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– Keynote Speeches –

Soil and land management under climate change

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Based on the six main functions of soil, the impact of climate change on the provision of goods and services for human societies and the environment is discussed, including possible impacts on civilisation. For the latter, a short introduction into the historical development of the relationship nature – human society is given, explaining the development of land use and population growth during the last 10,000 years on a worldwide level. This allows for defining the current state of human civilisation in a physical, social, economic, environmental and cultural context.

Based on this, different scenarios of climate change, especially referring to changes in precipitation and annual mean temperatures are given, explaining what climate change means for the provision of surface and ground water, the development of biodiversity, especially soil biodiversity, the impact on human health and the impact on biomass production, i.e. on the food chain and food security, in view of the fact that world-wide, food is produced on 12% of the land surface, by about 25% of the world population.

Different scenarios regarding the sensitivity of agro-ecosystems to global climate change are explained, showing examples for changes in rain fed cereal production as well as food produced by irrigation.

Finally the impact of climate change on the chemistry of the atmosphere is discussed, together with possible further changes in the terrestrial and aquatic systems, looking into the basic views on the relationship between human beings and nature, social and economic theories and the problem of globalisation of social and economic decisions on the production and trade of agricultural and other commodities.

Disruption of soil functions by land use changes in the Mediterranean

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In the last decades dramatic land use changes (LUC) occurred in many parts of European Mediterranean countries. Such changes are to be understood as consequence of a set of different factors. Some of them were driven by crisis of traditional agriculture and associated land set aside. Both the abandon of cultivation and the abandon of maintenance of soil and water conservation structures originated the loss of soil productivity, land capability and soil capacity to buffer extreme climate events like torrential rains or draught periods. Also the demographic and socioeconomic changes influenced the increase of forest fires with their consequences in land degradation and desertification processes.

Others main LUC were driven by the concentration of human activities in coastal areas. The littoralization trend originates enormous pressures in a limited and concrete part of the territory. These pressures came from agriculture intensification, urban and industrial expansion, infrastructures of communication, tourist and recreation developments and new suburban residence areas. The consequences in some extreme but not infrequent circumstances are the irreversible loss of very productive soils by the sealing effect of urbanization and consequently the irreversible loss of the biospheric potential of the affected land. Urbanization also affects the infiltration and run-off patterns, which become a serious problem during the frequent torrential rains and floods events. A process known as soil sealing which first consequence on the water cycle is the soil imperviousness.

The rapid increase of water demand associated with LUC, is also contributing to pessimistic scenarios. Climate change and aridification trend will exacerbate the unsustainable exploitation of water resources leading to serious environmental damage to land, including chemical and organic contamination, salinization-sodification and marine intrusion on coastal aquifers.

As a consequence of the preceding the European Mediterranean littoral is today a very dynamic area submitted to a very aggressive LUC driven by economic criteria. The tendency envisages the risk of the collapse of the soil productivity and ecological functions. There is a clear need to rationalize the land use planning of the Mediterranean coastal areas in order to make compatible the economic activities with the sound and ecological functions of the land that support them.

Soil erosion research: do we know what we need to know?

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Conservation of the soil resource is more than ever a preoccupation of governments and administrations all over the world. In this paper we want to investigate to what extent we have the necessary data and scientific understanding of soil erosion in order to meet this societal demand.

Over the last two decades soil conservation technologies have come to maturity and both in the developed world and the developing world examples can be found of successful soil conservation projects. Such projects demonstrate that the correct implementation of soil conservation measures can often dramatically reduce soil losses without jeopardizing the economic profitability of the farming system.

From such findings, one could conclude that the necessary understanding and technology exists and has been proven to be efficient and that therefore soil conservation is no longer a scientific but a societal issue. This conclusion is, to some extent, true. However this does not imply that our scientific understanding of erosion processes is complete: we will argue that there remain important scientific challenges with respect to soil erosion and in this paper we will investigate what (some of) these scientific challenges are. Often, we do not have sufficient scientific information to economically target soil conservation efforts. Furthermore, the consequences of the implementation of soil conservation measures for soil productivity, soil quality as well as sediment and nutrient movement through landscapes are incompletely understood. Our misconceptions may not be important for the promotion of soil conservation at the short term, but may have dramatic effects on how conservation efforts perform over longer time scales. A better understanding of some aspects of soil erosion and hence further scientific research are prerequisites

Water management under changing climate and land use: Use of simulation modelling

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Water, that is often the main limiting factor of plant growth, is also the main factor directly or indirectly responsible for soil and land degradation processes. These processes are strongly linked to unfavourable changes in the hydrological processes responsible for the soil water balance and for the soil moisture regime, which are affected by the climate conditions and variations, and by the changes in the use and management of soil and water resources. The soil moisture regime, determined by changes in soil water content with time, is the main single factor conditioning moisture availability, plant growth and crop production. It is mainly conditioned by soil properties affecting the capacity and possibilities of infiltration, retention and drainage of rainwater, and the limitations to root growth under the particular rainfall characteristics. These conditions may be modified by soil, water and plant management practices as tillage, irrigation, drainage, etc. The previewed effects of global climate changes would mainly affect hydrological processes in the land surface, mostly related to the soil water balance. Human activities leading to land degradation processes may affect more the soil hydrological processes than the previewed climate changes, or may increase the influence of those changes. The water balance may be drastically upset by the consequence of inappropriate changes in land use and management, and especially by the consequent land degradation.

