and 2009, and the amounts of changes were given in table as hectares and percentages. Then, a change matrix was composed to put forward the conversin of LU tyes from one to another.

Image classification and LU change analysis were realized by using Erdas Imagine and Idrisi Selva softwares.

3. Results and Discussion

According to change analysis, LU types in four districts of Izmir were changed in 9230 ha area. It means, 36% of the total area has changed between 1984 and 2009 (from, Nurlu et al., 2011). Artificial surfaces have increased by more than 4 times, from 968 ha in 1984 to 5141 ha in 2009.

The second biggest change has occurred in agricultural areas with the rate of 43%. The amount of the area covered by agricultural areas was 1829 ha in 1984, but decreased to 1045 ha in 2009. Water surfaces have also decreased by 34%, but it occurred due especially to landfill in shore area (Table 1). During 25 years period, forest areas increased with the rate of 6% du to afforestation studies.

Table 1. Land use in 1984 and 2009

Land Use Types	Area (ha)		Change	
	1984	2009	ha	%
Artificial surfaces	968.76	5141.79	4173.03	430.76
Agricultural areas	1829.61	1045.71	-783.9	42.85
Forests	6978.42	7418.07	439.65	6.30
Shrub and herbaceous vegetation	8528.04	6543.54	-1984.5	23.27
Water	416.88	272.07	-144.81	34.74
Others	6798.87	5094.27	-1704.6	25.07

LU changes can also give detailed information on the conversin of LU types. According to change matrix, artificial surfaces expanded mostly on others (2925 ha), agricultural (601 ha), and shrub and herbaceous vegetation (465 ha) LU types. On the other hand, the areas covered by shrub and herbaceous vegetation sprawled on forest, others and agricultural areas. It is thought that this situation occured due to growth of natural vegetation formations in abandoned areas. Agricultural areas occupyed 330 ha of land from others, shrub and herbaceous vegetation, and forests LU types, while lost 1114 ha of land due to artificial surfaces, forests, shrub and herbaceous vegetation (Table 2).

LU change and conversion matrix results diplayed that lands of four districts of Izmir; Güzelbahçe, Narlıdere, Karabağlar and Balçova faced with a great change due especially to expansion of urban and industrial areas. This situation resulted with the loss of agricultural areas and natural vegetation formation together with the bare areas. It is possible to say that ongoing LU change trend will continue increasingly due especially to growth of urban population, and, loss of agricultural and natural aeas will also increase.

To prevent the mentioned destructions, ecological land use plans should be developed and put into practice together with the regional and local conservation leislations which will be prepared by local authorities and the universities.

Table 2. Land use conversion matrix

		1984					
2009	Land Use Types	Artificial surfaces	Agricultural areas	Forests	Shrub and herbaceous vegetation	Water	Others
	Artificial surfaces	968.76	601.74	38.34	465.57	140.94	2925.27
	Agricultural areas	0	714.6	40.86	138.78	1.53	149.67
	Forests	0	166,77	5249.7	1884.42	0.99	113.67
	Shrub and herbaceous vegetation	0	183.78	1410.84	3964.23	2.79	979.11
	Water	0	0	1.26	0.45	267.75	2.61
	Others	0	161.91	235.44	2067.66	2.88	2624.85

Acknowledgements

The authors gratefully acknowledge the scientific research grant (ÇAYDAG 109Y210) of the Scientific and Technological Research Council of Turkey (TÜBİTAK).

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The Effects of Major Industrial Accidents in Soil Degradation

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Abstract
Major industrial accidents at fixed installations do occur causing significant impact both to the adjacent population and the environment. A distinction can be made between nuclear and chemical installations. Chernobyl (1986) is the most famous nuclear accident that left significant radioactive fallout to approximately 50000 km^2 of soil with consequences till today. SEVESO (1976) is another famous chemical accident that caused extensive soil pollution by dioxin and subsequent people evacuation for soil cleanup. In general chemical accidents cause high local contamination around their sites. However, in a few instances where large quantities of pollutants are more widely dispersed in the environment, the ecological impact is severe. The type of pollutants that normally affect the soil are generally *heavy metals*, *inorganic and organic compounds* Most of these compounds have the tendency to adhere to soil particles and to affect sensitive habitats such as rivers and biotas such as plants and animals that enter eventually into the food chain. Remediation of contaminated soil is a particularly difficult and costly operation, leading to environmental deterioration and lowering of the standards of living in the specific area, so accidental spills must be absolutely prevented
Keywords: major industrial accidents, environmental impact

Introduction

Major industrial accidents at fixed installations do occur causing significant impact both to the adjacent population and the environment. A distinction can be made between nuclear and chemical installations. Chernobyl (1986) is the most famous nuclear accident that left significant radioactive fallout to approximately 50000 km^2 of soil with consequences till today. SEVESO (1976) is another famous chemical accident that caused extensive soil pollution by dioxin and subsequent people evacuation for soil cleanup. In general chemical accidents cause high local contamination around their sites. However, in a few instances where large quantities of pollutants are more widely dispersed in the environment, the ecological impact is severe. The type of pollutants that normally affect the soil are: a) *heavy metals*, used as antioxidants, pigments, fire retardants and organometal stabilisers, namely, cadmium, tin, antimony and lead compounds, b) *inorganic compounds,* such as carbon monoxide, nitrous oxides, hydrochloric acid, hydrobromic acid, hydrofluoric acid, hydrogen cyanide, hydrogen peroxide and ammonia, and c) *organic compounds* determined in fumes from industrial fires, such as monomers of the plastics, epoxides, polyaromatic hydrocabons (PAHs), hydrocarbons, substituted benzenes, chlorinated aromatics and biphenyl. Most of these compounds have the tendency to adhere to soil particles and to affect sensitive habitats such as rivers and biotas such as plants and animals that enter eventually into the food chain. Remediation of contaminated soil is a particularly difficult and costly operation, as has been also proven in the SEVESO soil cleanup, which has cost three times the initially foreseen budget of 19 million US dollars. In the following of this paper particular mentioning will be made of how big oil tank fires pollute the soil.

Soil pollution owing to oil tank fires

The petrochemical industry normally uses large storage tanks, which contain considerable volumes of flammable and hazardous chemicals. Thus, the occurrence of a tank accident is possible and usually leads to fire and explosions. A thorough analysis of tank accidents with a classification of causes and contributing failures is presented by Chang and Lin (2006). The most common consequence of a tank accident is the fire. Although large scale tank fires are very rare, they pose a serious challenge to fire fighters, oil companies, the environment and the soil owing to the multiplicity of the physical processes involved in the fire phenomenon. According to the study of by Persson and Lonnermark (2004), there are two ways of dealing with a tank fire, either to let it burn-out fully and thereby self-extinguish or, alternatively, to extinguish the fire actively, using fire-fighting foams. Tank fires produce large quantities of combustion products, such as sulphur dioxide (SO2), carbon monoxide (CO), hydrogen sulfide (H2S), and lead to soot and particulates formation. More specifically, the transport of combustion products by a wind-blown smoke plume can distribute potentially hazardous materials over a large area and may lead to serious consequences for the health of people and for the environment including the soil.

The plume trajectory from tank fires depends on physical processes, which are highly complex and difficult to predict. The horizontal movement of the plume is determined by the prevailing wind, while its vertical movement is defined by the fire buoyancy forces. The most significant plume parameters, such as pool geometry (diameter, depth, substrate, heat release rate), fuel composition, ventilation conditions (wind velocity, air entrainment), humidity, temperature, atmospheric stratification and topography of the surrounding terrain, contribute, each in its own way, to the formation of the plume; the overall effect, however, is a complex combination of them.

The relatively unfortunate accident in the Buncefield oil depot on Sunday 11th December 2005, at Hemel Hempstead, Hertfordshire England has shed more light into this type of accidents relating to their effects to the environment and the soil. There was a major explosion, followed by a series of smaller ones resulting in the development of a massive fire which engulfed over 20 large fuel storage tanks and the facilities. The fire was burning for days, until Wednesday, 14th December, when the last major fires were finally extinguished. A number of smaller fires continued burning until Thursday, 15th December. The massive fire caused a huge smoke plume that covered a space of hundreds of kilometers and was also clearly seen by satellites. A great deal of the soot and particles contained in the plume have settled on the ground further kilometers downwind and have created problems to agricultural products along with pollution to surface waters. The same phenomenon has also occurred in the large oil tank farm fire of JETOIL company at Thessaloniki, Greece on February 1986 with similar soot deposition problems quite far away from the accident place and severe degradation of agricultural products.

The study of Argyropoulos et al. (2010) has shown that the maximum ground level concentrations of black smoke have been calculated at a distance range of 935 to 2 500 m downwind of the flow axis when the wind is not so strong and the heat strength of the burning liquid helps the plume rise high. On the contrary, if the wind blowing during the accident is strong, its inertia forces trap the smoke plume near the ground and produce very high ground-level concentrations of the toxic pollutants near the tank feet

An additional problem of oil tank fire extinguishing is the management of firefighting water and foam. If no provision is taken for gathering this water for reprocessing, a lot of harmful chemicals can enter the soil and then pollute the aquifer or open water resources. This has been the case of the big fire at Basel, Switzerland on 1986. The Sandoz chemical spill was a major environmental disaster caused by a fire and its subsequent extinguishing at Sandoz agrochemical storehouse in Schweizerhalle, Basel-Landschaft, Switzerland, which released toxic agrochemicals into the air and resulted in tons of pollutants entering the Rhine river, turning it red after they have polluted the soil as well (Güttinger & Stumm, 1992).

Polluted Soil remediation after a chemical accident

Emergency response personnel are involved in assessing the risk of hazardous material releases and working to avoid any harmful effects. Teams of workers evaluate the concentrations of the chemicals, where and how people might be exposed, and potential toxic effects on the exposed people. In many cases, emergency response teams are on twenty-four-hour call; if a spill occurs, they use source data (such as the hazmat placards on trucks and tanker cars), databases of chemical properties, and chemical movement models to rapidly predict the movement of contaminants and the toxicity of the spilled chemicals. If rapid spill cleanup is necessary, the emergency response team designs and implements cleanup measures to protect exposed populations and ecosystems from toxic responses. A wide range of cleanup systems has been developed for chemical spills. Small spills on land are cleaned up by simply excavating the contaminated soil and moving it to a secure landfill. Oil spills on water are contained using floating booms and adsorbents, or solid materials that capture the soil, so that it can be disposed of in landfills. Newer, more innovative methods for spill cleanup include bioremediation (using bacteria to metabolize the contaminants) and chemical oxidation (using oxidants, such as hydrogen peroxide and ozone to break the chemicals down).

However, chemical accidents and spills can be devastating to humans, wildlife, and the environment/soil. The best way to reduce the harm caused by chemical accidents is to design plants with better safety controls that operate at lower temperatures and pressures, and to use and manufacture less toxic compounds, a field that is being pursued by "green" chemists and engineers. But until toxic chemicals are routinely replaced by less harmful substitutes, the emergency response procedures developed by environmental scientists and engineers help lessen the human health and soil/atmospheric effects of chemical spills and accidents.

Discussion

Many if not most products we use in everyday life are made from chemicals and thousands of chemicals are used by manufacturing industries to make these products. The source of many of these chemicals is petroleum, which is refined into two main fractions: fuels and the chemical feedstocks that are the building blocks of plastics, paints, dyes, inks, polyester, and many of the products we buy and use every day called organic chemicals. The other important class of chemicals is inorganics, which include acids, caustics, cyanide, and metals. Commercial products made from inorganics range from car bodies to computer circuit boards.

Of the more than forty thousand chemicals in commercial use, most are subject to accidental spills or releases. Chemical spills and accidents range from small to large and can occur anywhere chemicals are found, from oil drilling rigs to factories, tanker trucks to storage tanks and all the way to private households.

Although most accidents do not cause major environmental damage, they occur frequently and habitats are continually impacted from accidents. Therefore, the general environmental degradation caused by repeated minor incidences must be considered as:

- the retarding of recovery of ecologically sensitive habitats such as industrial rivers
- the increase of background levels of persistent organic and inorganic pollutants
- the leading to wide scale contamination in areas of heavy industrialisation. This has certainly been the case in the past when less strict environmental legislation concerning accidents was in place.

Spilled chemical are a serious cause of soil pollution, among others, leading to soil degradation, as it is very difficult in most cases to achieve soil remediation and cleanup, leading to environmental deterioration and lowering of the standards of living in the specific area, so they must be absolutely prevented.

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Arbuscular Mycorrhizal Fungal Diversity under Long-Term Inorganic and Organic Fertilization Practices in Mediterranean Turkey

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Abstract

Arbuscular mycorrhizal (AM) fungi are major members of soil fungi could promote plant nutrient absorption. Therefore, appropriate management of AM fungi can contribute to effective fertilizer management in crop production. However, little information has been available concerning AM fungal association with crops in semi-arid zones such as southern Mediterranean Turkey where soil productivity is low due to unfavorable climatic effects and soil characteristics. We investigated AM fungal community structures in a long-term experimental field in Çukurova University, Adana, southern Turkey, under different fertilizer managements including AM fungal bio-fertilization. The field experiment was established in 1996 and treatments included farmyard manure (FM), plant compost (PC), mycorrhiza-inoculated compost (PC+My), traditional fertilization (TF) and no fertilization (CO) were examined with crop rotation of wheat and maize. Soil samples were collected in June 2009 during the wheat cropping season. Fine wheat roots were obtained from the soil using a 2 mm sieve and total DNA were extracted. Using AM fungal specific primers, PCR to amplify the 28S LSU rDNA, sub-cloning and sequencing were conducted to elucidate AM fungal flora. As a result, most of 201 cloned sequences were *Glomus* and the rest were *Scutellospora*. Although AM fungal diversity varied with treatments, their community structure in Plot TF tended to differ from the other treatment plots. The AM fungal species applied as bio-fertilizer were not dominant in Plot PC+My. These results strongly suggest that the inoculated AM fungal species could easily be replaced by endogenous ones which are well-adapted to the environments.

Keywords: Arbuscular mycorrhizal fungi, diversity, long-term fertilization, compost, mycorrhizal inoculation

Influence of Land Use Changes on Soil Degradation Indicators in Esfahan, Ira

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Abstract
At present soil degradation is a serious issue and it has economic and social harmful effects in local, national and global levels. Today, the researcher is unanimous that change is one of main factor to degradation and change in soil characteristic. Considering issue, study land use change and affect these changes on some soil degradation index done in Friedan region of Esfahan province in 2000 ha. Results of this research presented to increased bulk density, decreasing porosity, organic matter, going out macro nutrients follow of degradation in natural rangeland and converting them to abandon rain fed. Finally, use of these land according to capacity of use in right program and management can decrease of intensify degradation and loss of resources.
Keywords: Land Use Changes, Soil Degradation Indicators, Management Programming, Frieden Region

Introduction

Bimanual land use is using from land and management land. On other hands, land use and soil degradation has close relationship if use be irrational caused amount of degradation sever increase. In Iran ,amount of degradation along to amount of profiteering interference human have direct relation (Gholami, 2010).Evaluation land use changes and effect on soil degradation through soil subsequent land use change in rangeland and suggested some index about this issue by Khademi and Khayyer (2004). The most of these indexes are comparing changes in some of selective soil characteristics such as organic carbon and nutrients. land use Changes in short term result to change soil characteristics that led to decrease fertility of soil (Wange and Gong 1998).land use change of rangeland or grassland to farmland is worst change aspect of soil fertility and quality degradation and caused a healthy ecosystem without correct management in left condition is impossible because degradation are more important than pedogenesis.

Material and Methods

The studied area is part of Aghcheh basin with 2000 ha on Esfahan province, that located on Friedan county that from 50°2′13″ to 50°5′56″ eastern longitude and from 33°3′34″ to 33°7′25″ northern latitude. This area has natural capacity to be rangeland and in recent years is: rangeland, irrigation farming, rain fed and land tillage earlier but now harvest exactly application (abandon rain fed).

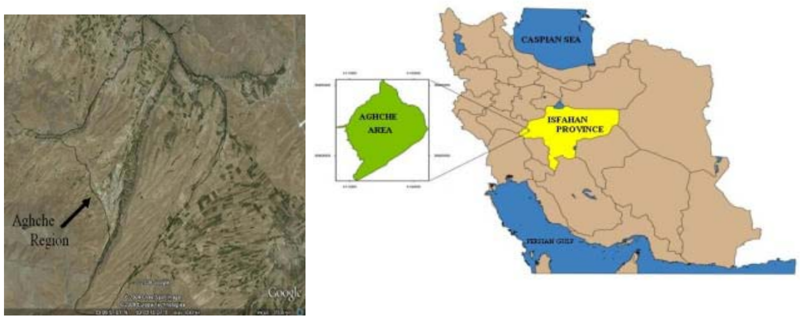

Fig 1.The study area in Isfahan province and Iran

Sampling of soil uses Transect method from 0-30 Cm depth (Zhao et al., 2005) and location of sampling register by GPS. According to researcher such as (Jafari et al., 2009; Wang and Jung, 1988) physical parameters such Bulk density, porosity and also parameters related to fertility and loss of nutrient of soil contains organic matter and macro nutrients (nitrogen, phosphor, Potassium) for evaluation soil degradation condition in different land uses, were measurement in Lab . Analysis of results done through SPSS software and repeated means of characteristics in different uses through Duncan range test in %5 levels and compare of probabilities. So table of descriptive statistical for soil degradation index on each land use, table of abundant cumulative data for each test, for each land use with histogram related to each index, table of compare soil degradation index means in different land use and table of analysis variance (ANOVA) effect of land use on soil degradation were made by SPSS .Also, for drawing charts used Excel software.

Result and Discussion

Table 1. The result of variance analysis of different land uses effect on soil degradation indexes

Mean of Squares						df	Variability
K (ppm)	P (ppm)	N_t (%)	O.M (%)	Porosity (%)	*pb* (gr/cm^3)		
24997.448*	1726.966*	0.002*	0.034*	0.005*	0.047*	3	Land Use

*: Significant in 5% of Duncan test.

Table 2. The comparison of soil degradation indexes mean in different land uses in study area

Index Mean						Land Use
K (ppm)	P (ppm)	N_t (%)	O.M (%)	Porosity (%)	*pb* (gr/cm^3)	
116.59 ^{d}	12.04 ^{c}	0.085 ^{b}	0.87 ^{c}	46.10 ^{a}	1.41 ^{c*}	Rangeland
197.14 ^{b}	39.47 ^{a}	0.087 ^{b}	0.92 ^{b}	40.80 ^{c}	1.57 ^{a}	Irrigation Farming
235.72 ^{a}	39.40 ^{a}	0.117 ^{a}	0.96 ^{a}	41.70 ^{b}	1.55 ^{b}	Rain Fed
195.30 ^{c}	35.17 ^{b}	0.057 ^{c}	0.83 ^{d}	42.50 ^{b}	1.51 ^{d}	Abandon Rain Fed

*: The similar data is non-significant in 5% of Duncan test.

As be for show, from the point of view statistical, there are significant different between bulk densities in different land uses. Process of land use change from rangeland to farmland and abandon land show increasing amount of index.

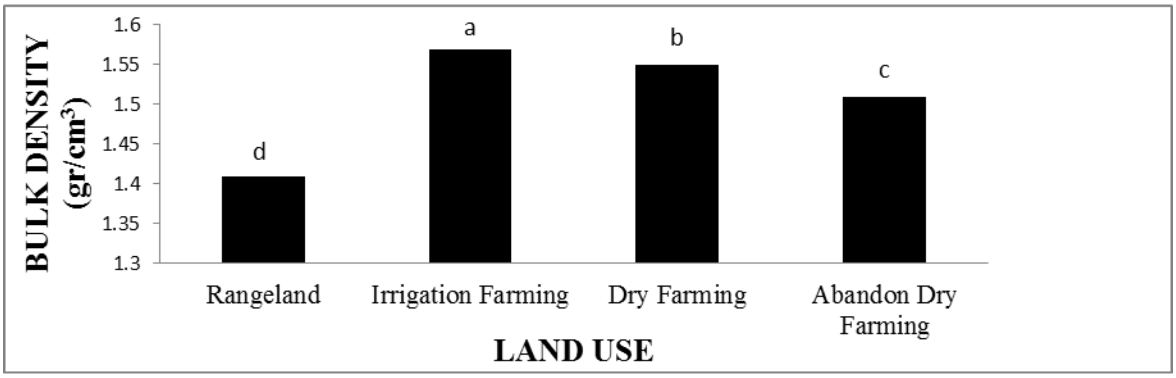

Fig. 2 the comparison of bulk density in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

Tillage after land use change in this area, caused change in amount of soil bulk density in cropland that fig. 2, show clearly this subject. Increasing soil bulk density follow land use change, it seems, can happen soil primary voids that influence of doing cultivation then irrigation or rainfall (Hajabbassi et al., 2008).

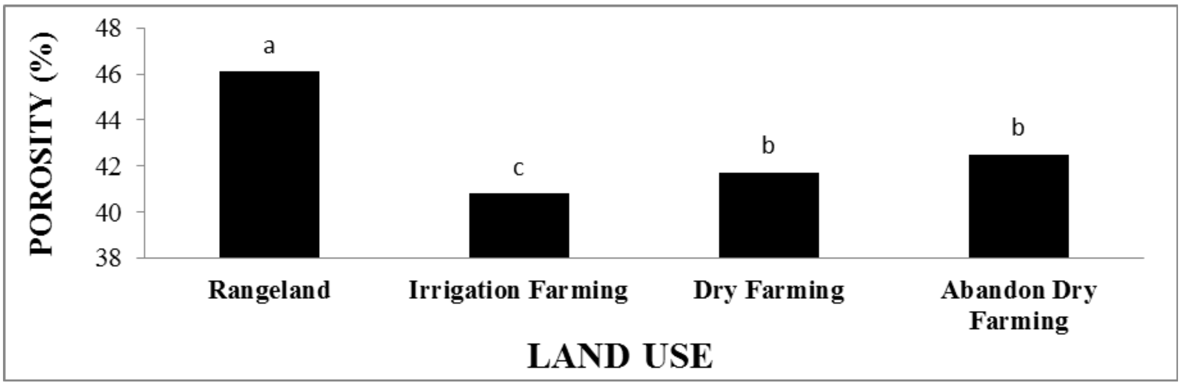

Fig. 3 the comparison of porosity in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

Fig. 3, related to soil porosity in different land use show relationship between porosity and bulk density that it confirm the index. The results from soil porosity are accordance to Lu et al., (2002) and Akbarzadeh et al., (2009) that they stated decreased in porosity follow rangeland change.

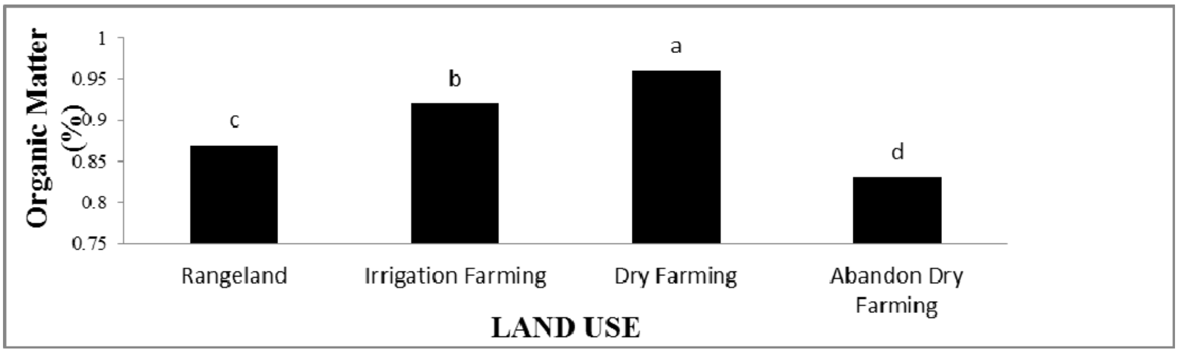

Fig. 4 the comparison of organic matter in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

In fig. 4 seen change land use from rangeland to cropland, caused increasing soil organic matter and in abandon rain fed caused decreasing amount of it. Vegetative cover condition (density and type) , how to use of land after land use change, intensity and alternation of tillage, manure, kind of crop after land use change, time of sampling effect on amount of decreasing and increasing soil organic matter accordance of how to land use change in the area studied. Rangeland in this area mostly had vegetative cover less till medium, and usually after land use change was under irrigation and had manure relatively suitable, caused crop had good yield and return organic matter to soil was relatively suitable, even amount of soil organic matter in land use change to cropland was more than pristine rangeland.

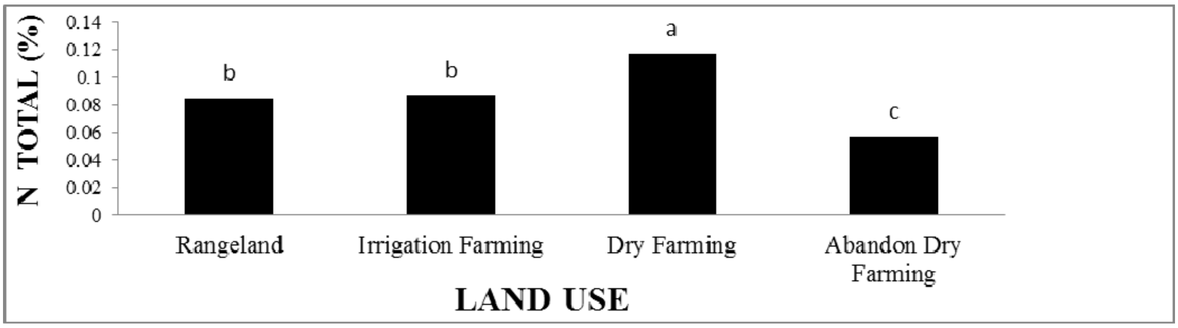

Fig. 5 the comparison of total nitrogen in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

Results of analysis statistics show amount of soil nitrogen that non different significant between rangeland and irrigation farming. Bolandnazr (2009) pointed of this matter in his researches, besides this research show nitrogen increased in rain fed compare to irrigation farming, that caused by use of today use of nitrogen manure, fixation of nitrogen by root, and non existing leaching factor because of non-irrigation in dry farming. Also, results analysis show significant different between amount of soil nitrogen in natural rangeland compare to abandon dry farming. In fig. 5 seen it significant different and can consider that degradation in natural rangeland and change to abandon dry farming caused loss of nitrogen. Probability, be caused of non vegetative cover and didn't nitrogen fixation through roots of plants and didn't manure caused went out nitrogen from topsoil.

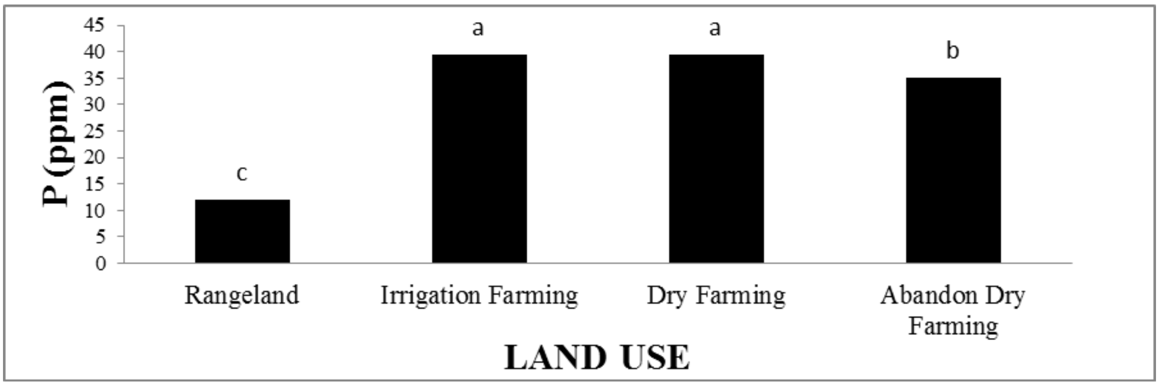

Fig. 6 the comparison of available phosphorus in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

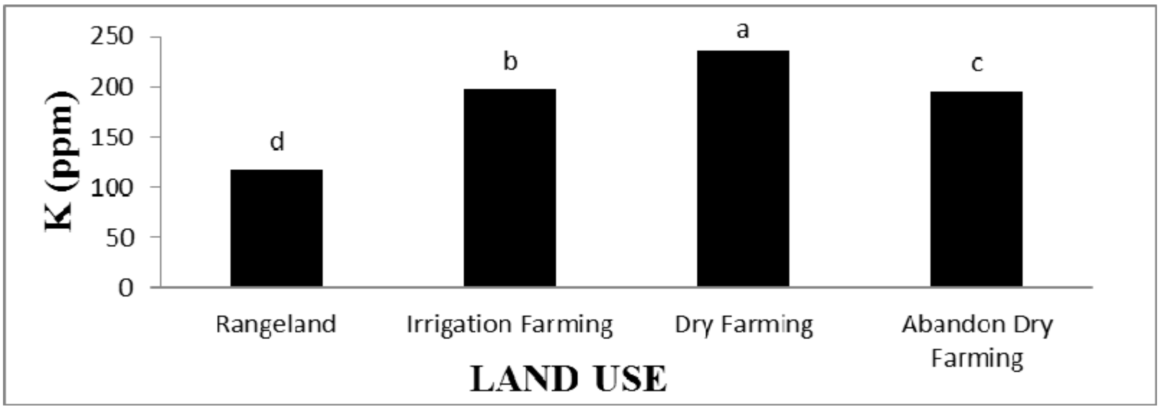

Fig. 7 the comparison of available potassium in different land uses in study area
(*: The similar data is non-significant in 5% of Duncan test)

Results from analysis statistical amount of phosphorus and potassium soil show in table 1, 2 and fig. 6, 7. Based on, there wasn't significant different between amount of plant available phosphorus in irrigation farming and rain fed, but there are significant different in other land uses. As regards available potassium, there is significant different between land use of this area. In both of them, land use change from rangeland to cropland caused amounts of potassium and phosphorus are increasing, that result from manure these land and immobilization these elements in soil. Results of research showed making any mistake in land use change and exploitation of land caused intensify soil degradation and irreparable damages. So, use of natural resources must be harmony with working potential in long-term or/and use of this resources must compatible with phenomenon and natural rules. Don't observation rules, soil quality decrease gradually, and if appropriate management doesn't replace with soil situation, soil may be loss its exploitation in long-term. Land Sustainable management with aim of prevention of soil and land degradation is solution for natural resources degradation for future generation.

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Temporal Effects of Conventional and Organic Farming Systems on Physical Properties of Typic Xerofluvent Soil

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Abstract

The aim of this study is to determine effects of conventional and organic farming systems on temporal variations of physical propersties and cotton and wheat yields of a Typic Xerofluvent soil. The experiment was conducted in Menemen Plain, in the Western Anatolia Region of Turkey (latitudes 38°36′37.22″–38°36′34.79″ N; longitudes 27°01′21.95–27°01′16.78″ E) between years of 2002 and 2008. The field study was conducted in 10 plots in a randomized-parcel design with five replications, during seven years. The plot dimensions were 9.12 m width and 15 m length. Chemical fertilizer was applied for conventional farming system (CFS). Green manures were applied for organic farming systems (OFS).

Results show that the most effects of applications were found on bulk density, porosity, scructure stability index and yields of cotton and wheat. Generally bulk densities values of soils were decreased by OFS more than CFS (ρb 2002 OFS 1.54 g cm^{-3}, CFS 1.50 g cm^{-3}; 2008 OFS 1.40 g cm-3, CFS 1.40 g cm^{-3}). On the other hand porosity (φ 2002 OFS 40.02 %, CFS 41.63 %; 2008 OFS 45.43, CFS 45.52 %) and SSI (SSI 2002 OFS 23.14, CFS 19.64; 2008 OFS 22.82, CFS 18.82).

Keywords: Organic Farming Systems, soil properties, Menemen plain

WETLAND SOILS AND CLIMATE CHANGE

ORAL PRESENTATIONS

Analysis of temperature and rainfall procedure as indicators of climate change in the northwest of Iran with Mann-Kendal method

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Abstract

Different climate indicators like temperature, humidity and rainfall in one region are affecting agents of region's climate which increase and decrease of them in several years or in one period of time are known reasons of climate change in that region. Aim of this research is Analysis of temperature and rainfall procedure as indicators of climate change in a period of 40 years in several weather stations in the northwest of Iran (Urmia, Khoy, Tabriz) with using Mann-Kendal method.in this method first with using Mann-Kendal rating method data changes and then type and time of them were identified. Results show that in Tabriz weather station monthly average weather temperature procedure in times of January, June and October are in the increasing order of 0.212,0.215, 0.241 & and in Urmia & Khoy weather stations were no changes. Researches show the order of monthly rainfall in those weather stations have great changes in comparison with temperature in months of the years which change of this parameter in Urmia, Tabriz & Khoy weather stations are -0.270, -0.312 &-0.341 respectively. Rainfall in Tabriz weather station in February, March, August, September, October are -0.25, -0.25, -0.30, -0.32 &-0.23 respectively. in weather station of Urmia in June, August, September were decreasing. Finally annual research on climate indicators with Mann-Kendal method shows existence of positive temperature average in Tabriz station and negative procedure in all three weather stations.

Key words: climate change, Mann-Kendal, analysis of temperature procedure, the northwest of Iran

Introduction

Different climatic indexes such as temperature, humidity, and precipitation in a certain location are the factors that affect the climate in that location. Studying these indexes contribute to the understanding of the climate of the location. Phenomena, such as increase or decrease in temperature, precipitation and etc. throughout a year or a certain period can attest to the climatic change in a region. Precipitation is a non-thermodynamic element and goes through considerable shifts in arid and semiarid regions in terms of place and time. Also, temperature variation can in turn precipitate physical, chemical, and biological changes on the Earth. Global warming triggers a change in global precipitation pattern. This change occurs as a result of a change in evaporation, and consequently, in water circulation patterns, which causes some regions to be more humid and some others drier. The process of precipitation and temperature is not the same throughout the whole planet. Climate change does not necessarily result in consequent changes in precipitation and temperature. In this case, precipitation may concentrate more on higher altitudes (Clark, 2003). Since it has a major effect on environment, economy, and society, climate change is a very important issue. Important human activities like agriculture and industry depends a lot on the stability of climate changes (Brison, 1997). Bin Domy (2006), after analyzing the temperature and precipitation changes through solidarity and Mann-Kendall methods, could show that the average of minimum and maximum temperatures indicated an inclination toward warmer climate from 1946-1999. The tendency toward getting warm had occurred during the spring and summer months of the year. Although the slope of the analyses on annual precipitation was negative, none of the time series showed a significant relationship in this regard. Cannarozzo et al (2006) analyzed the process of spatial distribution of precipitation in Cecily and asserted that climate change can have salient effects on various environmental variables such as precipitation in many of the countries. Changes in precipitation have had some effects over water resource management, agriculture, hydrology, and ecosystem. As a result, location and time changes in precipitation are important.

The results from this study indicated a positive trend in the region (Cannarozzo, 2006). Bartholy and Pongrácz (2007) studied the analysis of maximum temperature and precipitation in Carptin Basin from 1946 to 2001 and concluded that the global and continental temperature trends in central and Eastern Europe have risen in the second half of the 20th century. Hejam et al (2007) analyzed the seasonal and annual precipitation change process in central Iran via non-parametrical methods. To do so, 48 pluviometric stations in central Iran were used in a time span between 1970 and 1999. The results showed that the efficiency of both Mann-Kendall and Sen S Estimtor Slope methods in analyzing the seasonal and annual precipitation trends is similar in most cases. The results of this study indicated a significant falling trend in the time series through both the implemented tests. However, no significant positive trend was confirmed by both of the tests (Hejam et al, 2007). The goal of the present paper is to study the possible deviation from the normal state of some of the humidity and temperature elements, such as precipitation and temperature averages as well as maximum and minimum temperatures, in Northwestern Iran via Mann-Kendall method.

Material and Methods

In climate change studies, long-term statistics can depict the climatic changes and characteristics. Weather stations in Iran were first established in 1951 and this contributes to a short record period as well as other problems which has made climate studies very problematic in our country. The area under study is located in the north-west of Iran. The calculations and analysis of average precipitation and temperature have been done. The time span in this study consists of a forty-year period between 1965 and 2005 at Khoy, Tabriz, Orumiyeh weather stations (Table 1). The method implemented in this study is Mann-Kendall graphical statistics test, and the moving average is a five-year-long period. This test is used for exponential cases and progresses in series. In this method, the series are ordered in an ascending way and then are ranked. In this test, the lack of trend determines the randomness of data.

If a trend exists, the data are not random and to determine the randomness of data the following test is used (Kaviani and Asakare, 2002):

$$T = \frac{4p}{N(N-1)} - 1 \quad (1)$$

$$P = \sum_{i=1}^{n} n_i \quad (2)$$

T: Kendall Statistics

P: Sum of Higher Ranks

P for N>10 is similar to the normal distribution with zero average and a variance of $\frac{4N+10}{9(N-1)}$.

Therefore, the significance test can be calculated as following:

$$(T)_t = \pm \text{ tg } \sqrt{\frac{4N+10}{9N(N-1)}} \quad (3)$$

N: Total Number of Statistical Years

tg: Significance Possibility Level which equals 1.96

$(T)_t$: Mann-Kendall Statistics

Here, tg is equal to the critical value of the normal distribution standard (Z) which is equal to 1.96 with a 95% possibility. If this value is applied, $(T)_t$ will be equal to ±0.21. Now, considering the calculated critical value, if $(T)_t < T < (T)_t$ i.e. $-0.21 < T < +0.21$, no significant trend can be seen in series and the series are random. If $T < (T)_t$ i.e. $T < -0.21$, the negative trend will be dominant in the series. And If $T > (T)_t$ i.e. $T > +0.21$, the positive trend will be dominant in the series. In order to determine the existence of the trend and the types of changes and their times, Kendall's ranking test (Mann) is used. To do so, Kendall's Graphic Test is required. A special table is used for this. In this table, statistical data, row number data, parameter values, and numerical values of the items are listed in columns 1, 2, 3, and 4 respectively in an ascending way. To complete this table, we need to calculate the coefficient of "t" in Kendall test which can be attained through the following equation:

$$t_i = \sum_{i=1}^{n} n_i \tag{4}$$

And its distribution function is equal to the variance average asymptotically when the zero assumption is applied.

$$E\,(t) = \frac{n(n-1)}{4} \tag{5}$$

And its variance equals to:

$$\text{var}\,(t) = \frac{[n(n-1)(2n+5)]}{72} \tag{6}$$

It is quite clear that if this trend exists in a specific direction, this test is accurate only in its two-sided form. Accordingly, the zero assumption is rejected for the values higher than |u(t)|.
The following equation is used to obtain U(t):

$$u\,(t_i) = \frac{[t_i - E(t_i)]}{\sqrt{\text{var}(t_i)}} \tag{7}$$

U(t) is significant when the trend is either ascending or descending. In this case, U(t) > 0 or U(t) < 0. The values of t_i which are the sum of n_i and t_i equal to the sum of n_I – written in columns 7 and 8 respectively. The values of E(t) and var are calculated in columns 9 and 10 respectively. To identify the short and minor trends, the mutation and start points of the time series trend in time series diagram are used based on u(t) and U(t) Values. To draw up the time series diagram for consecutive values, u(t) and U(t) were calculated using Mann-Kendall Test. In order to calculate U(t) to determine t_i, instead of comparing the first datum with the consequent data, the last data are compared to the other data in the series, and, in fact, the calculation assumes a descending nature. In other words, the data are ranked and t_i (the rank of i compared to the previous ranks) is determined and the Cumulative frequency of t_i ($\sum t'_i$) is calculated. The mathematical hope, variance, and the index of U(t) are calculated as following:

$$\acute{E}\,(t) = \frac{[N-(n_i-1)](N-n_i)}{4} \tag{8}$$

$$V\,(t) = \frac{[N-(n_i-1)](N-n_i)[2(N-(n_i-1))]+5}{72} \tag{9}$$

$$\acute{U}(t) = \frac{-(\sum t'_i - E'_i)}{\sqrt{V'_i}} \tag{10}$$

In this method, the consecutive values of u_i and u'_i obtained from Mann-Kendall Test are shown graphically. If u_i and u'_i curves intercept one another several times, there will be no change in the trend. However, the curves represent the start point of the trends or the changes at the interception points. If the curves intercept between -1.96 and +1.96 zone, the interception suggests the beginning of an abrupt change. Yet, if they occur outside the critical zone, they signify a trend in the time series. In this research, any trend, abrupt change, increase, and decrease are represented by T, C, I, and D respectively.