For an adequate planning of soil and water management and conservation it is required an adequate understanding and prediction of the interactions between climate characteristics and soil properties, under different scenarios of changing climate and changing land use and management practices and systems. These complex interactions may be integrated over time using simulation modelling based on hydrological processes. The generated information may be used in planning strategies for land use, and in the selections of the soil and water management practices, based on probabilities of success, levels of risk and long term sustainability. There are presented examples of application of this approach to the evaluation of the effects on the soil water balance and soil moistures regime, associated to new land and crop management systems, and to the previewed climate changes, in dry-land and irrigated vineyards for wine production in NE Spain. Special attention is given to the water use efficiency, under the semiarid Mediterranean climate, with low and very variable and erratic rainfall, and with scarce availability of irrigation water, in relation to the production, both in quantity and quality, of grapevines and wine.

Soil degradation processes and extreme moisture regime as environmental problems in the Carpathian Basin

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The most important „life quality” criteria (healthy and good quality food; clean water; pleasant environment) are closely related to rational land use and the **sustainable management of land resources**, which have great significance both in the national economy and in environment protection.

The main element of **sustainable (agricultural) development** in the **Carpathian Basin** is the **rational use and conservation of soil resources and ecosystems**, maintaining their favourable „quality” and their desirable **multifunctionality**. This is the main goal of social and agricultural development, soil conservation, water management, environment protection and rural development and the joint responsibility of the state, land owners and land users, requiring priority attention and full support from the whole society.

The natural conditions (climate, water, soil and biological resources) of the Carpathian Basin (particularly the lowlands and plains) are **generally favourable** for rainfed biomass production. These conditions, however, show extremely high spatial and temporal **variability**, often **extremes**, and react **sensitively** to various natural or human-induced **stresses**. The main ecological constraints are:

- (1) **Soil degradation processes:** soil erosion by water or wind; soil acidification; salinization/alkalization/sodification; physical soil degradation (such as structure destruction, compaction, surface sealing etc.) and biological degradation (such as unfavourable changes in soil biota, decrease in soil organic matter).
- (2) **Extreme moisture regime:** simultaneous hazard of flood, waterlogging, over-moistening and drought sensitivity. The increasing water demand of the society must be satisfied from **limited** and not increasing **resources**, that show **extremely high spatial** (territorial) and **temporal variability** – even in micro-scale – and result in significant surface runoff, filtration and evaporation losses. **Extreme moisture regime** is the unfavourable consequence of high spatial and temporal variability of climatic conditions, especially atmospheric precipitation; heterogeneous macro-, meso- and micro-relief; and the unfavourable physical-hydrophysical properties of some soils. It can be forecasted that **water** will be the determining, sometimes limiting factor of food security and environmental safety in the region and the efficient control of moisture regime will be one of the key issues of agricultural production, rural development, soil conservation and environment protection. The control can be efficient only on the basis of comprehensive **risk assessments, impact analyses** and exact **prognoses**.
- (3) **Unfavourable changes in the biogeochemical cycles of elements**, especially of plant nutrients and environment pollutants.

In the last years the revolutionary development of in situ and laboratory analytics, remote sensing, informatics, computer technology, GIS/GPS applications, etc. has given opportunity for the organization of all available **soil information** into a well-structured up-to-date **soil database**. On this basis the „**environmental sensitivity/susceptibility/vulnerability**” of soils against these stresses were comprehensively analyzed and indicated on thematic maps in various scale.

On the basis of these information sustainable land use, site-specific soil management, yield stability, risk reduction, soil conservation, and the prevention, elimination or moderation of soil degradation processes and extreme moisture situations can be efficiently controlled. But it requires a well-coordinated multidisciplinary soil and water conservation strategy with the final aim: better life for each member of the society.

Concepts and tools for monitoring and managing desertification in different climates

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On the one hand desertification is claimed to be affecting large areas of the world and seriously damaging the provision of ecosystem goods and services (Rubio 2007). On the other hand it is being increasingly pointed out that the UN Convention to Combat Desertification is not underpinned by convincing scientific evidence of desertification in the same way as the Climate Change Convention (Montanarella and others 2007) is backed up by the studies of the IPCC. Governments have not realised that the soil, land degradation and desertification are cross-cutting issues that require focussed attention (Arnalds 2007). Instead, policies to combat it, just like the research that addresses it, is fragmented and embedded into mainly environmental or sustainable development policies, where it receives in fact little attention from scientists or politicians working in other areas or departments.

One objective of this paper is to suggest how some relatively simple conceptual frameworks can be used to define and agree on a common area of understanding within which a) scientific data and results can be shared and b) desertification measured and monitored with indicators and c) comparisons be made between climates. The concepts relate to ways of dealing with different spatial and temporal scales and change, with thresholds that separate different areas of attraction, and with how to link the actions of man to the changes that they bring about in the landscape.

The results will firstly illustrate the advantages of redefining desertification in terms of losses of function, ecosystem goods and services, capital, or of environmental security. The drivers can be explained in terms of concepts of capital, culture and of genetic evolution. For measuring and monitoring the above a design that follows the basic methodology of adaptive management is proposed. This enables a spatial stratification to be made according to the slow processes that confine or constrain change and for change to be studied in terms of the dynamic conditions that are driving change at fine scales.