Results

A. The analysis of Mann-Kendall Test on the annual and monthly data

The results from applying the Statistic Test (T) and Mann-Kendall Critical Statistic $(T)_t$ are shown in table 2. The comparison of (T) and $(T)_t$ of average monthly temperature shows that the changes in the parameters are limited to a number of months and have a limited span. Also, the lack of a trend dominates most of the months. The average monthly temperature among the research stations was subjected to the most alterations in Tabriz Station where a change of 0.215, 0.241, and 0.212 were recorded for January, June, and October respectively. According to the critical test, $(T)_t$ has had a positive or incremental trend. During the other months of the year, Tabriz Station did not have a notable trend. However, Urmia and Khoy stations did not have any positive or negative trends in the region under study throughout the year. Among the stations, the maximum temperature in Tabriz station has gone through changes, resulting in a negative trend for 3 months of the year. The minimum temperature has occurred only at two stations and only in one month of the year. Urmia station with 0.274 in February and Tabriz station with 0.233 in August have a negative trend.

Surveying the monthly precipitation series in the stations under study shows that it has a higher abundance compared to the temperature throughout the year, and a negative trend is evident in all of the cases. Like temperature, precipitation had the highest fluctuation in Tabriz station with 5 months of precipitation changes, namely February, March, August, September, and October having changes of -0.25, -0.25, -0.3, -0.32, and -0.23 respectively. After Tabriz Station, Urmia station ranks the second with three months of change in June, August, and September in the region under study.

The annual survey of the climate elements through Mann-Kendall method indicates a trend in the period of study. The temperature average has alteration only in Tabriz station and the trend of this change was positive. The two stations depict no trends. Also, no changes were observed in the maximum and minimum temperatures. However, the precipitation has an opposite characteristic. In other words, we have witnessed changes in the precipitation trends in all the stations which were negative. Precipitation parameter changes in Urmia, Tabriz, and Khoy stations were -0.27, -0.132, and -0.341 respectively.

B. The analysis of Mann-Kendall Schematic Test to Determine the Type and Time of the Change

To do so, all the elements under study were drawn using the U_i and U'_i components in a monthly and annual basis. Then, using the characteristics of Mann-Kendall Graphical Test, the type and the time were determined. The results of the analysis of the diagram are provided in table 3. Because of the high volume of the diagrams, it was impossible to accommodate all of them in this paper, so only one sample is presented in Picture 1. According to the diagrams, the start time of most of the changes turned out to be abrupt. As table 3 shows, most of the temperature changes in the study region in different months are abrupt and incremental. For instance, in Urmia and Tabriz stations, the changes are abrupt and incremental which happened in the recent part of the study period starting from 1995. The maximum and minimum temperatures have a similar trend, too. The abrupt, decreasing temperature changes are seen only in July at all three stations. As to the precipitation changes, they are all abrupt and decreasing. However, most of the annual temperature changes have a positive trend. Yet, most of the annual precipitation changes have a negative trend.

Table 2 – monthly result of Kendall Statistic (T) and critical statistic $(T)_t$ for the stations under study

Stations	Indexes	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Urmia	Max Temp.	0.084	0.146	-0.172	0.238	-0.197	0.007	-0.226	0.025	-0.021	0.053	-0.023	-0.1
Tabriz		0.133	0.015	-0.26	0.248	-0.221	0.066	-0.146	0.046	0.064	0.161	0.087	-0.018
Khoy		0.171	0.079	-0.138	0.184	-0.185	0.025	-0.141	-0.008	0.102	0.2	0.02	0.033
Urmia	Mean Temp.	0.102	0.197	-0.092	0.105	-0.012	0.166	-0.015	0.015	-0.107	-003	-0.105	0.015
Tabriz		0.215	0.169	0.153	0.194	0.161	0.241	0.11	0.182	0.2	0.212	0.058	0.128
Khoy		0.056	0.094	-0.033	-0.079	-0.2	-0.092	-0.192	-0.12	-0.133	-0.046	-0.133	-0.064
Urmia	Min Temp.	0.171	0.274	-0.048	-0.078	0.107	0.023	-0.023	-0.123	-0.136	-0.154	-0.159	0.015
Tabriz		0.248	0.174	-0.113	-0.008	-0.021	0.21	0.169	0.233	0.146	0.115	-0.021	0.007
Khoy		0.034	0.161	0.005	-0.151	-0.077	0.038	0.153	0.153	0.036	-0.046	-0.172	-0.1
Urmia	Precip.	-0.105	-0.03	-0.056	-0.09	-0.19	-0.217	-0.117	-0.43	-0.31	-0.19	0.013	-0.15
Tabriz		-0.18	-0.25	-0.25	-0.038	-0.02	-0.16	-0.084	-0.3	-0.32	-0.23	-0.051	-0.076
Khoy		-0.317	0.14	-0.112	-0.005	-0.134	-0.066	-0.064	-0.107	-0.15	-0.13	-0.035	-0.1
C. S. V.* (T)t		±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21	±0.21

*critical Statistical Value

Table 3 – Analysis of the Time and Type of the Monthly Climatic Parameter Changes at the Station under Study

Stations	Indexes	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Urmia	Max Temp.	CI1997	CI1999	CD1972	TI1993	-	CI1998	TD1978	-	-	CI2000	CD1968	-
Tabriz		CI1996	CI1999	TI1997	TI1988	TI1987	CI1987	CD1993	CI1997	CI2002	CI1999	CI2000	-
Khoy		CI1985	CI1999	CD1971	CI1993	-	CI1997	CD1984	-	CI2000	TI2001	CI1989	CI1980
Urmia	Mean Temp.	CI1999	CI1994	-	CI1998	-	TI1995	-	-	CD1968	CD1969	-	-
Tabriz		CI1995	-	CI2000	-	CI1994	TI1995	-	CI1997	CI2000	TI2001	CI2001	CI1996
Khoy		TI1994	CI1998	-	-	-	CD1970	TD1969	TD1967	CD1972	CD1969	-	CD1969
Urmia	Min Temp.	CI1994	TI1990	-	-	-	CI1993	CI1996	-	-	-	-	CI1992
Tabriz		TI1994	CI1976	CD1994	-	CD1972	TI1986	CI1983	TI1996	CI2000	TI1991	CD1970	-
Khoy		CI1994	CI1978	-	CD1968	-	CI1998	TI1997	-	-	-	CD1971	CD1969
Urmia	Precip.	-	TI1984	-	CD1970	CD1985	CD1996	CD1975	TD1969	CD1967	-	-	CD1994
Tabriz		CD1965	-	-	CD1971	-	CD1996	CI1996	TD1969	TD1974	TD1994	-	CD1972
Khoy		CD1986	CD1989	-	-	CD1979	CD1995	-	-	-	CD1992	CD1991	TD1979

Conclusion

Climate change bears a salient importance which has preoccupied the researches and even the heads of the states and organizations mainly because of its effects on the political, social, and economical activities. This issue was not given the importance it deserves in our country until recently. However, there have been a number of researches and conferences on this issue. The present paper is also dealing with this issue trying to analyze and evaluate the climate change (minimum, maximum, and average temperature as well as precipitation average) in the Northwestern Iran, which has been given little care and attention. The survey on the temperature and precipitation at three weather stations in the Northwestern Iran indicates that there were changes in these climatic elements from (1965-2005). These changes include both short-term fluctuation and trend which are evident in some of the monthly and annual series. The surveys on the average temperature series indicated that the changes are of trend type and incremental. Monthly changes showed that temperatures follow trends and have abrupt incremental changes. Yet, the precipitation showed more negative and dwindling trends. The onset of most of the changes is abrupt and follows a trend. Also, the change times at the stations are different and indicative of a lack of coordination in alteration phenomenon at the stations under study.

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Detection of Dependencies between Oceanic – Atmospheric and climatic parameters in order to monitoring drought using Data-Mining Techniques (Case study: Khuzestan province)

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Abstract
Drought is a natural phenomenon that starts slowly and spread equanimity and traces severity on all human activities. Therefore, complete recognition and exact monitoring of its can provide appropriate tools for dealing with it and decreasing damaging effects. One of the strategic areas that are very important in terms of agriculture is Khuzestan province. This province is very remarkable due to its permanent rivers, flood-prone rivers also having various reservoirs. The main objective of this study is to improve drought monitoring by finding dependencies between drought and several oceanic-atmospheric and climatic parameters in different way in comparison with statistical correlations. In this paper, we used Data Mining Techniques of Association Rules. Drought events were determined according to Standard Precipitation Index (SPI) and its Dependencies were surveyed using oceanic- climatic indices such as Southern Oscillation Index (SOI), Pacific/North American (PNA) Index, Multivariate ENSO Index (MEI), Pacific Decadal Oscillation (PDO) Index and North Atlantic Oscillation (NAO). Results showed that the selected patterns classes which are dominant on drought are similar in different time delays. It means that drought events are compeer with normal status of indices and are predictable with maximum and minimum accuracy 74.24 and 44.86 percent, respectively. Therefore, we can use these rules as a supplement to existing approaches for drought monitoring.
Keywords: SPI drought index, atmospheric-oceanic indices, Association Rules, drought prediction, Khuzestan

Introduction

Due to low precipitation and improper raining variance with regards to timing and locality aspects, Iran is considered among dry and semi-arid countries in the world and is intensely vulnerable in this regard (Bagherzadeh chehreh, 2005). Transformation of crisis management to risk management for minimizing the harmful effects of drought is an inevitable matter in managing natural calamities Therefore; one of the most essential tools in this regard is designing protection systems for drought (Jalily, 2005). The present research includes a part of necessary actions for designing the mentioned systems. Scientists have always intended from the past to provide relations between the rate of precipitations and small scale local meteorological parameters, but then by identification of large scale climate signals, their efforts were led in that direction, in order to define relations between the signals and raining variations that could be applied in forecasting drought (Glantz,1994 ; Ropelewski & Halpert,1987). Data mining is a new technology that could reveal the hidden relations and patterns inside a large number of data. Data mining has been applied in commerce, medical science and communication networks, but it has been only used once for the field of drought (Tadesse et al., 2004).

McCabe et al. (2007) considered the relations between the occurrence of drought in USA and the rate of sea surface temperature (SST) changes in pacific and North Atlantic oceans in the past few decades. The result was that SST variations in the 19th and 20th centuries have been considered as one of the important factors for droughts in the USA along with other elements like ENSO. Tadesse et al. (2004) analyzed the dependence between drought events and oceanic-climatic indices such as southern oscillations of Pacific Ocean (SOI), multi-variable ENSO (MEI), pacific decade oscillation (PDO) have rather stronger relations with drought incidents. Koorehpazan Dezfuli (2003) studied the effects of large scale meteorological signals such as SST, ENSO and north Atlantic oscillations (NAO) on the forecasting variations of rain in southern regions in Iran. The results showed that these regions confront up-scale rainfall in warm phases of ENSO, NAO and cold phase of SST, and confront low-scale rainfall in cold phases of NAO and ENSO and the warn phase of SST. Nazemosadat et al. (1995) and Nazemosadat (1998) showed that there is a

negative and significant correlation between winter temperature of Persian Gulf water surface and the winter precipitations southern and south west provinces of Iran (Fars, Boushehr, Khuzestan and Hormozgan). In a research, Karamouz et al. (2004) estimated the rate of rain due to the effects of the variables in the southwest of Iran, indicating that the global patterns of atmospheric cycles such as ENSO, NAO and Persian Gulf SST (PGSST) could be the representing elements of metrological drought in the studying regions.
It is observed in the studies for drought in the world and in Iran that the forecasting of drought has been considered less and the forecasts in this respect have been done hesitatingly (Bagherzadeh chehreh, 2005). In applying large scale climate signals and analyzing their effects on the rate of precipitations most researches have evaluated their simultaneous occurrences on rainfall, but the lags between their occurrences have not been considered. Therefore, it can be seen that there have been negligence in this case in a region where our country is located. The objective of this research is improving the drought monitoring and some atmospheric-oceanic parameters, as well as identifying the occurrence of drought events by a defined lagging aspect of the indices, by using the data mining association rule technique in Khuzestan province.

Materials and Methods

Scope of the study and the applied data for the research

Due to numerous operations of data mining association rule method and the requirements of it to Long-term historical data for ensuring the revealed patterns by it and also since this research considers the effects of large scale atmospheric-oceanic parameters on the drought in the province. A station with appropriate conditions was selected for doing the experimental works. Therefore, this research was done in the synoptic station in Abadan, situated in Khuzestan province, and had the long-term data regarding monthly precipitations for at least 50 years. This station is situated in the geographical longitude of 48.15 east's and latitude of 30.22 north's and the average amount of precipitation in this station is 167mm.The data regarding the monthly rate of precipitation in Abadan station was obtained from Iran Meteorological Organization (www.weather.ir) and the long-term data regarding each index was obtained from the following databank (www.cpc.ncep.noaa.gov,www.cdc.noaa.gov,www.jisao.washington.edu, www.cru.uea.ac.uk).

Atmospheric-Oceanic Indices

In this study five of the most common atmospheric-oceanic indices have been used that the following is a brief description of their:
Southern Oscillation Index (SOI): SOI represents the pressure gradient along the east-west Pacific (Bagherzadeh chehreh, 2005).Positive and negative SOI show Lanina condition (drier than normal) and Elnino condition (wetter than normal) respectively (Tadesse et al., 2004).
Pacific North America Index (PNA): PNA is a pattern that occurs in the above atmosphere. This phenomenon is one of the dominant models of climate change during the winter months in mid-latitude ground (Bagherzadeh Chehreh, 2005).
Multivariable ENSO Index (MEI): MEI is calculated based on six main observed variables in equator Pacific Ocean. These six main variables are: Sea Level Pressure (SLP), zonal and meridional components of the surface wind, Sea Surface Temperature and total cloudiness fraction of the sky. Positive MEI and negative MEI show respectively Elnino conditions and Lanina conditions (Tadesse et al., 2004).
Pacific Decadal Oscillation Index (PDO): PDO index is defined as the leading principal component of North Pacific monthly sea surface temperature variability pole ward of 20N. The positive values show the warm phase of the North Pacific sea surface temperature, and the negative values show the cold phase (Tadesse et al., 2004).
North Atlantic Oscillation Index (NAO): NAO is defined based on the normalized pressure difference between a station in Azores, a group of islands in the Atlantic, and other stations are in Iceland (Tadesse et al., 2004). Positive NAO index shows a condition more severe than normal in tropical high pressure center and a condition deeper than normal in low pressure center of Icelandic. Pressure difference between these two regions led to more severe winter's storms on many areas of the north Atlantic. Negative NAO index represents that tropical high pressure centers an Iceland low pressure centers are weak. Consequently, the pressure gradient between

these regions is reduced and it cause that weaker winter's storms happen in the east-west (Bagherzadeh Chehreh, 2005).

Standardized Precipitation Index (SPI)

SPI was developed by Mackee et al. for monitoring the climatic drought (meteorological) in 1993 (Karamouz and Araghinajad, 2005). Mackee et al. offered SPI index for different time scales such as 3, 6, 12, 24 and 48 months. Positive SPI values indicate greater precipitation than average precipitation and negative values mean that precipitation is less than average precipitation (Bagherzadeh Chehreh, 2005). There are different categories of SPI index. Each of these indices has classified SPI into 5-7 class which each class represent drought or wetness and its severity. Drought is a rare phenomenon and its occurrence is very low relative to normal and wetness condition. So if want to for each class of drought with different severity discover patterns from the database due to lack of data for data mining operations, patterns are meaningless and are not reliable. Therefore, according to table (1) two categories were considered for the SPI index that drier than normal condition have been called drought conditions. In this case, drought occurred 292 times in 50 years. Besides, approximately, 67.48 percent of months have experienced drought. In this study. SPI with the 12-month time scale (annual) was used and by the SPI software was calculated.

Table1. Classification of standardized precipitation index

Drought condition	SPI values
Wetter than normal	$SPI \geq 0$
Drier than normal	$SPI < 0$

Association Rules Method

Association rules are studying of attributes or characteristics that are associated with each other. Association rules imply to relationship and this rule established with confidence coefficient and support coefficient in database. It is appropriate to notice to relationships which have high confidence and support coefficients. These relationships that have high confidence coefficient and strong support are called strong rules (Alikhanzadeh, 2006). In this study, for final comment in addition to these constraints support and confidence has been used from the usefulness criterion of Leverage that can determine the influence power of relations to time. Criteria of support, confidence and Leverage are calculated based on the relationship (1) to (3).

$$Support(X \rightarrow Y) = Support(X \cup Y) \quad (1)$$

$$Confidence(X \rightarrow Y) = \frac{Support(X \cup Y)}{Support(X)} \quad (2)$$

$$Leverage(X \rightarrow Y) = Support(X \rightarrow Y) - Support(X) * Support(Y) \quad (3)$$

Where Support (X → Y), Confidence (X → Y) and Leverage (X → Y) are support, confidence and usefulness criterion of related patterns, respectively and Support(X), Support(Y) and Support(X ∪ Y) are the number of repeated patterns of X, Y and X with Y, respectively in the database.

Different algorithms have been presented for discovering of association rules such as Apriori algorithm (Alikhanzadeh, 2006). Due to the nature of the Apriori algorithm which uses in the purchase basket analysis the problem of time series and time lags has not been considered, But due to the nature of the drought that various factors is causing its occurrence and the effect of these factors on the drought, they usually show themselves with time lag. Therefore, it is necessary to do some changes in the Apriori algorithm to be used for drought surveying. Logic and methodology is similar the Apriori algorithm except that goal is finding patterns of atmospheric-oceanic parameters and drought which the antecedent and consequent of rules are separated and occurrence of consequent with a time lag relative to occurrence of antecedent will occur. A rule in the used algorithm is defined in a similar relation X → Lag Y. Where X and Y, antecedent (cause) and consequent event (effect), respectively and the lag is time delay between the events of the antecedent and consequent. This approach focuses on seeking rules which the antecedent and consequent events take place separately. Also, starting the consequent is following the start of the antecedent with a certain time lag. The mentioned algorithm has been used in the Khuzestan province for the period 1952 to 2001 (50 years) in Abadan station with regard to atmospheric-

oceanic parameters as a antecedent (the cause of rule) and drought events as the consequent (the effect of rule).
The standard method for applying association rules in numerical domain is discertization. For the monthly time series for 50 years, it has been assumed that atmospheric-oceanic indices follow the normal distribution. According to the standard deviation in normal frequency distribution they have been classified into 7 categories, shown in table (2).

Table 2- Threshold values for classification the atmospheric-oceanic indices (Tadesse et al., 2004)

classes	SOI	MEI	NAO	PNA & PDO
1	≥ 1.5	≤ -1.5	≤ -4	≤ -2
2	1 ≤X< 1.5	-1.5<X≤ -1	-4 <X≤ -3	-2 <X≤ -1.5
3	0.5 ≤X< 1	-1 <X≤-0.5	-3 <X≤ -2	-1.5<X≤ -1
4	-0.5 <X< 0.5	-0.5<X< 0.5	-2 <X< 2	-1<X< 1
5	-1 <X≤ -0.5	0.5 ≤X<1	2 ≤X< 3	1 ≤X< 1.5
6	-1.5 <X≤ -1	1≤X< 1.5	3 ≤X< 4	1.5 ≤X< 2
7	X≤ -1.5	X≥ 1.5	X≥ 4	X≥ 2

Results and Discussion
The mention data mining algorithm, based on association rule in no lag basis and also 1, 2, 3, 4, 5, 6, 9, and 12 months lags between occurrence of atmospheric-oceanic parameters and drought was performed in Abadan station. In each case, 98 association rules were obtained on average that included one to 5 member antecedent combinations of the indices, having the ability to forecast drought according to atmospheric-oceanic indices. As mentioned in the basis of association rules. The only rules are appropriate that are repeated sufficiently i.e. having the minimum support (6% in this research) and high rate of confidence. The minimum support of 6% has been obtained according to trials & errors and considering the point that increasing the supporting rate could reduce the number of produced rules and that reduction would lead to increasing the rules with difficult analysis. Thus, 38 association rules were obtained, on average that had the threshold of minimum support for each lag. Finally 9 patterns were selected for each lag, from the discovered rules, which included individual and compound combinations of the indices that have the highest values of leverage. The selected patterns are shown in table (3). The results showed that the types of selected patterns dominating drought in Abadan station are similar for different time lags, which means that the atmospheric-oceanic parameters, both individually and in 2-5 antecedent combinations, all include a condition that the indices are situated in their 4th classification regarding their group.

Table 3- Patterns selected as the antecedent of association rules (X in the rule of X→ Lag Y)

Pattern's Number	
1	SOI(4)
2	MEI(4)
3	PNA(4)
4	PDO(4)
5	NAO(4)
6	PDO(4),NAO(4)
7	PNA(4),PDO(4),NAO(4)
8	MEI(4),PNA(4),PDO(4) ,NAO(4)
9	SOI(4),MEI(4),PNA(4), PDO(4),NAO(4)

The numbers listed beside the indices name abbreviations in antecedent rule are related to classification of these indices.
The confidence values related to the selected patterns for different lags are shown in table (4). As observed, the distinguishing between the selected patterns in Khuzestan province indicates different combinations of the indices with each other, despite the similar classification of them (4th classification) and the confidence values regarding the patterns. According to the selected patterns, obtained on average between 882 association rules (98 rules for each lag). It can be concluded that

drought is occurred with drier conditions than normal situations. In Khuzestan province, most of the time, where the indices in the intermediate or 4th level are situated according to their standard deviations and this level is usually considered normal, regarding the strength or weakness of the indices. In normal conditions, the expectations is on the long-term average value or the maximum normal humidity, but according to the used method, which has a high capability in revealing the relations and concealed patterns in the data bank. We conclude that by observing the values of the indices of SOI & MEI in between -05 to 0.5, PNA & PDO in between -1 to 1, NAO in between -2 to 2 and in according to their standard deviations, we should expect drought by the maximum of 74.24 and minimum of 44.86. The maximum value is related to the pattern number 9 in a 6 month lag. The minimum value is related to pattern number 2 in a 12 month lag. In other words, for pattern number 9 for the lag time of 6 months. According to relationship (4) would have:

$$IF(S(4), M(4), PN(4), PD(4), N(4)) \rightarrow Lag = 6\ Drought \quad (4)$$

Expressing that in 66 repetition of 5 mentioned indices in the databank an in their 4th level of their classification according to the standard deviation, 49 cases were followed by drought. According to the definition of confidence for association rules, the confidence value would be 74.24%, According to relationship (5):

$$Confidence((S(4),M(4),PN(4),PD(4),N(4)) \rightarrow Lag{=}6\ Drought) = \frac{49}{66} = 0.7424 \quad (5)$$

Table 4-Selected confidence rates of association rules for different time lags

Time Lags (month) / Pattern's Number	0	1	2	3	4	5	6	9	12
1	54.96	53.31	52.89	55.79	54.13	53.72	55.37	52.89	46.28
2	55.56	56.38	55.56	56.38	57.20	55.97	54.37	49.38	44.86
3	48.74	47.49	46.98	48.99	47.99	48.49	49.25	47.24	46.73
4	51.12	50.62	51.12	50.87	50.12	50.62	50.87	48.63	48.13
5	49.13	48.95	48.08	48.43	47.38	47.90	47.55	46.85	47.03
6	51.44	50.91	50.65	50.91	49.09	49.87	50.13	47.78	47.78
7	51.48	49.63	50.00	51.48	49.63	51.85	52.96	49.63	48.15
8	59.68	59.68	60.48	64.52	62.10	63.71	64.52	58.87	48.39
9	69.70	69.70	68.18	72.73	68.18	68.18	74.24	63.64	45.45

Different confidence rates of selected patterns indicate the effects of the indices on drought happening during the time and show the accuracy of forecasting drought for different time lags. According to table (4), using the combination of atmospheric-oceanic indices has caused the increasing in accurate forecasting drought in different time lags. In other words, using more antecedent combination in a definite time lag causes the increase in confidence rate of association rules. Therefore, by applying the combinations we could predict the happening of drought with acceptable accuracy in Abadan station.

Moreover, according to confidence values of selected rules, it can be observed that some atmospheric-oceanic indices separately have more relations with droughts in Abadan station. In other words, their association rules have higher confidence values that indicate more implication of its association rules. Pattern number (2) that expresses the 4th level of MEI index, i.e. MEI (4), is considered as the antecedent to association rule in forecasting drought, and has most relations regarding the occurrence of drought in Abadan station. Patterns number (1, 4, 5, 3) follow that, respectively. As it can be observed, PNA index has the least relations with occurrence of drought. This is important since we could use atmospheric-oceanic indices for drought monitoring systems having more relations with drought occurrence. In other words, they have higher confidence rates for forecasting drought. Surveying the relationship of atmospheric-oceanic indices separately on drought event should consider the rules usefulness. Accordingly, based on the usefulness values of association rules for different time lags PNA, PDO and NAO indices have lower confidence value compared with SOI and MEI indices, but their rules usefulness was 1.5 to 2.5 times of SOI and MEI indices. Repetition of rules antecedent and repetition of pattern compared with the entire

period (50 years) was more than repetition of rule antecedent and repetition of patterns of MEI and SOI indices but repetition of their pattern compared with repetition of rules antecedent was low. This issue is responsible of reduction of confidence values of their association rules. So, single patterns of PNA, PDO and NAO is in spite of lower confidence values compared with SOI and MEI indices were more beneficial, and repetition of their patterns was very high in database. In other words, trust to their confidence values is more. In this aspect, all of single patterns of indices are proper for applying in drought forecasting systems.
According to discovered association rules for time lags (1, 2, 3, 4, 5, 6, 9 and 12 monthly) we concluded that using of each of indices separately or combinatorial had different prediction accuracy for different time lags. Therefore, if SOI index situate on the fourth class of its classification, after three months drought have occurred with greater reliability than other lags. This issue has been increased confidence values to 79.55. In other words, if SOI index stands in fourth class, after three months it will have the maximum of its effect in Abadan station and on this view prediction of drought, time lag is optimum. Similar to what was said for SOI index, optimum time lag for the MEI, PNA, PDO and NAO indices according to 2 to 5 patterns of Table 3, are four, six, zero (or two) and zero months, respectively. For patterns of 6 to 9 which indicate the antecedent combinations of two to five members optimum time lag are zero, six, three (or six) and six months, respectively. For a general comparison with the algorithm that is used in this study, statistical method of linear correlation has been used in order to determine the correlation of atmospheric-oceanic and climatic parameters. According to this statistical technique, the linear correlation coefficient values for each of the atmospheric-oceanic and climatic parameters have been calculated at different time lags. Using statistical methods of linear correlation, relationship between drought index and atmospheric-oceanic indices are weak (less than 0.02). Therefore, based on the statistical methods, strong and approved correlation was not observed between SPI (for 12 months) and atmospheric-oceanic indices. The confirmed result in both data mining operation and statistical is that dependency of the standard precipitation index (SPI for 12 months) with atmospheric-oceanic indices like SOI, MEI and PDO is relatively more than dependency of the SPI with PNA and NAO. In this study, in spite of the classical statistical methods that have been used in internal and external research, the new technique called association rules was used. The results show that the data mining algorithms of association rules which used in this study was a useful tool for monitoring of drought in Abadan station by identification and production of the association rules between the drought events with atmospheric-oceanic indices. In addition, these rules showed that the atmospheric-oceanic parameters used in this study could apply as a drought warming in Abadan station.

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Evaluation of Large Scale Climate Signals and Sea Surfaces Temperature for drought forecasting by Artificial Neural Network in the Khuzestan province, Iran

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Abstract:
Drought is a climatic normal phenomenon and its occurrence is inevitable. Drought prediction can play a crucial role in water resources management and optimum operation. The goal of this study is evaluating the possibility of using large scale climate signals and sea surfaces temperature in Persian Gulf and Red Sea in drought forecasting based on artificial neural network in Ahwaz station. In this study, a multilayer perceptron network for recovering of nonlinear mapping between the large scale signals (SOI, MEI, PNA, PDO, and NAO), sea surfaces temperature (the Persian Gulf and Red Sea) and the monthly drought (SPI) were designed. Predictions were done by 10 models by 3-month intervals for a period of 24 months. The results showed that SOI, MEI, PNA, PDO and NAO signals are not capable for predicting drought but sea surfaces temperature showed a good performance in some periods such as (1,6,12,18, and 24 months). Adding signals to the previous month data of SPI index improved forecasts. By increasing the number of inputs and using the information of month data at previous year for the certain month the network performance considerably increased. Results of the best model showed that artificial neural networks can often predict class status of the observed drought index in more than 60 percent of cases. So indicators used in this study can be used as drought warning in Ahwaz stations.
Keywords: Large scale signals, artificial neural network, SPI index, Drought prediction, Khuzestan

Introduction

Precipitation in Iran is less than normal and there is not appropriate spatio-tempral distribution of rainfall in the country. Therefore, Iran is classified as arid and semi-arid countries and highly vulnerable for drought. (Bagherzadeh chehreh, 2005). Drought is a natural phenomenon with slowly starting and expanding but severely impact all aspects of human activities. Drought is a natural phenomenon that starts slowly and spread equanimity and traces severity on all human activities. Therefore comprehensive and accurate monitoring could provide a good tool to deal and reduce the harmful effects (Ansari, 2003). In order to minimize the harmful effects of drought, transfer of crisis management to risk management is inevitable. So, a drought monitoring system could be an effective tool (Jalily, 2005). Present study, includes some necessary efforts for designing such systems. In the past, scientists tried to establish the relationships between rainfall and local meteorological parameters in small scale. By increasing the knowledge of large scale climate signals, researchers try to establish and define the relationships between these signals and precipitation changes which could be used in drought forecasting (Glantz,1994 ; Ropelewski & Halpert,1987). Artificial Neural Networks is a powerful and effective in simulation of nonlinear systems, mathematical structure of Artificial Neural Networks is similar to human brain function (Fathi and kochakzadeh, 2004). In recent decades, the Artificial Neural network has been used widely for model making, control and management of different systems, patterns separation, Financial and Economic Forecast (French, et al., 1992; Jain, et al., 1999; Kummar, et al., 2002; Minnes and Hall, 1996; Srinivasa, 1998).
McCabe et al. (2007) studied the relationship between the occurrence of droughts in the United States with the change of sea surface temperatures (SST) in the Pacific and North Atlantic during recent decades. Results showed that SST change at19 and 20 Century as one of the main factor of drought in the U.S. alongside other indicators, such as ENSO. Tadesse et al. (2004) studied dependency between drought events and indicators of oceanic-atmospheric; they used The Southern Oscillation Index (SOI), Multi-variable ENSO Index (MEI), Pacific/North American

(PNA), The Pacific Decadal Oscillation (PDO) and North Atlantic Oscillation (NAO) as indicators. The results showed that some of these indicators like SOI, MEI and PDO have relatively strong relationships with drought events. Karamouz, et al. (2004), in a research showed that global patterns of climate cycle such as ENSO, NAO and the Persian Gulf sea surface temperatures (PGSST) could be indices of meteorological droughts in the south-western limits of Iran.
The main objective this study is investigating the possibility of using large scale climate signals and sea surfaces temperature of Persian Gulf and Red Sea in drought forecasting by artificial neural network. This research is also looking for the verification of the following hypotheses:

1) Each large scale climate signals and sea surfaces temperature of Persian Gulf and Red Sea has ability of drought forecasting separately with high accuracy and integrating them together cause be the forecasts improved.
2) Artificial neural network only with past information of the SPI drought index has ability to forecast drought with high precision. Adding the signals and sea surfaces temperature as the input models, increases the accuracy of forecasting.
3) Increasing the number of network inputs and using information of a same month from previous year cause increasing in network performance.

Materials and Methods

Scope of the study and the applied data for the research

In this study, Khuzestan Province has been chosen as case study. Khuzestan is one of the strategic areas in terms of agriculture. This research has been done on the synoptic station of Ahvaz in Khuzestan province in southwestern Iran. This station is including the important area of the province and on the other hand has long-term monthly rainfall, at least 50 years. The station located at latitude and longitude, 31.20 north and 48.40 east respectively and the average annual rainfall station is 242 mm. Statistics related to monthly rainfall of Ahvaz station obtained from Iran Meteorological Organization (www.weather.ir). After the formation of time series of given data, proceeded to reconstruction the Rainfall data. Thus the 50 year long-term data during 1952-2001 provided and as raw data was used in next steps to calculate drought index. Large-scale climate signals and temperature of the sea surfaces used in this study are respectively: SOI, MEI, PNA, PDO, NAO, Persian Gulf sea surface temperatures (PGSST) and red sea surface temperatures (RSSST). First, long-term data obtained from (www.cpc.ncep.noaa.gov, www.cdc.noaa.gov, www.jisao.washington.edu, www.cru.uea.ac.uk and www.cdc.noaa.gov/cdc/data.noaa.ersst.html). Then; time series of each during 1952-2001 was formed. This information was used as input of models in artificial neural network. Geographical location of Ahwaz station is shown in Figure 1.

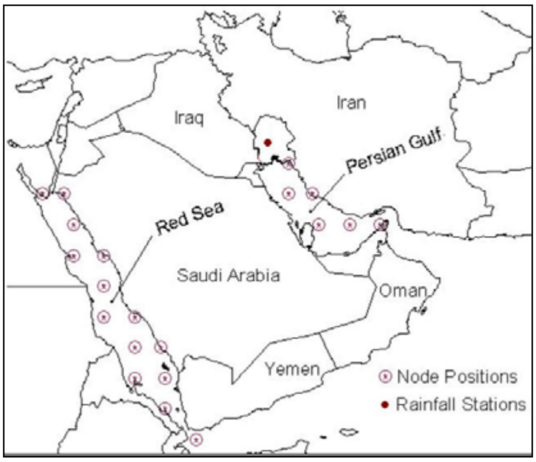

Figure 1. Geographic location of studied station and nodes of ranges the Persian Gulf and Red Sea

SPI was developed by Mackee et al. for monitoring the climatic drought (meteorological) in 1993 (Karamouz and Araghinajad, 2005). Mackee et al. offered SPI index for different time scales such as 3, 6, 12, 24 and 48 months. Calculation of this index for each location has been established based on long-term rainfall records in the desired time period. Based on classification of National

Drought Mitigation Center United States of America (NDMC) SPI Index was divided into seven classes that are shown in Table 1. In this study SPI with the 12-month time scale (annual) was used and by the SPI software was calculated.

Table 1. Threshold values used to classify drought episodes (Tadesse et al., 2004)

Drought category	Extremely dry	Severely dry	Moderately dry	Normal	Moderately wet	Severely wet	Extremely wet
SPI	≤ -2	-2 <x≤ -1.5	-1.5 <x≤ -1	-1 <x< 1	1 ≤x< 1.5	1.5 ≤x< 2	≥ 2

Selection of the network type is the first step for establishing a neural network model. About 90 percent of artificial neural networks which used in the hydrology processes are forward neural networks with error propagation algorithm (Bagherzadeh chehreh, 2005). In this study the neural network with multi-layer perceptron structure, forward process and learning algorithm of the error propagation with momentum was used. Also active function of Log sigmoid for both the hidden and output layers was applied. According to conducted research's a perceptron network with one hidden layer can approximate any nonlinear function (Fathi and kochakzadeh, 2004). Therefore in this study a perceptron network with one hidden layer was used and then the optimum neuron number for the layer was obtained with trial and error. Large-scale climate signals SOI, MEI, PNA, PDO, NAO, Persian Gulf sea surface temperatures (PGSST), red sea surface temperatures (RSSST), rainfall data and past time series of SPI index was used as input parameters in the models. The SPI Monthly drought index was as output parameter. In order to the SPI drought index forecasting based on the mentioned parameters the following 10 triple models was investigated for the formation of the neural network inputs:

- Model 1: $SPI_{t+L} = f(SPI_t, \quad SPI_{t-1}, \quad SPI_{t-2}, \quad SPI_{t-3})$
- Model 2:
- Model 3: $SPI_{t+L} = f(SOI_t, \quad MEI_t, \quad PNA_t, \quad PDO_t, \quad NAO_t)$
- Model 4: $SPI_{t+L} = f(PGSST_t, \quad RSSST_t)$
- Model 5: $SPI_{t+L} = f((Model1),(Model2))$
- Model 6: $SPI_{t+L} = f((Model1),(Model3))$
- Model 7: $SPI_{t+L} = f((Model1),(Model4))$
- Model 8: $SPI_{i+L} = f((Model3),(Model4))$
- Model 9: $SPI_{t+L} = f((Model1),(Model2), \quad (Model3),(Model4))$
- Model 10: $SPI_{t+L} = f\left((Model9), \quad SPI_{(t+L)-12}\right)$

At these models SPI is representative of the drought index, R is rainfall, SOI, MEI, PDO, PNA and NAO are atmospheric-oceanic indices, PGSST and RSSST is respectively sea surface temperature Persian Gulf and Red Sea. Index (i +1) and (i, i-1, ..., i-m) represent the next and before times of parameters respectively. Forecasting was done for the period of (L) 1, 3, 6, 9, 12, 15, 18, 21 and 24 months. Also at the models for predicting the certain month, the data of the same month at the previous year was used which at the tenth model was showed with $SPI_{(i+L)-12}$, this idea is same of the performance of ARIMA time series model. After preparation of the input models their performances for prediction the 1 to 24 month of the drought index in Ahwaz station were evaluated. To assessment the performance of neural network, three criteria namely: correlation coefficient (R^2), mean square error (MSE) and mean absolute error (MAE), was applied.