The loss of soil quality is common feature of much desertification. What is urgently needed is agreement regarding a common methodology. The paper will also describe a simple tool box that can be used to monitor the loss of soil functions almost everywhere. The value of the state and transition concept for desertification interpretation will be illustrated.

Intentions about Soil Conservation Service in the Soil Thematic Strategy of the European Commission

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The European Commission established under the thematic strategy for soil protection reports (EUR21319 EN/6). One report was from the task group 'Soil and Data Property, Soil Legislative Frame Work, Soil Conservation Service'. Here are the intentions of soil conservation service presented for discussion.

Roots, fields and targets of soil conservation are not always very clear today. Therefore organization structures are split, not well established or lost. One reason is the shift from agricultural use of soils to urban industrial, traffic and mining ones. The past time priority of soil use for food and timber supply for sustaining quality of life has lost much of its original economic relevance. Numerous other types of soil use occur and must become objectives of soil conservation to keep and improve living standard. There are requests for soil properties from new types of soil use which must become part of soil conservation as well as the effects of new types of soil use on soil properties changes.

Important part of soil conservation is its role as link between soil and socio-economy. Today socio-economic demands changes are strong. The traditional socio-economic tasks to gain land, to protect and develop soil fertility, for settlers, refugees, to improve tax income, to fight against hunger and malaria, to keep the population in the country and region are still valid particular for some poorer regions of the world. The investments for this are long lasting ones. But for most of the world harvests gained only from properties of natural soil fertility have lost its importance. The place is taken by investments with short term returns. That means properties of soil productivity are of importance. The other point is perhaps that we have to face a renaissance of better use of the soil as a volume as result of soil are shortage.

Today new long lasting socio-economic demands on soils and their properties occur. Health problems are close related to pollution, dust, overheating, pathogen organisms from soils. The aging world population is very sensitive to them. Many other demands on soils exist such as for example from water winnings, waste decay, recreation, sealing, heat storage. All demands to soils must be efficient organized under one roof of soil conservation service and legislation.

Contaminated Soil Legislation – Necessary inclusions with examples showing their effectiveness

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A significant cause of soil degradation arises from contamination. Whilst contamination is commonly associated with industrial use, it can also arise from agricultural activities. Approximately 2.4 million square kilometres of the Earth's surface is contaminated. Most of this is located in areas inhabited by humans. The effect of soil contamination on human health and the environment can be severe. A number of industrialised countries now have legislation concerning contaminated soil. Some countries have significantly amended their legislation, due to difficulties encountered in its administration. This provides a valuable insight into what legislative provisions may or may not be effective.

This paper examines the appropriate and necessary components of legislation concerning contaminated soil, such as definitions, access to information, notification requirements, and remediation of contaminated soil. It also discusses additional matters for inclusion in such legislation. The paper identifies various options for each legislative component, and examines advantages and disadvantages of those options, together with practical difficulties in their implementation. The paper concludes that the choice of option for any such legislative component requires a balancing of numerous but sometimes conflicting factors (such as cost, affordability, political considerations, expertise and infrastructure capacity). However, truly effective legislation to address the degradation of soil due to contamination needs to be based on long term goals for a sustainable future.

Towards an integrated approach to soil conservation

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Experiences from several research project are summarized, especially two European Union Framework Programme Projects. These projects were SHASEA (Sustainable Highland Agriculture in South-East Asia; Framework 4) and BORASSUS (Framework 6). Specific project design and management lessons were gained from both projects, which can be employed by similar research projects promoting sustainable agro-environmental development in the tropics and subtropics. Both projects postulated that environmental protection and socio-economic development were complimentary, synergistic and achievable aims. These aims can largely be achieved by adopting holistic and integrated approaches to soil conservation. While soil conservation is largely an environmental engineering problem, we need to recognize that effective conservation has social, economic, educational and political dimensions. The case for an integrated environmental and socio-economic approach to soil conservation is supported by detailed case studies from Yunnan Province (China) and São Luís (Brazil). Specific lessons from the reviewed projects include:

- (1) Recognizing the importance of both 'north-south' and 'south-south' co-operation in development projects. For instance, a particularly important aspect of the SHASEA Project was the Chinese-Thai collaboration in developing viable solutions for agro-environmental problems in the highlands of South-East Asia.
- (2) Integrating local stakeholders as full partners in the research programme. This should include genuine consultation and feedback of research information, so that stakeholders see tangible benefits from the project.
- (3) Addressing the problem of 'time horizons'. Farmers usually have short time horizons, while government policy tends to be much longer-term (five years plus). Matching these different aspirations poses many challenges to the development of appropriate agro-environmental policies.
- (4) Multidisciplinary teams must be developed to include biophysical scientists and socio-economists. Due to differences in approaches, this can be challenging and, therefore, necessitates regular and persistent dialogue and information exchange.
- (5) For soil conservation initiatives to be effective, it is imperative farmers' gain income from their activities. Many well intentioned projects have floundered because local farmers do not embrace the technologies. While the soil conservation technologies may be technically feasible, they have not been implemented because farmers cannot efficiently gain income by their adoption.
- (6) Education is the key to success. Urbanized societies are becoming progressively remote from the food resource base and generally have vague and sanitized views of agricultural production systems. Educators have a pivotal role to play in increasing knowledge, awareness and understanding of soil system dynamics at multiple levels, from school to University level and to the general public. To achieve long-term success, developing 'land literacy' amongst people is crucial.