Results and discussion

Results in Testing process for all the input models based on the forecasting periods for Ahwaz station (Obviously, There are better conditions for the training process) and classification of the networks performance are shown in tables 2 and 3 respectively. Average performance could be seen for the first, second and sixth models. These models include the before months information of

SPI index, rainfall and combination of before months information of SPI index plus oceanic-atmospheric signals. For example, R^2 values those in testing process for nine-month period for first, second and sixth months was equal to 0.3966, 0.3849 and 0.4227 respectively. The third model includes of a quintuple combination of the oceanic-atmospheric signals showed weak performance in all periods. The fourth model includes dual combination of the sea surface temperature of Persian Gulf and the Red Sea and the eighth model includes of quintuple oceanic-atmospheric signals plus sea surfaces temperature. These models showed a different performance so that for periods of 1, 6, 12, 18 and 24 months a good performance could be seen. for example, R^2 values those in Testing process for 18-month period was equal to 0.5860 and 0.5698 for the fourth and eighth months respectively but for periods of 3, 9, 15 and 21 months there is poor performance e.g. R^2 values in Testing process for nine-month period was equal to -0.1136 and 0.0258 for the fourth and eighth months respectively. Good performance in all periods could be seen for the fifth and seventh months. The fifth model includes combination of the previous month information of SPI index plus rainfall and the seventh model includes combination of previous month information of SPI index plus sea surfaces temperatures. For example, R^2 value those in Testing process for 24-month period was equal to 0.5946 and 0.6253 for the fifth and seventh months respectively. Therefore, it is concluded that application of the previous month information of SPI index and rainfall causes average performance but their combination together improves the network performance from average to good performance. Also using quintuple oceanic- atmospheric signals has not ability to predict the drought index but by combination with the previous months information of SPI index, improvement in result till the average performance for all periods, is expected. Such results are expected for combination with the signals of sea surface temperature of the Persian Gulf and Red Sea, in some periods (1, 6, 12, 18 and 24 months). Also, application of the signals of sea surface temperature of the Persian Gulf and Red Sea has ability to predict the drought index with good performance in some periods(1, 6, 12, 18 and 24 months) but by combination with the previous months information of SPI index, good performance of the model could be seen in all periods.

Table 2. Correlation coefficients of the input models based on prediction periods for testing process

Prediction periods / models	1	3	6	9	12	15	18	21	24
MODEL1	0.4205	0.2506	0.2477	0.3967	0.3838	0.2359	0.1865	0.4424	0.3713
MODEL2	0.3412	0.4665	0.4226	0.3849	0.3941	0.2718	0.4540	0.4221	0.5148
MODEL3	-0.0332	-0.0246	0.0872	0.1537	-0.0239	-0.1366	-0.0706	0.2079	-0.0527
MODEL4	0.3680	0.0871	0.5555	-0.1137	0.4788	0.1089	0.5860	0.1544	0.5185
MODEL5	0.5351	0.3993	0.4812	0.6183	0.5850	0.3517	0.4711	0.6051	0.5947
MODEL6	0.3556	-0.1350	0.2155	0.4227	0.3623	0.2440	0.1655	0.4402	0.3266
MODEL7	0.5383	0.3519	0.5672	0.3614	0.4910	0.2207	0.5791	0.4424	0.6254
MODEL8	0.3284	-0.1184	0.5439	0.0259	0.4551	0.0632	0.5698	0.1968	0.5243
MODEL9	0.4796	0.3646	0.5799	0.5991	0.4938	0.3195	0.5637	0.6096	0.5576
MODEL10	0.5229	0.4167	0.5957	0.6123	0.5065	0.4285	0.5755	0.5894	0.5771

Table 3. Classification of the networks performance based on correlation coefficients in the different prediction periods

network performance	threshold of the correlation coefficients average in prediction periods
Poor	$R^2 \leq 0.2$
Average	$0.2< R^2 \leq 0.5$
Good	$0.5< R^2 \leq 0.6$
Very good	$R^2 \geq 0.6$

Generally, combination of first, second, third and fourth models which formed the fifth, sixth, seventh and eighth models improved the networks performance even dramatic improvement could be seen in some cases. The ninth model which is the combination of the first, second, third and fourth model showed better performance compared to the previous eight models. It was determined that by increasing the number of network entries prediction accuracy increases and in all periods a very good performance could be seen. For example, the R^2 value in testing process for 9-month period was equal to 0.5991. By adding the information of month data at previous year for the certain month in the ninth model which forms the tenth model, the network performance considerably was increased. For example, the amount of R^2 in testing process for 9-month period was equal to 0.6122. So the tenth model that uses for the certain month the information of month data at previous year has the best performance and selected as the best model. Results in the Training and Testing process of this model for 9-month period were equal to 0.6533 and 0.6122 respectively. Another analysis that done for review the performance of tenth model prediction results was the comparison of observed and forecasted classes of the SPI index in the different prediction periods. Also the tenth model for drought or wet weather conditions had correct prediction (Table 4).

Table 4. The tenth model prediction for drought or wet conditions in different periods

prediction periods	1	3	6	9	12	15	18	21	24
Training process	58.88	57.77	68.61	63.33	56.66	57.50	59.16	63.88	60.55
Testing process	60.83	53.33	60.83	64.16	55.00	56.66	60.83	60.83	60.83

Consequently, in this research attempted for investigating the possibility of using large scale climate signals SOI, MEI, PNA, PDO, NAO and sea surfaces temperature of Persian Gulf and Red Sea in the drought forecasting by using of artificial neural networks. The results showed that the signals of SOI, MEI, PNA, PDO and NAO have not ability to forecast the SPI drought index at Ahvaz station but sea surfaces temperature of Persian Gulf and Red Sea in some periods (1, 6, 12, 18, and 24 months) have ability of forecasting with a good accuracy. Integration of Signals with sea surfaces temperature had similar results of sea surfaces temperature separately. Application of the previous month information the SPI index and rainfall separately had average performance in forecasting but their combination together caused improvement of network performance. By adding the signals of SOI, MEI, PNA, PDO and NAO to the previous month information the SPI index not afford the sensible change at results, but adding the sea surfaces temperature caused dramatic improvement for the network results. Also increasing the number of network inputs and adding the information of month data at previous year for the certain month caused significant increase in network performance increased. The results showed that large-scale climate signals and the sea surfaces temperature of Persian Gulf and Red Sea which used in this study can be combined with previous month information the SPI index and rainfall in the form of the tenth model as a drought warning in Ahwaz station. The advantage of methodology of this study is that in declaring the future status, only wet and dry conditions are not reported but its intensity will also offer.

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The Influence of Distance of the Horizontal Pipe Drainage on Moisture Dynamics of Soil Types Pseudogley

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Abstract
In order to assess the efficiency of variants of spacing of horizontal drainage pipes, installed at the experiment field of Varna near Šabac owned by Institute of Soil Science, Belgrade, for regulation of the water regime of soil type pseudogley, it was carried out systematic monitoring of soil moisture dynamics and registering of basic climatic parameters of the studied site in the period 2006-2009 years.
The moisture content in the soil is affected by the complex factors such as climate, physical features of soil, agricultural production, selection and species of grown culture, evapotranspiration by plants, groundwater depth and others.
The results of analysis of the data on the current values of the moisture for all variants of drain spacing experiment are showing that the most favorable moisture regime is registered for the drain spacing of 20 meters, followed by a variant of the drainage pipe spacing of 25 meters, then 30 meters, while the least favorable moisture regime is for control variant where reclamation measures were not implemented.
Key words: horizontal pipe drainage, pseudogley, soil moisture dynamics

Introduction
Experimental drainage field of the Institute of Soil Science, Belgrade-Varna is located on the tenth kilometer road which leads from Šabac, southeast to Loznica and Valjevo, at the entrance to the village Varna (44°41′38″N; 19°39′10″E).
The site belongs to the area of Mačva, which represents the western extension of Srem depression. The terrain is mostly flat, but with expressed micro relief.
The experimental filed Varna was established in 1950, in order to monitor the effects of fertilization on pseudogley soils (as per WBR, 2006 clasification, stagnosol).
This soil type is characterized by adverse chemical, physical and water-air properties, and requires the implementation of complex ameliorative techniques.
The area belongs to the crop-vegetable agricultural region that is characterized by milder form of moderate - continental climate. For the entire area it was identified processes of seasonal over moisten soil.
In 1978 the main project of the drainage of a part of sample plot was constructed (Pivic, 2005). Drainage sample plot consists of two separate parts of rectangular form, separated by a road for mechanization. One part consists of three plots: A,B,C, and the other part consists of six plots designated and to VI. All the plots are of the same size 75.0x52.0m, individual area 0.39ha. The basis for dewatering of the nine sample plots is flexible perforated PVC drainage pipes, spacing 25 metres. Within the plots there are two drains ∅80mm, at the depth of 0.95m. Drain length is equal to plot length and amounts to 52m, minimal design slope is 0.25%. The experiment was amended in 2002 by adding two additional variants of drain spacing treatments: 20m (field A) and 30m (field C), at the same depth of 90 cm, and perforated PVC pipes Ø80mm. Figure 1. shows layout of set horizontal pipe drainage.

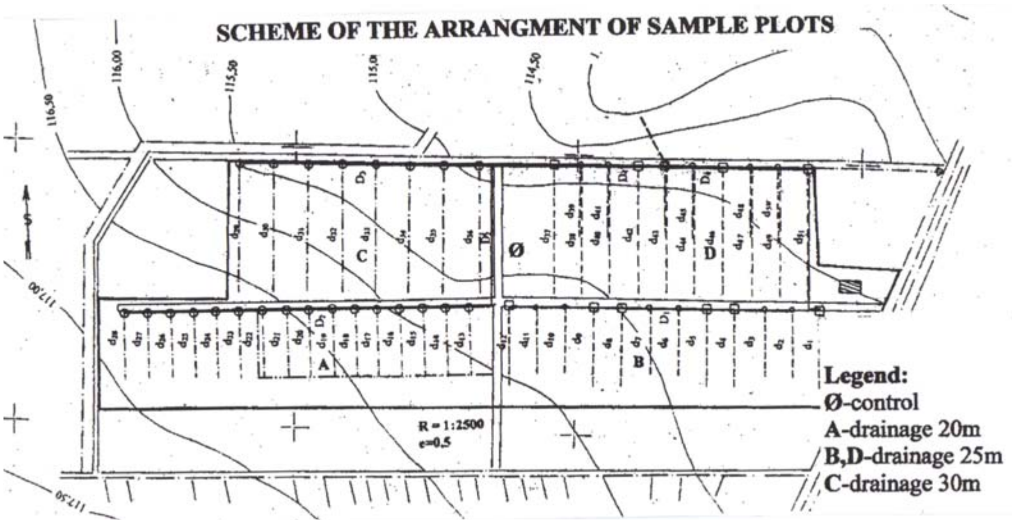


Figure 1. Scheme of the arrangement of sample plots Varna

Materials and Methods

Climate characteristics of the study region are based on the data of long-term monitoring of the main climatic elements: precipitation, mean air temperature, relative air humidity, insolation, cloudiness and wind at weather stations Šabac, Varna, Loznica and Valjevo for the period 1964-2009, obtained from the Republican Hydro-meteorological Bureau.

Potential evapotranspiration in the study period was calculated after H.F.Blaney and W.D.Criddle (Doorenbos and Pruit, 1975).

Water content in the soil was measured by gravimetric method (SRPS ISO 11465:2002), in four variant tests. The instantenous soil moisture was continuously followed (Rasulović H. et al., 1967), on four variants of experiment in the period 2006-2009: control variant (I) and horizontal pipe drainage for drain spacing of 20m(variant II), 25m(variant III) and 30m(variant IV)), up to the 1m of depth on every 10 cm. By comparing three variants of drainage spacing (Carter C.E. et al., 1994) the most efficient one is determined by soil moisture dinamic.

The results of the following of instantaneous soil moisture are presented in the comparative diagrams in the form of chrono-isopletes based on volume %, after Visocki and Rode,1960 and supplemented method of aqua-chrono-isopletes after Milivojević et al., 1983.

There are three categories of moisture:
- moisture higher than membrane capillary capacity - wet phase,
- moisture between membrane capillary capacity and wilting point – moist phase,
- moisture lower than wilting point – dry phase.

Bulk density was determinate using Kopecky's cylinders 100cm^3,(SRPS ISO 11272:2007). Membrane capillary capacity was determinate using aparatus Pressure Plate Extractor and wilting point using aparatus Pressure Membrane Extractor – Richarda (SRPS ISO 11274:2004).

Results and Discussion

The values of the main climate elements are presented in the Table 1.

Table 1.- Mean monthly value of meteorological data (1964 -2009)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	$\bar{x}$
Air temperature (°C)	0.1	2.5	6.8	11.8	17.2	20.3	22.0	21.4	16.9	11.8	6.1	1.7	**11.5**
Relative air humidity (%)	87.0	84.0	77.0	74.0	74.0	77.0	76.0	77.0	81.0	84.0	86.0	89.0	**80.0**
Precipitation (mm)	44.5	50.1	54.4	58.7	64.1	86.8	75.0	59.7	57.8	59.4	63.7	62.6	**61.4**
Insolation (%)	65.1	91.7	143.3	177.7	231.6	252.0	298.8	269.9	199.5	151.3	82.9	53.2	**168.1**
Cloudiness (0-10)	7.2	6.7	6.2	6.2	5.7	5.3	4.2	4.1	5.1	5.6	6.9	7.5	**5.9**

The climate of the wider region represents (Milosavljević M., 1980.) a milder form of temperate continental climate, with a strong influence of the vicinity of the river Sava, as wet air masses from northwest penetrate through its valley, altered by dry southeast wind Košava.

Average annual precipitation for study locality is 703 mm, it has mainly a uniform distribution throughout the year per months, except in June and July when somewhat higher values of this climatic element were recorded. Precipitation frequency is expressed through high-intensity precipitation in short periods, which is, together with mean annual air temperature 11.5 ^{o}C, the main characteristic of the climate in this region.

From the aspect of reclamation issues, it was interesting to analyze the duration of wet, moist and dry phases of study variants. As the depth of 0.5m is the average norm of drainage in the analyzed region, the average duration of wet, moist and dry phases to the depth of the norm was determined throughout the analyzed depth.

Figure 2, shows the representation of wet, moist and dry phases in study variants to the depth of 100cm and to the depth of 50cm.

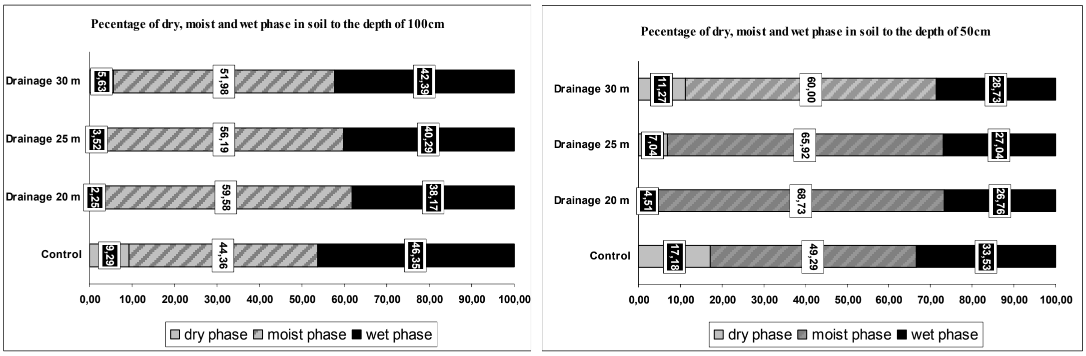
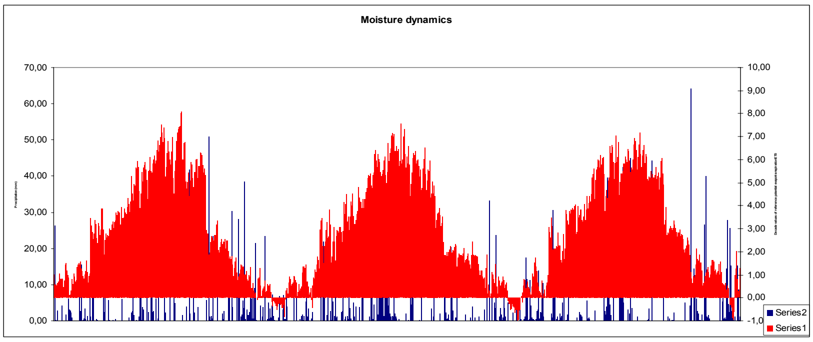


Figure 2.-Persentage of wet, moist and dry phases in study variants

The state of water regime is presented by combined diagrams (Figure 3.) by the method of aqua-chrono-isopletes. The upper parts present daily precipitation and their decade amounts and daily and decade values of reference potential evapotranspiration. The lower parts present the profile of the study soil and relative percentages of the recorded states of water content in the soil, covered by aqua-chrono-isopletes.



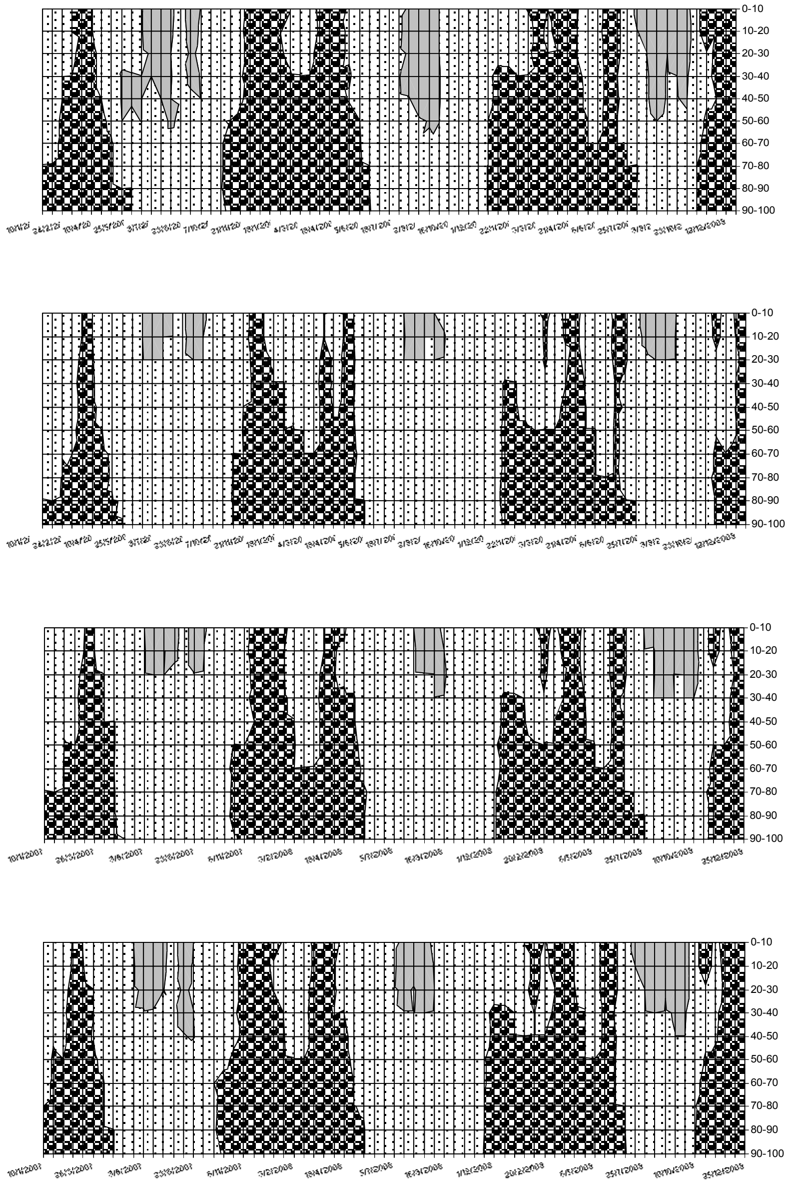


Figure 3.- Aqua-chrono-isopletes (%vol) in control and variants 20,25 and 30 m

The following results were obtained by the monitoring and processing of data on the values of instantaneous moisture in the period between 2006 and 2009, in four study variants:

- the representation of wet phase up to the depth of average norm of drainage in study area, amounting to 100 and 50cm in study region, was as follows: I>IV>III>II;

- dry phase was recorded throughout the depth of the soil profile. It was the longest in variant II, followed by variants III and IV, while it was the shortest in variant I;

- the representation of dry phase up to the depth of 100 and 50cm was as follows: I>IV>III>II;

- based on the above data, the most favorable moisture regime occurs in variant II, followed by variant III and IV, and the most unfavorable moisture regime occurs in variant I.