Opportunities and challenges of basic research on soil and water conservation in China

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Soil and water loss has become a major global environment problem that has severe impacts on human survival and sustainable development. In China sci-tech development of soil and water conservation has a long history nearly 100 years. The research achievements have obvious features and predominance in the world. Coming into the 21st century, regional eco-environment rehabilitation brings new opportunities and challenges to scientific and technologic research of soil and water conservation. Based on the analysis of international development trend and requirement of China, the priority research programs, key technologies and measures are proposed in this paper.

To address this, Soil erosion process and control research has been put in the national basic research program in 2006. The project will focus on the process of soil erosion in four water-erosion regions namely, the gentle hilly black soil regions in northeast China, the Loess Plateau in northwest China, the red soil hilly region in south China and the purple-soil hills in southwest China. The project plans to address the following three problems: the formative process and driving mechanism of the soil erosion in water erosion regions, the theory and methods for developing a model of soil erosion in complicated conditions, and the theory and regulating mechanism for evaluating the impacts of water and water loss and the benefits of soil and water conservation. In particular it aims to: (1) Establish the scientific basis for soil and water conservation; (2) Resolve some specific unanswered questions; (3) Establish the mechanisms of runoff and sediment transport; (4) Develop an integrated multi-scale model for monitoring and forecasting soil erosion; (5) Establish a methodology to assess the impact of soil erosion and soil and water conservation measures. Its primary objective is to establish the fundamental causes of soil erosion and its driving mechanisms. The project will supply scientific basic for soil and water conservation decision-making.

Keywords: soil and water loss, basic research, soil erosion process

– Oral presentations –

Response of runoff and erosion during extreme events to climate change in Mediterranean watersheds

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Climate change is expected to increase temperatures and lower rainfall in Mediterranean regions, increasing the intensity of extreme rainfall events at the same time. These changes could impact the driving forces behind catchment response to storms in both positive and negative ways, since higher intensity could be counteracted by a decrease in hydrological connectivity caused by lower soil moisture. This work analyzed this problem for two watersheds with contrasting conditions, both located in Portugal: Odeleite, with a semi-arid climate and covered mostly by natural vegetation, and Alenquer, located in an agricultural region with a humid climate. Daily results from the PROMES regional climate model for two emission scenarios (B2 and A2) indicate a decrease in annual rainfall (20 to 30%) coupled with an increase in rainfall for extreme events during the latter part of the wet season (4 to 20%). The SWAT hydrological model was run with these results to determine impacts on seasonal-scale soil moisture and vegetation cover; the results indicate that the former is expected to decrease (35 to 70%) while the latter is expected either to have no significant changes or, for natural shrublands, to increase up to 60%. These results were used to parameterize the MEFIDIS storm-scale hydrological and erosion model, aiming to verify the compounded impact of these changes on runoff and erosion during extreme events. Despite the larger rainfall decrease in the A2 scenario, results show an increase in runoff and sediment yield in Alenquer (10 and 20%, respectively). The increase in erosion was mostly in small areas already affected by significant erosion rates. In Odeleite, runoff and sediment yield were reduced (25 and 75%, respectively), but these impacts are smaller for the strongest storms and the most extreme floods could remain unchanged. The area affected by significant erosion problems showed a decrease, but remaining areas showed only small changes to erosion rates. These results show that catchment response to extreme rainfall events for runoff and sediment yield could show smaller changes than the reduction of annual rainfall would suggest. In agricultural regions, this response could actually increase despite the drier climate patterns.

Climate change – aridification – changing soil – transforming landscape

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The effects of globalisation are becoming more and more obvious not only in the world economy but also in the natural processes. In the international scientific world the effects of global warming can be observed the most in aridification process but many scientists presume connection with the increasingly unpredictable flood events too. Few think, however, that the changed climate of the several decades can be resulted in the transformation of the natural landscape.

The change of natural water cycle is the most important factor in environmental changes which through several direct and indirect effects transform the characteristics of landscape components. Short term changes are evident: droughts and poor crop, floods, inland water. The most important long term effect is the decrease of ground water – though it is not obvious for the first sight.

As a result of precipitation decrease, the greatest changes in the ground water table, which sank at some locations by 7 m, were experienced on the plains rimmed by Hungary's two largest rivers, the Danube and the Tisza. We applied GIS for determining *the degree of annual water shortage*, the estimated maximum of which was 4.8 km^3 , occurring in 1995 and 2003. The above value is seemingly low, however it is *almost as much as the total annual water consumption of the country*.

Changes in ground water can also modify the vertical water and salt transfer in soils, which might result the transformation of genetic soil types. As a consequence, sodification processes or under reverse conditions desalination can be observed. In both cases *the modification of soil type is followed by the change of natural vegetation*. In Hungary climatic changes are best indicated by sodic soils. In less than 30 years sodic soils with sparse vegetation have transformed into steppe soils, and grassland vegetation advanced (see photos). The previously dominant sodium content has sharply declined, while organic material content increased.