Conclusions indicate that, in order to regulate water regime in pseudogley (stagnosol) soils, it is necessary to implement pipe drainage. The lowest drainage spacing is giving the best results, but implementation of spacing of 30 m is most economy acceptable.

Results of examination of the representation of dry phase leads to the conclusion that implementation of horizontal pipe drainage, does not affect the drying of soil during the vegetation period.

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Sensitivity to Desertification in Lebanon In View of Biogeophysical Factors and Climate Change

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Abstract
Land degradation is affecting the majority of the Lebanese territory witnessing overexploitation of limited natural resources. Available models accessed desertification in 2003 using small scale climate, geormorphology, soil, vegetation and human pressure information. The new assessment methodology adapted site specific environmental biophysical indicators and socio-economic parameters including the new detailed soil map at 1:50.000 scale, the historical data of 15 climatic stations spread over Lebanon, the land cover map at 1:20.000 derived from IKONOS 2005. The potential sensitivity to desertification was estimated for the near and far future, considering the predicted changes in climate (temperature and precipitation), assuming a stable scenario for the present state of soil, vegetation and socio-economic conditions. Results showed that, even under good quality soils; vegetation and socio-economic conditions, climate impact is paramount on settling the vulnerability of the land to degradation. The actual extent of desertification covers 57% of the total national territory, much of which occurs under the dominant semi-arid climate. The predicted climate change scenarios would worsen the situation throughout the century.
Keywords: Land degradation, Climate Change, East Mediterranean, vulnerability modeling.

Introduction
Land degradation and desertification (LDD) affects most of the drylands in the Mediterranean areas due to a combination of natural and manmade factors. The extreme vulnerability of sensitive ecosystems to climate change was mentioned by the Intergovernmental Panel on Climate Change (IPCC) and numerous workers (Giannakopoulos *et al,* 2005; Christensen *et al.,* 2007; ISMEA IAMB, 2009; Shaban 2011). If more humid land ecosystems possess some inherited resilience, arid areas are extremely sensitive to climatic variability resulting in expanded LDD (Bullock and Le Houérou, 1996). Covering over one third of the world‘s land area, dryland ecosystems are extremely vulnerable to excessive human pressure and mismanagement of land resources (Le Houérou, 2002). Poverty, political instability, mining of natural resources and bad agricultural practices undermine land productivity (UNCCD, 1994) and lead to increased desertification risk which impacts the poor as the most vulnerable part of the population. Thus the need for integrated analysis using adequate tools to delineate hotspots and identify bright spots with the aim to plan mitigation and prevention measures to combat poverty and food insecurity (Verstraete *et al.,* 2008). After the qualitative assessment of global land degradation by GLASOD (Oldeman *et al.,* 1991), studies assessed the normalized differential vegetation index/net primary production (NDVI/NPP) index to globally detect significant biomass changes (Bai *et al.*, 2008). A step forward was the adoption of comprehensive framework approach to investigate environmental and socio-economic problems in the drylands (Reynolds et al., 2007) and integrate the bio-physical and socio-economic dimensions of land degradation (Lorent *et al*., 2008).
The vulnerability of Lebanon to LDD arises from the abrupt changes in topography and climate, rich diversity of soil (Darwish and Zurayk, 1997) and vegetation cover (Abi-Saleh and Safi, 1998). Therefore, the need for desertification risk assessment based on detailed and updated geoinformation integrating the physical, biological and human factors to assess current and expected LDD in view of climate change.

Materials and Methods
Lebanon is a mountainous, east Mediterranean country with complex. Landform, climate, soils, and vegetation cover. The country is characterized by four main geomorphological (physiographical) units as follows: (eastward) narrow coastal plain and two mountainous chains (Mount Lebanon and Anti Lebanon) separated by a fertile and relatively elevated depression (700 to 1,100 m altitude) named Bekaa Plain. Lebanon is under the influence of the Mediterranean

climate with four clearly distinguished seasons: hot and dry summer, cool and rainy winter, moderately dry fall and spring. While the coastal and mountainous areas are characterized by abundant rainfall (up to 1, 200 mm) mainly distributed between December and March, the Bekaa Valley has a semi-arid to continental climate with unpredictable rainfall and recurrent drought. The framework adopted in this work assessed the bio-physical status of the land using a set of indicators including climate, soil and vegetation. The assessment is based on assigning scores, as from the less vulnerable (1) to the more vulnerable (2), to the different ranges of each of the land indicators used by the European Environment Agency (EEA, 2008). The climatic aspects were analyzed following the UNEP, 1992 climatic aridity index (CAI), which is the ratio of precipitation over potential evapotranspiration to develop the climatic quality index (CQI). The soil quality index (SQI) was developed following the Sahara and Sahel Observatory (OSS), based on five parameters: Parental material (PM), slope (S), soil depth (SD), texture (T) and organic matter (OM) content using the new soil map of Lebanon (Darwish et al., 2006). The vegetation quality index was assessed in relation to three main parameters: erosion protection (EP), resilience to drought (RD) and resistance to fire (RF). The socio-economic indicators were composed from dwelling, education, access to water and sewage network, and income over the twenty six Cazas to which the country is divided. Poverty was assessed using the UNDP Unsatisfied Basic Needs Method available from the Living Conditions Survey (CSA, 2007). The sensitivity to desertification was obtained as a geometrical average of the listed climatic, soil, vegetation and socio economic quality indexes.

Results and Discussion

The CQI revealed great variability of climatic zones with clear altitudinal sequence from arid and semi arid on the coastal area to subhumid in the high mountains with CAI values exceeding 0.65. The absolutely lowest values of CAI are observed in North east Lebanon. In total, the areas with high climatic vulnerability accounts for 78% of the Lebanese territory. The assessment of VQI revealed that the majority of high western peaks of subhumid zones and of the semi arid eastern mountain chain is occupied by low quality vegetation. The vegetation cover with moderate VQI is spread over the inland Bekaa valley, southern plateau and large part of the coastal zone. Vegetation with high VQI providing good soil erosion protection background and possessing remarkable tolerance against drought and fires is sporadically spread over the 35% of the Lebanon mainly on the western mountain chain and northern coastal area. The rest of the country can be considered as moderate and low VQI (30% and 35% respectively).

Historically, the Lebanese peaks used to be covered with dense forest cover. Deforestation caused deep change in landscape due to erosion-sedimentation and mass movement. However, the effect of relict forest is still revealed in the relatively high organic matter content in the shallow bare soils of high altitudes which receive large amount of snow lasting from December until May. Other soil types of Lebanon (65% of the soil cover) are characterized by moderate and deep root penetration zone, adequate geomorphology and thus represent valuable resources possessing native resilience to erosion and drought, and therefore, resistance to desertification if properly managed. The analyses of socio-economic conditions showed that population living in more than 66% of the Lebanese area has the lowest living satisfaction conditions for water, education, dwelling area and income. Such social driving force can be a main pressure on limited resources leading to possible mining of land and notable vegetation cover.

Areas prone to desertification (moderate, high and very high sensitivity classes) represent 57% per cent of the total territory of the country. While moderate sensitivity covers 16.8 per cent and the remaining 26.17 per cent of the land is under low and very low sensitivity to desertification (Figure 1). More sensitive areas can be considered as hot spots requiring immediate attention and participatory approach to elaborate mitigation measures and alleviate the negative effect of land degradation. Areas with a moderate sensitivity to desertification need measures to improve the status while low and very low sensitivity to desertification or even “bright spots” still require attention to protect and prevent any deterioration in the fragile balance between natural components and human induced factors.

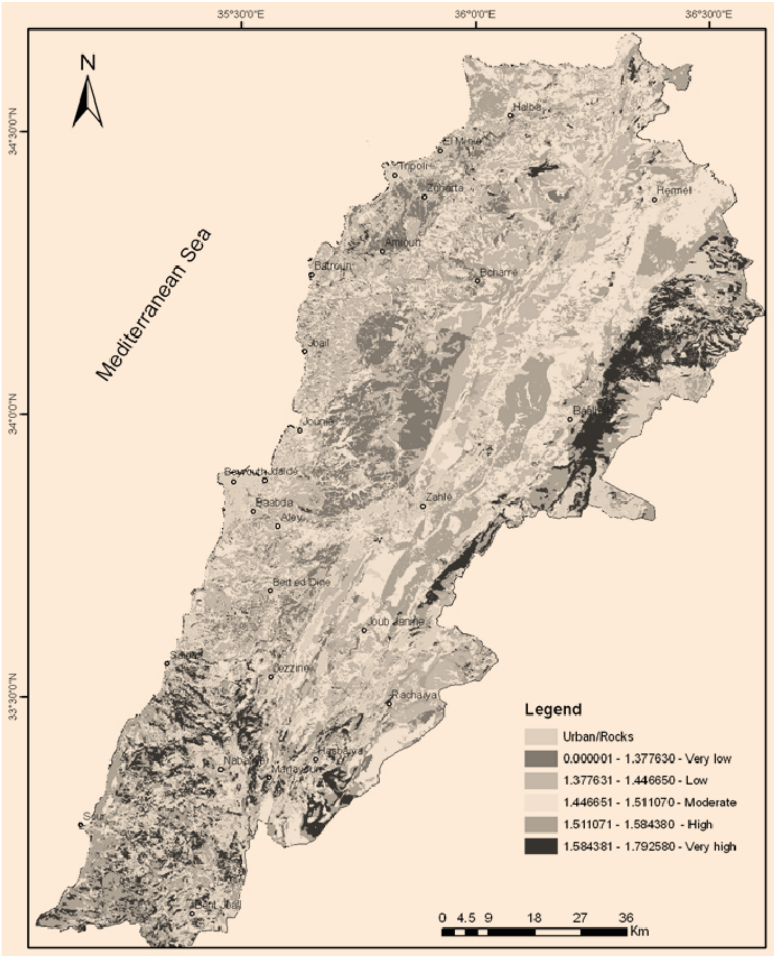

Figure 1. Current sensitivity to desertification over Lebanon.

The extrapolated desertification risks in relation to expected climate change would exacerbate the impact of natural and manmade factors. The next step would be elaborating different climate change scenarios and implementing the model with supposed stable state of other natural and human factors. Uncertainty arises from the simple way approach while natural phenomena can integrate the multiplying effect of several other dynamic factors impacting our changing world and leading to unexpected catastrophes whose extend is difficult to predict and damage is more difficult to estimate.

Conclusion

A new desertification risk assessment for Lebanon based on the integration of biophysical and socio-economic conditions was achieved using updated and more detailed soil and vegetation information. The current sensitivity to desertification was estimated using the climatic quality index (CQI), soil quality index (SQI), vegetation quality index (VQI) and socio-economic quality index (SEQI) categorized into five sensitivity classes ranging from very low (scored 1) and very high (scored 2).Sensitivity to desertification was modeled at local level which can help better elaboration and implementation of the national action program to combat desertification.

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WETLAND SOILS AND CLIMATE CHANGE

POSTER PRESENTATIONS

Detection of Dependencies between Oceanic – Atmospheric and climatic parameters in order to monitoring drought using Data-Mining Techniques (Case study: Khuzestan province)

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Abstract
Drought is a natural phenomenon that starts slowly and spread equanimity and traces severity on all human activities. Therefore, complete recognition and exact monitoring of its can provide appropriate tools for dealing with it and decreasing damaging effects. One of the strategic areas that are very important in terms of agriculture is Khuzestan province. This province is very remarkable due to its permanent rivers, flood-prone rivers also having various reservoirs. The main objective of this study is to improve drought monitoring by finding dependencies between drought and several oceanic-atmospheric and climatic parameters in different way in comparison with statistical correlations. In this paper, we used Data Mining Techniques of Association Rules. Drought events were determined according to Standard Precipitation Index (SPI) and its Dependencies were surveyed using oceanic- climatic indices such as Southern Oscillation Index (SOI), Pacific/North American (PNA) Index, Multivariate ENSO Index (MEI), Pacific Decadal Oscillation (PDO) Index and North Atlantic Oscillation (NAO). Results showed that the selected patterns classes which are dominant on drought are similar in different time delays. It means that drought events are compeer with normal status of indices and are predictable with maximum and minimum accuracy 74.24 and 44.86 percent, respectively. Therefore, we can use these rules as a supplement to existing approaches for drought monitoring.
Keywords: SPI drought index, atmospheric-oceanic indices, Association Rules, drought prediction, Khuzestan

Introduction

Due to low precipitation and improper raining variance with regards to timing and locality aspects, Iran is considered among dry and semi-arid countries in the world and is intensely vulnerable in this regard (Bagherzadeh chehreh, 2005). Transformation of crisis management to risk management for minimizing the harmful effects of drought is an inevitable matter in managing natural calamities Therefore; one of the most essential tools in this regard is designing protection systems for drought (Jalily, 2005). The present research includes a part of necessary actions for designing the mentioned systems. Scientists have always intended from the past to provide relations between the rate of precipitations and small scale local meteorological parameters, but then by identification of large scale climate signals, their efforts were led in that direction, in order to define relations between the signals and raining variations that could be applied in forecasting drought (Glantz,1994 ; Ropelewski & Halpert,1987). Data mining is a new technology that could reveal the hidden relations and patterns inside a large number of data. Data mining has been applied in commerce, medical science and communication networks, but it has been only used once for the field of drought (Tadesse et al., 2004).
McCabe et al. (2007) considered the relations between the occurrence of drought in USA and the rate of sea surface temperature (SST) changes in pacific and North Atlantic oceans in the past few decades. The result was that SST variations in the 19th and 20th centuries have been considered as one of the important factors for droughts in the USA along with other elements like ENSO. Tadesse et al. (2004) analyzed the dependence between drought events and oceanic-climatic indices such as southern oscillations of Pacific Ocean (SOI), multi-variable ENSO (MEI), pacific decade oscillation (PDO) have rather stronger relations with drought incidents. Koorehpazan Dezfuli (2003) studied the effects of large scale meteorological signals such as SST, ENSO and north Atlantic oscillations (NAO) on the forecasting variations of rain in southern regions in Iran. The results showed that these regions confront up-scale rainfall in warm phases of ENSO, NAO and cold phase of SST, and confront low-scale rainfall in cold phases of NAO and ENSO and the warn phase of SST. Nazemosadat et al. (1995) and Nazemosadat (1998) showed that there is a

negative and significant correlation between winter temperature of Persian Gulf water surface and the winter precipitations southern and south west provinces of Iran (Fars, Boushehr, Khuzestan and Hormozgan). In a research, Karamouz et al. (2004) estimated the rate of rain due to the effects of the variables in the southwest of Iran, indicating that the global patterns of atmospheric cycles such as ENSO, NAO and Persian Gulf SST (PGSST) could be the representing elements of metrological drought in the studying regions.
It is observed in the studies for drought in the world and in Iran that the forecasting of drought has been considered less and the forecasts in this respect have been done hesitatingly (Bagherzadeh chehreh, 2005). In applying large scale climate signals and analyzing their effects on the rate of precipitations most researches have evaluated their simultaneous occurrences on rainfall, but the lags between their occurrences have not been considered. Therefore, it can be seen that there have been negligence in this case in a region where our country is located. The objective of this research is improving the drought monitoring and some atmospheric-oceanic parameters, as well as identifying the occurrence of drought events by a defined lagging aspect of the indices, by using the data mining association rule technique in Khuzestan province.

Materials and Methods

Scope of the study and the applied data for the research

Due to numerous operations of data mining association rule method and the requirements of it to Long-term historical data for ensuring the revealed patterns by it and also since this research considers the effects of large scale atmospheric-oceanic parameters on the drought in the province. A station with appropriate conditions was selected for doing the experimental works. Therefore, this research was done in the synoptic station in Abadan, situated in Khuzestan province, and had the long-term data regarding monthly precipitations for at least 50 years. This station is situated in the geographical longitude of 48.15 east's and latitude of 30.22 north's and the average amount of precipitation in this station is 167mm.The data regarding the monthly rate of precipitation in Abadan station was obtained from Iran Meteorological Organization (www.weather.ir) and the long-term data regarding each index was obtained from the following databank (www.cpc.ncep.noaa.gov,www.cdc.noaa.gov,www.jisao.washington.edu, www.cru.uea.ac.uk).

Atmospheric-Oceanic Indices

In this study five of the most common atmospheric-oceanic indices have been used that the following is a brief description of their:
Southern Oscillation Index (SOI): SOI represents the pressure gradient along the east-west Pacific (Bagherzadeh chehreh, 2005).Positive and negative SOI show Lanina condition (drier than normal) and Elnino condition (wetter than normal) respectively (Tadesse et al., 2004).
Pacific North America Index (PNA): PNA is a pattern that occurs in the above atmosphere. This phenomenon is one of the dominant models of climate change during the winter months in mid-latitude ground (Bagherzadeh Chehreh, 2005).
Multivariable ENSO Index (MEI): MEI is calculated based on six main observed variables in equator Pacific Ocean. These six main variables are: Sea Level Pressure (SLP), zonal and meridional components of the surface wind, Sea Surface Temperature and total cloudiness fraction of the sky. Positive MEI and negative MEI show respectively Elnino conditions and Lanina conditions (Tadesse et al., 2004).
Pacific Decadal Oscillation Index (PDO): PDO index is defined as the leading principal component of North Pacific monthly sea surface temperature variability pole ward of 20N. The positive values show the warm phase of the North Pacific sea surface temperature, and the negative values show the cold phase (Tadesse et al., 2004).
North Atlantic Oscillation Index (NAO): NAO is defined based on the normalized pressure difference between a station in Azores, a group of islands in the Atlantic, and other stations are in Iceland (Tadesse et al., 2004). Positive NAO index shows a condition more severe than normal in tropical high pressure center and a condition deeper than normal in low pressure center of Icelandic. Pressure difference between these two regions led to more severe winter's storms on many areas of the north Atlantic. Negative NAO index represents that tropical high pressure centers an Iceland low pressure centers are weak. Consequently, the pressure gradient between

these regions is reduced and it cause that weaker winter's storms happen in the east-west (Bagherzadeh Chehreh, 2005).

Standardized Precipitation Index (SPI)

SPI was developed by Mackee et al. for monitoring the climatic drought (meteorological) in 1993 (Karamouz and Araghinajad, 2005). Mackee et al. offered SPI index for different time scales such as 3, 6, 12, 24 and 48 months. Positive SPI values indicate greater precipitation than average precipitation and negative values mean that precipitation is less than average precipitation (Bagherzadeh Chehreh, 2005). There are different categories of SPI index. Each of these indices has classified SPI into 5-7 class which each class represent drought or wetness and its severity. Drought is a rare phenomenon and its occurrence is very low relative to normal and wetness condition. So if want to for each class of drought with different severity discover patterns from the database due to lack of data for data mining operations, patterns are meaningless and are not reliable. Therefore, according to table (1) two categories were considered for the SPI index that drier than normal condition have been called drought conditions. In this case, drought occurred 292 times in 50 years. Besides, approximately, 67.48 percent of months have experienced drought. In this study. SPI with the 12-month time scale (annual) was used and by the SPI software was calculated.

Table1. Classification of standardized precipitation index

Drought condition	SPI values
Wetter than normal	SPI$\geq$ 0
Drier than normal	SPI< 0

Association Rules Method

Association rules are studying of attributes or characteristics that are associated with each other. Association rules imply to relationship and this rule established with confidence coefficient and support coefficient in database. It is appropriate to notice to relationships which have high confidence and support coefficients. These relationships that have high confidence coefficient and strong support are called strong rules (Alikhanzadeh, 2006). In this study, for final comment in addition to these constraints support and confidence has been used from the usefulness criterion of Leverage that can determine the influence power of relations to time. Criteria of support, confidence and Leverage are calculated based on the relationship (1) to (3).

$$Support(X \rightarrow Y) = Support(X \cup Y) \quad (1)$$

$$Confidence(X \rightarrow Y) = \frac{Support(X \cup Y)}{Support(X)} \quad (2)$$

$$Leverage(X \rightarrow Y) = Support(X \rightarrow Y) - Support(X) * Support(Y) \quad (3)$$

Where Support (X → Y), Confidence (X → Y) and Leverage (X → Y) are support, confidence and usefulness criterion of related patterns, respectively and Support(X), Support(Y) and Support(X ∪ Y) are the number of repeated patterns of X, Y and X with Y, respectively in the database.