Impact of climate change on freeze-thaw function and freeze-thaw erosion in Black Soil Region of Northeast China

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In this paper, impact of climate change on freeze-thaw function and freeze-thaw erosion in Black Soil Region of Northeast China are analyzed to probe into the climate environment of Freeze-thaw and the impact of climate environmental change on freeze-thaw. The results show that the annual mean temperature has increased distinctly, together with a declining precipitation. With the variation of temperature and precipitation in Black Soil Region of Northeast China, the frozen soil depth and the thaw depth of soil decrease, which are gradually decreasing from the north to the south in this region. The frozen date of soil was postponed and the thaw date of soil was advanced, and the south freeze ahead of the north but thaw later in this region. With the rising of the spring air temperature and snowfall increasing in winter, the freeze-thaw erosion was aggravated.

Keywords: Climate environment; Climate Change; freeze-thaw function; freeze-thaw erosion; Black Soil Region of Northeast China

The studying of climate change's effect on the farmer's land use option in Farming-grazing Transitional Zone – Taking Ejin Horo Banner in Inner Mongolia of China as a Case

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The farming-grazing transitional zone in northern China is an ecological transitional zone where the ecological problems represent collectively, including land degradation, farmer's poverty. The study is based on investigated household data of spot check, domestic statistical data, and meteorological data. The results indicated that the land degradation was caused by climate change as well as farmer's land use options; and meanwhile the land use options were caused by the climate fluctuating and the population pressure on the land resources. The frequent change of climate resulted in productivity fluctuation in different extent; and because of this change, the land adapts to crop plantation during one period, but adapts to stockbreeding in another period. Studying the problem of land use caused by climate fluctuation and the countermeasure of farmer's response is in favor of adjusting human land use, and can bring the ecological protection engineering into effect, as well as farmer's production and living.

The study results showed that the changes in drought/humid were corresponded with the alternation of plantation and stockbreeding during the latest 2000 years in this region. The investigation of farmers represented that the land cultivation and abandonment had been correlated closely with precipitation. Farmers plowed grassland in some years, when the precipitation was higher, but were compelled to abandon the arable land in drought years. The cultivation area has relation with precipitation. The dry farming restricted by precipitation fluctuation has great risk. The temperature condition is not restriction factor for one harvest a year as well as grazing, but drought and water shortage are the key factors to influence the crop growth, yield and forage quantity. The precipitation in Ejin Horo Banner is above 400mm; It is good for grass and shrub growth, but not fit to crops well.

Precipitation had obvious effect on grain output. The fluctuation of grain output had clear correlation with precipitation. When the precipitation was higher, the grain yield was high. The seasonal distribution of precipitation had also important effect on output of grain.

Influenced by climate change, farmers took adaptable countermeasure in land use. In the aspect of crop production, they planted big area for obtaining a large amount of grain in rich rain years in case of no output in drought years. The cultivated area dropped in Ejin Horo Banner during 1960s to 1970s with the intimidation of land degradation. It also decreased with the irrigable land increasing in 1980s.

The farmers planted different crops that had different growing season for avoiding climate risk, because the rain season might come early or late, and stopped early or late. The farmers in Ejin Horo Banner plant at least tree kinds of crops every year; some even seven kinds. Digging wells can develop irrigable land. The number of digging wells of investigated farmers in Ejin Horo Banner from 1978 to 1998 was in inverse correlation to the annual precipitation of the last year. Win the irrigation land increasing, the total cultivated land was decreased, because the irrigable land had higher and stable yield and could supporting more people per hectare.

In the aspect of stockbreeding, farmers reforested edible shrubbery to supply forage, because the shrubs are much tolerance to drought then herb grass. In drought year, farmers increase the amount of livestock selling to reduce loss due to the shortage of forage.

Key words: farming-grazing transitional zone, climate change, land use change, farmer's options

Complex geo-ecological responses to climatic changes in an arid area: the case of the northern Negev desert

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Drylands are regarded as highly sensitive to climatic changes. A positive relationship between rainfall and environmental factors (water availability for plants, productivity, species diversity, etc.) is often assumed for areas with an annual rainfall of 100-300 mm. This assumption disregards the fact that a climatic change in arid and semi-arid areas is not limited to climatic factors. This change is often accompanied by a parallel change in surface properties, such as deposition of loess during a wet climatic phase and sand during a dry phase. The alteration of surface properties may have opposite effects on the water regime and ecosystem characteristics. Data on rainfall, runoff, soil moisture regime, soil properties and vegetation cover were collected at several sites in the Negev desert along a rainfall gradient of 86 to 160 mm. Data obtained reveal a complex response to climate change. Loess deposition resulted in an increase in salt input (by dust and rainfall) and a limited leaching depth related to the high water absorption capacity of the fine-grained material. The combined processes led to soil salinization and desertification. An opposite trend occurred during the following dry period. The negative effect of rainfall decrease was counteracted by sand deposition that allowed deep rainwater infiltration and good water preservation. However, when sandy areas along a rainfall gradient are considered rainfall increase had contrasting, positive and positive effects, on the water regime and vegetation cover. Results obtained cast doubt of the prevailing idea regarding the positive relationship between average annual rainfall and ecosystem characteristics. The findings are attributed to the decisive role played by the contrasting effects that the change in surface properties had on the hydrological regime and resulting water resources.

Barrier functions of soils and sensitivity of environment to pollution

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Approaches to the problem: -sustainability of ecosystem to pollution is provided by the ability of all natural media to support the vital capacity of living organisms under pollution. Atmosphere and hydrosphere is favored this by self-cleaning from pollutants. Soils are taking the pollutants. The ecological state of soil in ecosystem depends on how much, how strong soils will adsorb pollutants. Buffer ability of soil is the universal weakening mechanism for support the chemical substances availability, first of all- their concentration in soil solutions.

Objects of investigation podzols and soddy-podzolic soils of natural and technogenic landscapes of Russian taiga: soils, soil extracts and lysimetric water.

Methods of investigation: Laboratory and field experiments: adsorption- desorption of metals (Cu, Zn) by soils. Analysis of metals species in lysimetric water and water extracts.

Results and discussion: Buffer ability of soils towards metals is realized because of dynamic equilibrium between ions in soil solution and their mobile species in solid soil components. The quantitative parameters of potential affectivity of these processes have been received in the laboratory experiments. The leading position in metals bounding in the letters of the investigated soils occupied presumably the formation of solid Zn salts with organic anions, in humus-accumulative- ion exchange, in the illuvial horizon Me adsorbed specifically, almost without ability for exchange. The most level of soil buffer ability towards metals was marked in humus horizon. Metals desorption can be intensify by their secondary microbiological mobilization. This process is accompanied with the increasing mobility of Cu and Ni species. The composition of forming Me species is favorable for the increasing of Me mobility.

Conclusion: 1) potential buffer ability of investigated soils is provided by all mechanisms of their bonding; 2) processes of microbial destruction of organic mineral soil solid compounds lead to the secondary mobilization of metals; 3) the percolate water regime is favorable for Me leaching from the polluted investigated soils, it leads to the local pollution of the drinking water of the region; 4) the ratio processes of Me adsorption-desorption assure the barrier functions of soils in ecosystem.

Monsoonal climate variability and its impact on susceptibility of rainfall to cause erosion

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Climate changes have repeatedly affected much or all of the earth. Recent evidence suggests that climate in fact is changing and is very likely to continue changing in the future. Monsoons are no exception. Monsoonal climate is primarily evident in tropical countries like India where more than 75% of annual rainfall is caused by monsoons. All erosive rain is concentrated during the monsoon months. As a result, any change in monsoon rainfall intensity or quantity will bring changes in its erosivity patterns. This paper studies Indian monsoonal climate variabilities in the past 50 years. Since rainfall intensity is the prime determinant of soil erosion, emphasis is placed on the change in monsoon rainfall patterns in terms of intensity of rainfall in the recent decades. The more intense the rainfall is the more it is susceptible to cause erosion. This susceptibility when quantitatively estimated is termed rainfall erosivity factor in the Revised Universal Soil Loss Equation² (model RUSLE²). The quantity of soil erosion is directly proportional to the rainfall erosivity when other factors affecting erosion are constant. The paper will present the results of a study which have been carried out on how the change in monsoon rainfall intensity affects the rainfall erosivity factor when the total quantity of annual rainfall is negligibly changed. Annual rainfall erosivities are determined for all the 50 years so as to study the inter-annual variabilities with change in monsoonal rainfall patterns. It was found that the 90's decade experienced a number of rare rainfall events with very high 24 hour maximum rainfall. Results have shown that the rainfall erosivities are not only dependent on the quantity but also on the intensity of the rainfall; and most importantly that any change in monsoonal climates will bring massive change in erosivities and in turn in soil erosion.

Crop and soil management adaptation to sustain field crop productivity and improve soil water regime under global changing climatic conditions in Lithuania

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Climate change is becoming one of the main factors directly or indirectly affecting the productivity of agricultural crops, the efficiency and stability of agriculture and related industries. **Reality of climate changes** requires a careful revision of traditional soil and plant management technologies. **In addition**, a new approach and propagation of sustainable soil management technologies implementation in practical farming becomes very important.

Reduced tillage and even direct drilling become increasingly popular in Lithuania. Ploughless tillage has been adopted already approximately on 5 thousand ha of agricultural land and this area increases every year.

The goal of this study was to evaluate the changes of soil physical and chemical properties and plant available soil moisture conservation by implementing different crop and soil management systems during a 7 year's investigation.

It was revealed that direct drilling caused higher soil moisture content after crop sowing in the upper 0-5 and 5-10 cm soil layers, while this index in deeper layers was essentially lower compared to both conventional and reduced tillage. In spite of soil moisture regime in the upper 10 cm layer under no-tillage improved, unfortunately, soil moisture content has reduced in the 10-20 cm soil layer. The same tendency persisted during vegetation period of all crops investigated. Plant residues in all soil layers determined significantly higher moisture content compared with the plots where residues had been removed.

Subsoil texture had a key role on the yield of a crop rotation. Prevailing sand particles within 20-40 cm soil layer had reduced available water content and amount of nutrients in the top soil causing a lower field crop yields.

Soil fertility as an indicator of climate-sensitivity of the soils

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The knowledge of the effect of climate on the soil properties, especially on the soil water regime is of major importance in agriculture, as they have significant effects on soil fertility, soil aeration, soil temperature, drainage, irrigation and cultivability. Vice versa, the soil fertility may act as an indicator of soil's climate-sensitivity.

This study was conducted to quantify the impact of climatic variability on the soil water regime and fertility of different Hungarian soils. Using different Hungarian soil-databases representative soil types were chosen and average water balances were calculated. The biomass productions of different years and soil types were then compared with the predicted water-supply, using statistical methods. The results show that soil fertility is able to indicate the effect of climate on the soil water regime depending on the soil hydrophysical soil properties.