Different algorithms have been presented for discovering of association rules such as Apriori algorithm (Alikhanzadeh, 2006). Due to the nature of the Apriori algorithm which uses in the purchase basket analysis the problem of time series and time lags has not been considered, But due to the nature of the drought that various factors is causing its occurrence and the effect of these factors on the drought, they usually show themselves with time lag. Therefore, it is necessary to do some changes in the Apriori algorithm to be used for drought surveying. Logic and methodology is similar the Apriori algorithm except that goal is finding patterns of atmospheric-oceanic parameters and drought which the antecedent and consequent of rules are separated and occurrence of consequent with a time lag relative to occurrence of antecedent will occur. A rule in the used algorithm is defined in a similar relation X → Lag Y. Where X and Y, antecedent (cause) and consequent event (effect), respectively and the lag is time delay between the events of the antecedent and consequent. This approach focuses on seeking rules which the antecedent and consequent events take place separately. Also, starting the consequent is following the start of the antecedent with a certain time lag. The mentioned algorithm has been used in the Khuzestan province for the period 1952 to 2001 (50 years) in Abadan station with regard to atmospheric-

oceanic parameters as a antecedent (the cause of rule) and drought events as the consequent (the effect of rule).
The standard method for applying association rules in numerical domain is discertization. For the monthly time series for 50 years, it has been assumed that atmospheric-oceanic indices follow the normal distribution. According to the standard deviation in normal frequency distribution they have been classified into 7 categories, shown in table (2).

Table 2- Threshold values for classification the atmospheric-oceanic indices (Tadesse et al., 2004)

classes	SOI	MEI	NAO	PNA & PDO
1	≥ 1.5	≤ -1.5	≤ -4	≤ -2
2	1 ≤X< 1.5	-1.5<X≤ -1	-4 <X≤ -3	-2 <X≤ -1.5
3	0.5 ≤X< 1	-1 <X≤-0.5	-3 <X≤ -2	-1.5<X≤ -1
4	-0.5 <X< 0.5	-0.5<X< 0.5	-2 <X< 2	-1<X< 1
5	-1 <X≤ -0.5	0.5 ≤X<1	2 ≤X< 3	1 ≤X< 1.5
6	-1.5 <X≤ -1	1≤X< 1.5	3 ≤X< 4	1.5 ≤X< 2
7	X≤ -1.5	X≥ 1.5	X≥ 4	X≥ 2

Results and Discussion
The mention data mining algorithm, based on association rule in no lag basis and also 1, 2, 3, 4, 5, 6, 9, and 12 months lags between occurrence of atmospheric-oceanic parameters and drought was performed in Abadan station. In each case, 98 association rules were obtained on average that included one to 5 member antecedent combinations of the indices, having the ability to forecast drought according to atmospheric-oceanic indices. As mentioned in the basis of association rules. The only rules are appropriate that are repeated sufficiently i.e. having the minimum support (6% in this research) and high rate of confidence. The minimum support of 6% has been obtained according to trials & errors and considering the point that increasing the supporting rate could reduce the number of produced rules and that reduction would lead to increasing the rules with difficult analysis. Thus, 38 association rules were obtained, on average that had the threshold of minimum support for each lag. Finally 9 patterns were selected for each lag, from the discovered rules, which included individual and compound combinations of the indices that have the highest values of leverage. The selected patterns are shown in table (3). The results showed that the types of selected patterns dominating drought in Abadan station are similar for different time lags, which means that the atmospheric-oceanic parameters, both individually and in 2-5 antecedent combinations, all include a condition that the indices are situated in their 4th classification regarding their group.

Table 3- Patterns selected as the antecedent of association rules (X in the rule of X→ Lag Y)

Pattern's Number	
1	SOI(4)
2	MEI(4)
3	PNA(4)
4	PDO(4)
5	NAO(4)
6	PDO(4),NAO(4)
7	PNA(4),PDO(4),NAO(4)
8	MEI(4),PNA(4),PDO(4) ,NAO(4)
9	SOI(4),MEI(4),PNA(4), PDO(4),NAO(4)

The numbers listed beside the indices name abbreviations in antecedent rule are related to classification of these indices.
The confidence values related to the selected patterns for different lags are shown in table (4). As observed, the distinguishing between the selected patterns in Khuzestan province indicates different combinations of the indices with each other, despite the similar classification of them (4th classification) and the confidence values regarding the patterns. According to the selected patterns, obtained on average between 882 association rules (98 rules for each lag). It can be concluded that

drought is occurred with drier conditions than normal situations. In Khuzestan province, most of the time, where the indices in the intermediate or 4th level are situated according to their standard deviations and this level is usually considered normal, regarding the strength or weakness of the indices. In normal conditions, the expectations is on the long-term average value or the maximum normal humidity, but according to the used method, which has a high capability in revealing the relations and concealed patterns in the data bank. We conclude that by observing the values of the indices of SOI & MEI in between -05 to 0.5, PNA & PDO in between -1 to 1, NAO in between -2 to 2 and in according to their standard deviations, we should expect drought by the maximum of 74.24 and minimum of 44.86. The maximum value is related to the pattern number 9 in a 6 month lag. The minimum value is related to pattern number 2 in a 12 month lag. In other words, for pattern number 9 for the lag time of 6 months. According to relationship (4) would have:

$$IF\big(S(4), M(4), PN(4), PD(4), N(4)\big) \rightarrow Lag = 6\ \textit{Drought} \qquad (4)$$

Expressing that in 66 repetition of 5 mentioned indices in the databank an in their 4th level of their classification according to the standard deviation, 49 cases were followed by drought. According to the definition of confidence for association rules, the confidence value would be 74.24%, According to relationship (5):

$$Confidence\big((S(4), M(4), PN(4), PD(4), N(4)) \rightarrow Lag=6\ Drought\big) = \frac{49}{66} = 0.7424 \qquad (5)$$

Table 4-Selected confidence rates of association rules for different time lags

Time Lags (month) / Pattern's Number	0	1	2	3	4	5	6	9	12
1	54.96	53.31	52.89	55.79	54.13	53.72	55.37	52.89	46.28
2	55.56	56.38	55.56	56.38	57.20	55.97	54.37	49.38	44.86
3	48.74	47.49	46.98	48.99	47.99	48.49	49.25	47.24	46.73
4	51.12	50.62	51.12	50.87	50.12	50.62	50.87	48.63	48.13
5	49.13	48.95	48.08	48.43	47.38	47.90	47.55	46.85	47.03
6	51.44	50.91	50.65	50.91	49.09	49.87	50.13	47.78	47.78
7	51.48	49.63	50.00	51.48	49.63	51.85	52.96	49.63	48.15
8	59.68	59.68	60.48	64.52	62.10	63.71	64.52	58.87	48.39
9	69.70	69.70	68.18	72.73	68.18	68.18	74.24	63.64	45.45

Different confidence rates of selected patterns indicate the effects of the indices on drought happening during the time and show the accuracy of forecasting drought for different time lags. According to table (4), using the combination of atmospheric-oceanic indices has caused the increasing in accurate forecasting drought in different time lags. In other words, using more antecedent combination in a definite time lag causes the increase in confidence rate of association rules. Therefore, by applying the combinations we could predict the happening of drought with acceptable accuracy in Abadan station.

Moreover, according to confidence values of selected rules, it can be observed that some atmospheric-oceanic indices separately have more relations with droughts in Abadan station. In other words, their association rules have higher confidence values that indicate more implication of its association rules. Pattern number (2) that expresses the 4th level of MEI index, i.e. MEI (4), is considered as the antecedent to association rule in forecasting drought, and has most relations regarding the occurrence of drought in Abadan station. Patterns number (1, 4, 5, 3) follow that, respectively. As it can be observed, PNA index has the least relations with occurrence of drought. This is important since we could use atmospheric-oceanic indices for drought monitoring systems having more relations with drought occurrence. In other words, they have higher confidence rates for forecasting drought. Surveying the relationship of atmospheric-oceanic indices separately on drought event should consider the rules usefulness. Accordingly, based on the usefulness values of association rules for different time lags PNA, PDO and NAO indices have lower confidence value compared with SOI and MEI indices, but their rules usefulness was 1.5 to 2.5 times of SOI and MEI indices. Repetition of rules antecedent and repetition of pattern compared with the entire period (50 years) was more than repetition of rule antecedent and repetition of patterns of MEI and SOI indices but repetition of their pattern compared with repetition of rules antecedent was low. This issue is responsible of reduction of confidence values of their association rules. So, single patterns of PNA, PDO and NAO is in spite of lower confidence values compared with SOI and MEI indices were more beneficial, and repetition of their patterns was very high in database. In other words, trust to their confidence values is more. In this aspect, all of single patterns of indices are proper for applying in drought forecasting systems.

According to discovered association rules for time lags (1, 2, 3, 4, 5, 6, 9 and 12 monthly) we concluded that using of each of indices separately or combinatorial had different prediction accuracy for different time lags. Therefore, if SOI index situate on the fourth class of its classification, after three months drought have occurred with greater reliability than other lags. This issue has been increased confidence values to 79.55. In other words, if SOI index stands in fourth class, after three months it will have the maximum of its effect in Abadan station and on this view prediction of drought, time lag is optimum. Similar to what was said for SOI index, optimum time lag for the MEI, PNA, PDO and NAO indices according to 2 to 5 patterns of Table 3, are four, six, zero (or two) and zero months, respectively. For patterns of 6 to 9 which indicate the antecedent combinations of two to five members optimum time lag are zero, six, three (or six) and six months, respectively. For a general comparison with the algorithm that is used in this study, statistical method of linear correlation has been used in order to determine the correlation of atmospheric-oceanic and climatic parameters. According to this statistical technique, the linear correlation coefficient values for each of the atmospheric-oceanic and climatic parameters have been calculated at different time lags. Using statistical methods of linear correlation, relationship between drought index and atmospheric-oceanic indices are weak (less than 0.02). Therefore, based on the statistical methods, strong and approved correlation was not observed between SPI (for 12 months) and atmospheric-oceanic indices. The confirmed result in both data mining operation and statistical is that dependency of the standard precipitation index (SPI for 12 months) with atmospheric-oceanic indices like SOI, MEI and PDO is relatively more than dependency of the SPI with PNA and NAO. In this study, in spite of the classical statistical methods that have been used in internal and external research, the new technique called association rules was used. The results show that the data mining algorithms of association rules which used in this study was a useful tool for monitoring of drought in Abadan station by identification and production of the association rules between the drought events with atmospheric-oceanic indices. In addition, these rules showed that the atmospheric-oceanic parameters used in this study could apply as a drought warming in Abadan station.

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Temporal Organic carbon changes in the surface sediments of the Gomishan wetland, in the north of Iran

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Abstract
Information on which management practice can enhance soil organic matter content and quality can be useful for developing sustainable wetland systems. The objective of this study was to investigate the concentrations of total organic carbon in the surface sediment of the Gomishan wetland which is situated at the southeast of Caspian Sea were recorded. Sampling was monthly at five research stations inside of logoon from soft-bottom sediments during summer and fall seasons. By considering the whole wetland, total organic carbon (TOC) shows statistically significant positive changes. Organic carbon of sediment increased in the second, third, fourth, fifth and sixth months, by 10%, 8%, 11%, 26% and 36% respectively in comparison with first month, (July). On an average, organic carbon showing an increase from July to December, due to the almost complete decomposition of huge macrophytes biomasses and sedimentation of phytoplankton in fall. Gomishan's wetland joins Caspian Sea and this will result in sediment problems, threat to human and fish health. If these changes continue, there will be serious threat to ecosystem health.
Keywords: Organic matter, Wetland, Macrophytes, Ecosystem health

Introduction

Transitional waters such as estuaries and coastal wetlands are classified by the European Water Framework Directive (WFD; 2000/60/EC) as one of the five categories of ‘‘surface water”, which also include coastal waters, rivers, lakes, and artificial and heavily modified bodies of water. Due to their partly saline character ‘‘substantially influenced by freshwater flows” and their usually high sediment-surface-area to water-volume ratio, transitional waters can be considered a very sensitive aquatic system where benthic components and processes play an important regulatory function for the whole ecosystem (Viaroli et al., 2004)

Organic material from autochthonous and allochthonous origin accumulates in the sediment of aquatic ecosystems. Here it supports bacterial activity that results in decomposition and nutrient recycling (Zink et al, 2004).

Soil organic matter can be important for categorizing wetland soils and interpreting soil nutrient variables. Wetland soils often are characterized by the accumulation of organic matter because rates of primary production often exceed rates of decomposition. Some wetlands accumulate thick layers of organic matter that, over time, form peat soil. Organic matter provides nutrient storage and supply, increases the cation exchange capacity of soils, enhances adsorption or deactivation of organic chemicals and traces metals, and improves overall soil structure, which results in improved air and water movement (Nelson and Sommers 1996).

Materials and Methods

The Gomishan Wetland is a natural coastal wetland located at the south-eastern coast of the Caspian Sea in the province of Golestan in the Islamic Republic of Iran, with an area of nearly 17,700 ha (Fig1). It is part of two river basins, the Atrek/ Atrak and the Gorgan. However, these rivers do not play a major role in the wetland’s water supply. The central part of the wetland is covered by saltmarsh vegetation as well as flats of glasswort species, interspersed with pickle-weed and sarsazan grasses which are flooded seasonally. The depth of water is variable and depends on fluctuations in Caspian Sea water level. In spite of this variation, Gomishan wetland is about 1m depth in most locations except of north west region which may reach to 2.5 m in depth (Gandomi et al, 2011)

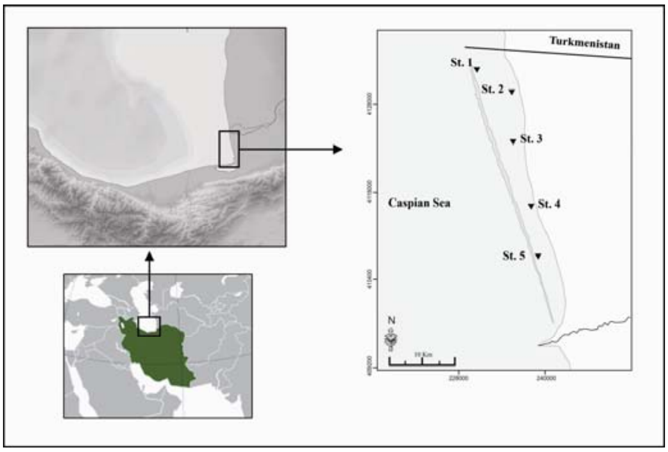


Figure. 1. Map of study area showing locations of sampling stations

The bed formation consists of soft clay and mud. Aquatic macrophytes include Ceratophyllum demersum, Callitriche palustris, Aeluropus littoralis, Myriophyllum spicatum, Phragmites australis, Potamogeton pectinatus, Juncus effusus, Typha angustifolia,and Zannichellia palustris (Scott, 1995; Kiabi et al., 1999a zoo).

The sampling was done by Van veen Grab from the Surface sediment (about 10 cm thick) of the wetland bottom for 6 continuous month (July to Desember 2010).Total organic carbon(TOC) of sediments determined by the Walkley and Black (1934) procedure. For all samples, three replicates were analysed and means and standard errors were calculated. Differences between treatments were tested for significance using one way analysis of variance (ANOVA) for multiple comparison of means at a significant level of 0.05 using software SPSS for Windows 18.0.

Results

The TOC concentrations in sediment are shown in (Fig 2). There is a wide significant temporal variation in the TOC concentrations. The results show that the lowest and highest TOC concentration respectively occurs in July (1.31%) and the end of December (2.05%). On average, no significant differences in organic carbon contents between August, September and October were found.

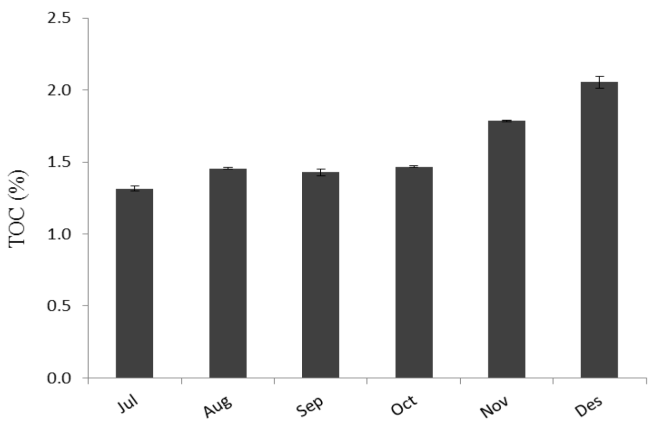
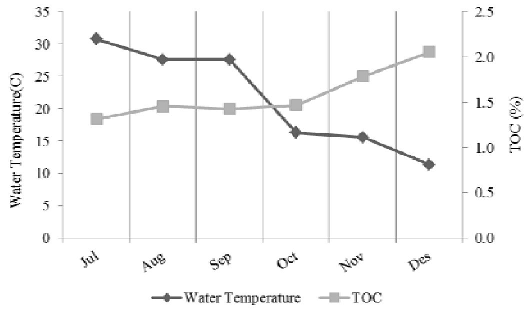
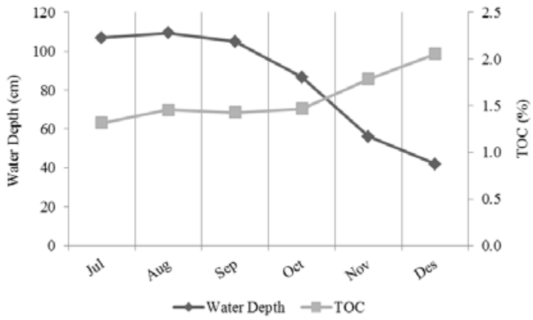


Figure. 2. TOC Temporal changes in Gomishan coastal wetland

The percentage of TOC concentration in sediment on the other hand shows an increase with the decrease of temperature (Fig 3/a) during study period. A similar trend has been observed for depth showing in Figure 3/b.



(a)



(b)

Figure. 3. Relation between TOC and Water temperature (a) and Depth (b)

Discussion

The most important factor, which has the potential to have a detrimental effect on the natural ecological character of the wetland, is the Caspian Sea's fluctuations in water level, causing the wetland's shoreline to change. Moreover, due to the Caspian Sea's connection to the wetland — with only a narrow sandy barrier separating the two — all the exotic species introduced to the former may affect the site (ECE, 2011). Also Naturalistic observation indicated that the biomass of the aquatic vegetation increased in summer and decreased during autumn.

According to the above mentioned, It seems lower temperature in Autumn lead to disappearance of aquatic plants. And this lead to increased amounts of organic matter in sediments. Naturally-occurring organic carbon forms are derived from the decomposition of plants and animals. In soils and sediments, a wide variety of organic carbon forms are present and range from freshly deposited litter (e.g., leaves, twigs, branches) to highly decomposed forms such as humus (Schumacher, 2002).

Coastal human population growth and the Caspian Sea level fluctuations are the main threads which Gomishan wetland faces. In addition different sources of pollution inter the wetland through river and Caspian Sea. Previous investigations have confirmed high ecological values of Gomishan wetland (Gandomi et al, 2011).

Acknowledgment

We are grateful to Gomishan land unit for her support during the study and also we would like to thank Eng. Ebrahim Saniei for their helps.

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Spatial changes in organic matter content in benthic sediment of Gomishan wetland, northern Iran

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Abstract
Soil carbon pools play a critical role in global C cycling which is an important part of potential sink for atmosphere CO_2. The purpose of the studies done in summer and fall seasons in a shallow Gomishan wetland located on the southeast of Caspian Sea was to assess and spatial changes in organic matter content in bottom sediments during six months at five research stations. The station 2, characterized by partially vegetated sediments, showed higher amounts of organic matter, but station 1 and 5 with low macrophyte cover show lowest sediment organic matter during study period. Organic carbon of sediment increased in the second, third, fourth and fifth stations, by 24%, 19%, 8% and 2% respectively in comparison with first station, control station. Overfishing and progressive environmental degradation of the inside wetland appear to be threatening the ecological integrity. We suggest that monitoring programs should primarily investigate and consider the cohesive fraction of sediments in order to allow a better assessment of macrophyte –sediment relationships and ecological quality of the system.
Key words: Organic matter, Wetland, Macrophytes, Ecological quality

Introduction
Coastal wetlands can be broadly defined as natural lentic water bodies distributed along the continental shoreline. However, sometimes coastal wetlands are confused with other coastal inland aquatic ecosystems, such as salt marshes and estuaries. Thus, coastal wetlands can be precisely defined as shallow aquatic ecosystems that develop at the interface between coastal terrestrial and marine ecosystems and can be permanently open or intermittently closed off from the adjacent sea by depositional barriers (Kjerfve, 1994; Gönenç and Wolflin, 2004).
Across a coastal wetland, there is a gradual departure from the marine environment toward habitats characterised by a high variability of environmental parameters and increasing levels of stress, for organisms that live there, caused mainly by organic matter accumulation and reduced water exchange(Tagliapietra, 2004).
Organic matter provides nutrient storage and supply, increases the cation exchange capacity of soils, enhances adsorption or deactivation of organic chemicals and trace metals, and improves overall soil structure, which results in improved air and water movement (Nelson and Sommers 1996). Compared to terrestrial ecosystems, most wetlands show an accumulation of organic matter, and therefore wetlands function as global sinks for carbon. Accumulation of organic C in wetlands is primarily a result of the balance of C fixation through photosynthesis and losses through decomposition (EPA, 2008)

Materials and Methods
The Gomishan Wetland is a natural coastal wetland located at the south-eastern coast of the Caspian Sea in the province of Golestan in the Islamic Republic of Iran, with an area of nearly 17,700 ha (Fig1). It is part of two river basins, the Atrek/ Atrak and the Gorgan. However, these rivers do not play a major role in the wetland’s water supply. The central part of the wetland is covered by saltmarsh vegetation as well as flats of glasswort species, interspersed with pickle-weed and sarsazan grasses which are flooded seasonally. The depth of water is variable and depends on fluctuations in Caspian Sea water level. In spite of this variation, Gomishan wetland is about 1m depth in most locations except of North West region which may reach to 2.5 m in depth (Gandomi et al, 2011)

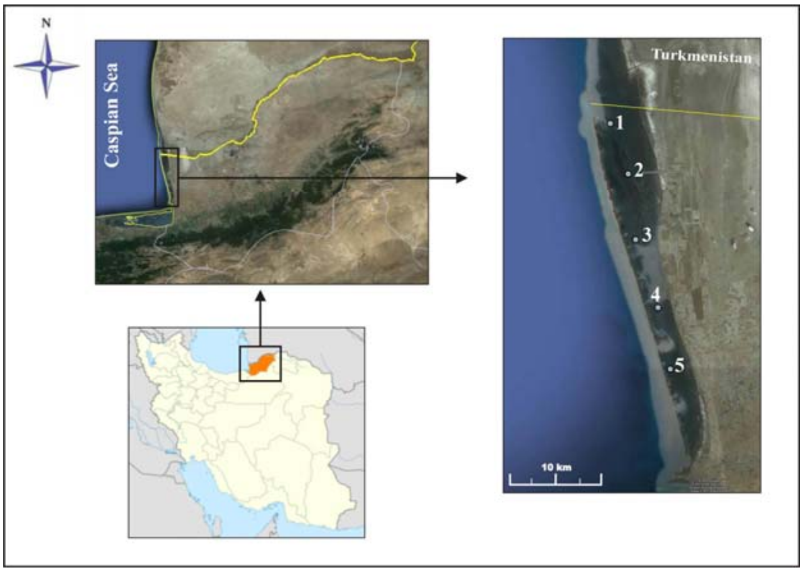

Figure. 1. Map of study area showing locations of sampling stations

The bed formation consists of soft clay and mud. Aquatic macrophytes include Ceratophyllum demersum, Callitriche palustris, Aeluropus littoralis, Myriophyllum spicatum, Phragmites australis, Potamogeton pectinatus, Juncus effusus, Typha angustifolia,and Zannichellia palustris (Scott, 1995; Kiabi et al., 1999a zoo).
The sampling was done by Van veen Grab from the Surface sediment (about 10 cm thick) of the wetland bottom during six months (July to Desember 2010) at five research stations. Total organic carbon (TOC) of sediments determined by the Walkley and Black (1934) procedure. For all samples, three replicates were analyzed and means and standard errors were calculated. Differences between treatments were tested for significance using one way analysis of variance (ANOVA) for multiple comparisons of means at a significance level of 0.05 using software SPSS for Windows 18.0.

Results
The results show that the lowest TOC concentration occurs at station 1 (1.4%) located in the northern part of wetland and highest occurs at station 2 (1.8%). no significant differences in organic carbon contents between station 1 and station 5 were found.

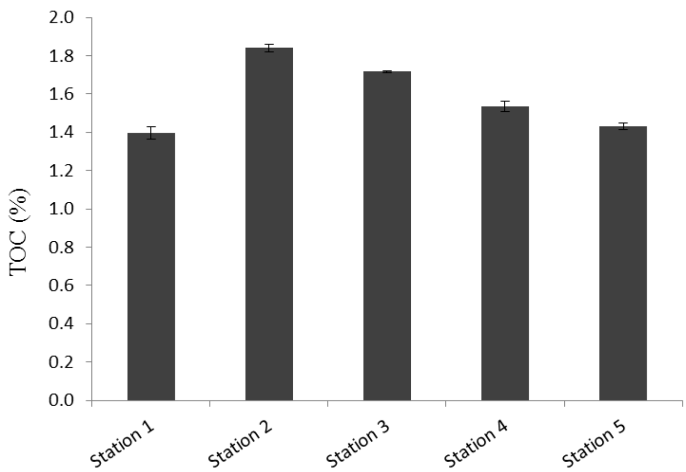

Figure. 2. TOC Spatial changes in Gomishan wetland

Discussion
According to research by Gandomi et al (2011), The central part of the wetland (station 2 and 3 in this study) is covered by saltmarsh vegetation. In soils and sediments, a wide variety of organic

carbon forms are present and range from freshly deposited litter (e.g., leaves, twigs, branches) to highly decomposed forms such as humus (Schumacher, 2002). As shown in Fig. 2, in Compare to other stations, station 2 and 3 have the highest amount of organic matter. Considering that this wetland is not exposed to pollution, It seems disappearance of aquatic plants lead to increased amounts of organic matter in sediments.

Acknowledgment
We are grateful to Gomishan land unit for her support during the study and also we would like to thank Eng. Ebrahim Saniei for their helps.

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Ecological Approach of Medieval Wetland Fort Korođ

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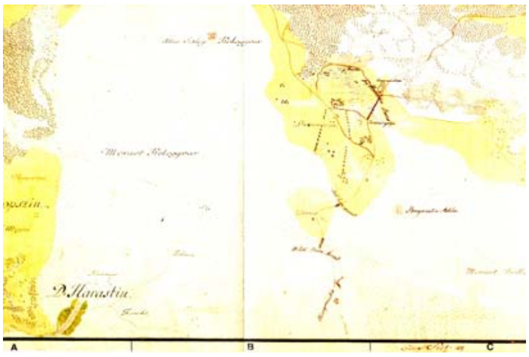
Abstract: Medieval fort Korođ was mentioned for the first time in 1290. It was constructed in the centre of a large wetland which, by the records and maps from the 18 th century, occupied approx. 100 km ^{2} area. This facility doesn't exist any more. Some rare and specific plants (*Acer tataricum, Fraxinus exscelsior, Glycyrrhiza echinata* etc.) and animal species, primarily birds (*Ardea obscura, Vultur percnopterus, Rallus pusillus* etc.) as well as indigenous insects (*Meloides adamovichiana, Papilo Kolosvarensis* etc.) have been found within this valuable habitat. The fort is also interesting as an architectonic facility. It was constructed on the island in the midst of the wetland on the wooden fork made of the oak (*Quercus robur).* Sustainability of the abovementioned plant species on a certain area has been proved by studying old written materials, using comparative morphology methods and comparing recorded variability. Possible methods of reconstruction have been suggested aiming to return historical forts into a natural habitat.

Key words: ecological approach, medieval, wetland, fort Korođ

Introduction

Medieval wetland fort Korođ was mentioned for the first time in 1290 as *castrum Kourougy*. The fort was owned by the aristocratic family Korođ after which it was named. Philip Korodj was given Čepin estate by the king Bela IV in 1256 since he accompanied him while the king escaped from the Mongols. Thus, the fort Korodj was erected on the Čepin estate (Bösendorfer, 164). Korodj is, by its position and construction, a unique example of the early medieval fortified town in the wetland, i.e. *"Wasserburg"* in Croatia. It was built on the place of the former prehistoric settlement and later Roman fort. The whole complex was artificially erected in the prehistory. By the first defensive earth wall one can see remains of the interesting and mysterious Korođvar wetland, being a part of the „*Palača*“ wetland (Map 1, Horbec-Jukić, section 38). There is a round elevation derived from the first part of water known for the former defensive fortifications i.e. palisades (Photo 1, by A. Turalija, 2012). The first earth wall was followed by a deep round moat and finally by the ancient town of Wasserburg Korođ built on the hilly area (Đurić – Feletar, 259). It was surrounded by a deep ditch with town-leading drawbridge (photo 2, by A.Turalija, 2012). The town entrance was in the eastern part of the complex. High circular layout wall mantle was approx.40 m in diameter with walls about 7 m high. The walls are about 2 m thick and brick built. The fort was called by its exterior and annular moat surrounding it in the ring or circle form (photo 3) i.e. Hungarian derivative of the same concept and meaning – *korongh* (Pavić – Šušak, 14). In literature the term is related to the Korogy family who built the Fort. However, historically, it was not proved whether the Fort name was connected with the family name or architectonic trait. The city of Osijek and Korodj fort were occupied by the Turks in 1526 and 1541 respectively. It is approved by the wetland meaning for the medieval wetland which protected and secured defence during the Turkish occupation. After having being destroyed in the Turkish occupation period the Fort has never been reconstructed (Mažuran, 111). Thus, its reconstruction is a very important progress in preserving the valuable habitat and unique wetland town.



Map 1) Big wetland Palaća and fort Korođ from 18th century Source: Horbec-Jukić, section 38

Photo 1) Place of the defensive palisades, today- dry overgrown moats
Source: Alka Turalija, 2011

Photo 2) Ditch the fort was surrounded by

Source: Alka Turalija, 2011.

Photo 3) Korođ fort remains and a ring-like moat
Fource: Alka Turalija,2012.

Materials and Methods

Inventory of the whole location (25ha area) and comparison with historical data brought about an expert evaluation whereas proposed reconstruction model was developed based upon the existed status and possible return into the origin status of the location parts. Flora has been determined and evaluated by the Manual for Inventory and Monitoring (Nikolić, 31) whose procedure is in progress. Conclusions have been drawn and graphs developed by the historical study of flora and fauna list on a certain site including today's state comparison. Comprehensive photo documentation and archives have been especially investigated and gathered within a unique map that will be presented in the next paper.

Discussion

The medieval Korođ town is a unique town locality in the wetland which is partly preserved and whose timber poles are still visible. The fort has been erected on the oak columns and raised in the middle of the wetland. Once it was the wetland called Palača extended on the 24 km^2 area. Its water depth was changeable with the deepest point of 2, 5 fathoms. The shores of the wetland were not steep but the bottom was muddy. It was characterized by length being two hours, width 1 hour (Horbec-Jukić, 256) and soft bottom which did not allow access except by boats. Among valuable plant material chervil (*Miscanthus sinensis*), sedge (*Carex riparia*) and common rush (*Heleocharis palustris* (L.)), should be particularly pointed out (Photo 4). All the aforementioned plants have existed in this area for several centuries (Piller-Mitterpacher, 31). Big land-reclamation activities were mentioned in the travel-record from 1782 where Ivan Kapistran Adamović, an imperial advisor – the owner of the then whole estate around Korođ city, drained large parts of the wetland. He also cultivated its estate and produced arable crops on it whereas 500,000 square fathoms of the drained area were used for cattle pasture. Few pits with water were left since peasants used them for soaking hemp and flax. A noble husband Adamović invented a plough- like device with a big knife used for cutting fens, common rush and sedge roots. Very soon clover - plant useful for cattle feed - became dominant. It grew with crowded stems and looked like being sown. Water bodies having permanent soil sources were used as fishponds. It takes 2 hours by boat to reach the fort from the shortest coast (Piller-Mitterpacher, 29-31). There was a small island within the wetland in the Turkish occupation period. It was described by a passenger in 1782 stating that remains of very high ancient vine, fruit trees and garden were visible (Piller-Mitterpacher, 33). The travel record noted a list of unusual plant species such as a special licorice *Glycirrhiza echinata,* distinguishing from the well-known tongue licorice as well as tatarian maple (*Acer tartaricum*). Furthermore there is a rich list of birds and insects with a special butterfly of Metulja Kološvarski (*Papilio Kolosvarensis)* and Adamović's possession *Meloides adamovichiana*, (Piller-Mitterpacher, 51). Today, direct environment has been drained by land reclamation measures and canals system in spite of visible moats. The neighbouring area is rich in live sources and belongs to the river Vuka basin whereas fishponds were constructed in the part of the open sources left (photo 5, Orto-photo image of wider area). Dense sets of forests were planted by the fort for economic usage of the Croatian forests. The plants are as follows: *Popuslus canadensis, Quercus robur, Fraxinus angustifolia, Salix alba.* There are few several centuries old plants *Populus alba* (2 plants) and*Quercus robur* (4 plants) within the imaged area. Identified plant species, by the moats beyond land reclamation canals, have been listed in Table 1 together with their function as soil and water purifier. Soil profile analysis determined that the soil belongs to hydromorphic soil known for wetland Slavonia parts (wetland glei soil – amphiglei being obvious on the geological map of the Republic of Croatia (photo 6).

Photo 4) Remains of the wetland habitat
Source: Alka Turalija, 2012

Photo 5)Sources of live water
Source: Google Earth

Figure 6) Geological map
Source: web pages of the Ministry of Environment and Croatian Waters (MZOPUIG)

Both plant cover and soil profile approve water presence in this area for series of years and continuation. Other surrounding areas have been intensively cultivated for more than 250 years while the whole region has been drained by canals net system. As for arable crops there are equal oil and cereal ratio with dominant crops such as wheat, maize, soybean and sunflower. Legal property rights of the land (borders of this study procedure – the Republic of Croatia and local administration – municipalities of Čepin and Antunovac.

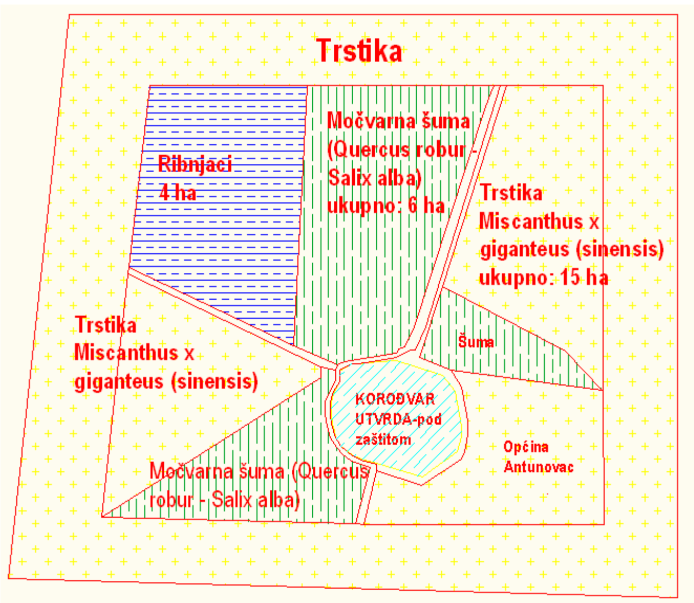
Table 1) Plant species determined in the study area (Source: Alka Turalija 2011.):

LATIN NAME OF THE PLANT:	FUNCTION:
Acorus calamus	purifier
Alisma plantago- aquatica	purifier
Butomus umbellatus	purifier
Caltha palustris	purifier
Carex acutoformus	purifier
Carex gracilis	purifier and reinforces pond shore
Carex hirta	purifier and reinforces pond shore
Carex riparia	purifier and reinforces pond shore
Cladium mariscus	purifier and reinforces pond shore
Eleocharis palustris	Deep purifying
Eupatorium cannabium	purifier
Filipendula ulmaria	purifier of the muddy bottom – wetland plant
Geum rivale	purifier
Glyceria fluitans	purifier
Hottonia palustris	purifier
Iris pseudacorus	purifier
Juncus effusus; Juncus infexus	purifier
Lythrum salicaria	purifier
Lemna minor	
Mentha aquatica	purifier
Miscanthus sinensis	purifier
Myriophyllum verticillatum	purifier
Oenanthe aquatica	purifier
Petasites hybridus	purifier
Phalaris arundinacea	purifier
Phragmites comunis	purifier
Polygonum amphibium	purifier
Ranunculus aquatilis	purifier
Potamogeton sp.	deep purifier
Scirpus lacustris	purifier
Sparganium erectum	purifier
Typha angustifolia; Typha latifolia	purifier

Conclusion

By the detailed inventory analysis of the given research area it can be concluded that there are still sufficient preserved habitats of the wetland eco-system within 25 ha of the selected area. Thus, a reconstruction project, as given in the Map 1, could be conducted. Degradation of the wetland ecosystem area started in the 18th century and agriculture modernization in the post Second World War period brought about a complete intensive agriculture without flooding fear. Aiming to return historical heritage and preserve biological diversity of the area, this paper offers reconstruction solution so that a part of the wetland ecosystem should be returned in the environment as a key purifier. Also the protected fort (whose former appearance could be completely reconstructed) should be renewed in tourist, historical and cultural purposes. Fishponds bodies will be returned in the position they were 200 years ago and their 4ha area will meet commercial and sports-recreational demands within organized family farm. Protection belt covered by chervil (*Mischantus* x *gigantea*) will be the new staff in this area. The aforementioned plant species is known by extremely intensive annual growth on the selected location of the above identified parameters (the expected annual growth is 30 t/ha). It was approved by the experiments on the limited lots within the two year testing (Kraljević, D., Miscanthus species for ecological growth, 2012). Characteristics of the chosen plant species are as follows: not invasive to surrounding habitats, convenient habitat for many wetland birds, essential source of the cheap biomass (raw material for energy and technological needs), there are no known pests (no chemical treatments), newly grown root system enables better soil structure, good water purifier (Christian, D., G., Haase, E., Schwarz, H., Dalianis,C., Clifton-Brown, J.C. und Cosentino, S., 2001). Forest economic areas return indigenous plant species. Further investigations will aim to design project being a model of ecological sustainability of wetlands and meadows of the Republic of Croatia. It will be ecologically accepted agriculture development model.

Map 1. Areas in the proposed project – ecological reconstruction approach



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Takım Numarası: 978-975-96629-6-7 (tk.)
ISBN: 978-975-96629-7-4 (1.c)