Isolation, Screening and Characteristics of Hydrogen-oxidizing Bacteria in Soybean Rhizosphere

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A set of theories that H₂ released from Hup⁻ legume root nodule can improve the reproduction of hydrogen-oxidizing bacteria and the developed bacteria colony increased plant growth put forward firstly in recently. But HOB is extremely difficult and less progress was made in research. In this study the soils from Hup⁻ nodules were cultured in H₂ mixture gas for isolating HOB. The characteristic of HOB was also studied primarily. The main content as follows:

A set of equipment of gas-cycle incubation system(H₂ treatment system) was developed that provided stable H₂ exposure rate (4.16×10^{-5} - 1.25×10^{-4} mol·L⁻¹) by electrolysis, gas flow rate is 280ml/min. The equipment was used in soil enrichment and hydrogen-oxidizing bacteria culture.

Mineral salt agar medium(MSA) was used to separate HOB which were able to utilize hydrogen as sole energy. 40 strains were isolated by incubation system with 1.25×10^{-4} mol·L⁻¹ H₂ mixture gas, and the capabilities of uptake hydrogen of these strains were measured. The results showed that the volume of uptake hydrogen of 22 strains more than 1.25×10^{-4} mol·L⁻¹, and 9 strains in the 22 strains was consumed completely. The results of autotrophic growth tests showed that 22 strains had the ability to grow chemolithoautotrophically. 20 strains were preliminarily identified as HOB.

The ability of heterotrophy and the capability of utilizing different carbon resources were studied through cultivating bacteria in liquid MSA medium with different carbon resources without H₂ mixture gas. Bacteria colony form and physiological- biochemical characteristics were also studied. The growth-promoting capability of 20 strains was tested. 10 strains were tested that they could markedly promote root growth of wheat and corn. Increasing amplitude of rootage was from 117% to 397%.

Keywords: Hup⁻ legume rhizosphere soil; Hydrogen-oxidizing bacteria; Growth-promotion

Spatial and temporal pattern of pH and Eh in wetlands¹

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Vegetation patterns have direct and indirect influence on chemical reaction and redox condition of soils. Present paper deals with the relationship between some environmental factor (such as vegetation pattern, micro-relief, abundance of water, temperature and incident solar radiation) and the pH and Eh of soils in a headwater wetland in Transdanubia, Hungary. Measurements have been taken in four different patches and in their boundaries: sedge (*Carex vulpina*, *Carex riparia*, three patches and two species), sedge-grass (*Equisetum arvense*), common nettle (*Urtica dioica*). The spatial pattern of the studied parameters influenced by abundance of water, by micro-topography, by temperature and by direct and indirect effects of vegetation. The indirect effect can be the shading, which has influence on soil temperature and on the incident solar radiation (PAR). Direct effect can be the root respiration and excretion of organic acids. We have measured individual pH and Eh characteristic in the studied patches.

The differences between patches are always changing. The highest differences can be found around midday (between 10:00 and 15:00), while lower ones can be measured between sunset and sunrise. However pH and Eh are also changing, their ratios are also changing. The highest pH values and the most oxidative conditions prevail on night time. Increasing PAR results lower pH and Eh by root activity.

Eh and pH have seasonal dynamics as well. Higher redox potentials (more oxidative conditions) and higher pH values were measured between late autumn and early spring. The increasing physiological activity of plants causes lower pH and Eh and it causes higher spatial differences. However temperature is an essential determining factor for Eh and pH, but our results suggests it rather has indirect affects through plants on wetlands.

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An Integrated Italian Research Project on “Evolution of cropping systems as affected by climate change” (CLIMESCO): first results on spatial and climatic characterization of two agricultural lands

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The climatic change induced by the global warming is expected to modify the agricultural activity and consequently the other social and economical sectors. In this context, an efficient management of the water resources is considered very important for Italy and in particular for Southern areas characterized by a typical Mediterranean climate in order to improve the economical and environmental sustainability of the agricultural activity. Climate warming could have a substantial impact on some agronomical practices as the choice of the crops to be included in the rotations, the sowing time and the irrigation scheduling. In this paper, a three-year Project, funded by three Italian Ministries (University, Agriculture and Environment) and involving Italian Research Institutions of Agricultural National Council. After presenting the different types of methodologies that we are applying, the first results will be presented with particular reference to the first workpackages (WP). The objective is to characterize the two areas in the southern part of Italy subjected to intensive agricultural activity. The characterization of two areas is based on spatially distributed data concerning the soil, the climate and soil use. Several techniques of data spazialization, clustering, geostatistical analysis, GIS are utilized in order to achieve homogeneous areas. Informative layers of GIS about land use, soil properties and climate are produced to describe the two areas. For estimating the local weather forecast for several decades at daily scale, starting from a General Circulation Models (GCM) data, two method of downscaling (regionalization techniques), dynamical and statistical, are adopted and compared.

Influence of the change in land use on the soil water properties of Andisols (Tenerife, Canary Island, Spain)

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Undisturbed Andisols are considered resistant to water erosion, a characteristic closely associated with their high porosity and high structural stability. The aim of the present work is to study, through field rainfall simulation tests, the influence on infiltration when such soils are put to different uses.

Four sites were chosen, all of which are located on the northern side of the island and between 825-1400 m.a.s.l. The soils are allophanic Andisols (Typic/Lithic Hapludands-Sites 1 and 2 and Typic Haplustands-Site 3) and non-allophanic Andisols (Ultic Fulvudands- Site 4) under different uses. To determine infiltration, a rainfall simulator with the following characteristics was designed: 35 x 25 x 30 cm metal box with nozzles in the bottom, 2.5 cm apart (diameter of drops = 2-3 mm). The box's 4 adjustable legs were set at 2 m height. Prior to installing the rainfall simulator, study zones were marked out using 30 cm-tall metal sheets. Each area measured approximately 875 cm² with a slope of around 20%. At the end of the slope a 25 cm-wide collector was semi-buried to collect runoff and sediment. Rainfall of variable intensity between 80-100 mmh⁻¹ was simulated for periods of 30-45 minutes. The results were as follows: In Site 1, infiltration decreased in the following order: potential vegetation (green forest-86 mmh⁻¹), repopulated pine (75 mmh⁻¹), repopulated pine with selective cuttings (11.5 mmh⁻¹) and deforested (5 mmh⁻¹); the field plot with green forest recorded 95% higher infiltration than the deforested plot. In Site 2, where the natural pine cover was removed in some parts to allow cropping, a slight decrease in infiltration was seen (18 to 12 mmh⁻¹). In Site 3, where pine forest coexists with zones repopulated with eucalyptus, the highest values were observed in the repopulated parts (37 vs 21 mmh⁻¹). In Site 4, infiltration in green forest was 39 mmh⁻¹ compared to 30 mmh⁻¹ in the pine forest. Sediment generation was greatest (738 gm⁻²) in the cropped plot (Site 2) and less than 15 gm⁻² in the other cases, except the eucalyptus repopulated plot (Site 1, 31 gm⁻²) and the deforested plot (Site 1, 61 gm⁻²). The results show the importance of changes in land use as regards the generation of erosion processes.

Use of factor analysis to evaluate soil quality relation to land use change in Azadshar district, North of Iran

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Land degradation in the forms of soil erosion, declining fertility and destructive flooding are serious challenges induced by land use change over past decades in Golestan province, north of Iran. Despite the general recognition of the threat from land degradation on land productivity and ecosystem sustainability, few studies have been made to quantify the proper indicators for evaluating and monitoring soil quality. Soil quality is one of the most important factors in sustaining the global biosphere and developing sustainable land uses. For soil quality assessment, a minimum data set (MDS) should be composed of soil attributes that account for majority of the variances. This data set will have the smallest possible number of soil attributes for a practical assessment. Ideally, the selected attributes should be easily measured and the measurements are reproducible and standardized. This study conducted to determine minimum data set using factor analysis for evaluating soil quality in relation to deforestation and land use change in the loessial hillslopes of Shastkola district in Golestan province. Forty soil samples were collected from the 0-30 cm depth of four different adjacent land uses including (1) natural forest, (2) cultivated land (3) reforested with *Olive*, and (4) reforested with *Cupressus*. Soil attributes including pH, EC, Sand, Silt, Clay, Microbial Respiration Rate, Soil Erodibility Factor (K factor), Water Stable Aggregate (WSA), Mean Weight Diameter (MWD), Available Water Holding Capacity (AWHC), CaCO₃, Soil Organic Matter(SOM), Total Nitrogen(TN), and Bulk density (BD) were determined using standard methods. Descriptive statistic analysis showed that all variables were approximately normally distributed. Highly positive correlations are obtained for total nitrogen versus soil organic matter, and mean weight diameter versus water stable aggregates($r>0.90$). Highest negative correlation was obtained for sand versus silt ($r=-0.89$). Factor analysis was done by maximum likelihood method using SPSS software. For the 14 soil attributes measured, there exists a maximum of 14 factors that may explain the total variance. The results of factor analysis showed that factors 1 through 3 are more significant in explaining the system variance than the remaining factors. The first and most important factor (Factor1) explained 50.79 % of the total variance. Second factor accounted for a further 15.86% of total variance. Factors 1 through 3 collectively accounted for 76.28% of the total variance. The magnitude of the eigenvalues was used as a criterion for interpreting the relationship between soil attributes and factors. Soil attributes were assigned to a factor for which their eigenvalues was the highest. Factor 1 explained 50.79% of total variance with a high positive loading (>0.85) from MWD, TN, WSA and SOM (Table 4). It also had positive loading from MR, and silt content (>0.75). Factor 1 also had moderately positive loading from AWHC (>0.5) and low positive loading from EC (0.15). The three factors explained approximately 99% of variance in sand content, SOM, TN, WSA, and MWD; $>84\%$ in silt content and MR; $>60\%$. EC was the least important attribute due to the lowest communality estimates. Based on the results of factor analysis and communality values, in the present study the attributes which explained the most portion of total variance included sand content, SOM, TN, WSA and MWD. Overall results revealed that, these parameters are the reasonable indicators for the soil quality assessment in the study region in relation to land use changes.

Keywords: Soil quality indicators, land use change, factor analysis

Soil surface compaction: How land abandonment interacts with fire in a Mediterranean environment

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The abandonment of agricultural landscapes has been a widespread phenomenon in European Mediterranean areas since the second half of the past century. Land abandonment promotes soil structure and other soil quality parameters. Nevertheless, old agricultural landscapes show consequences of previous human activities and the development of spontaneous vegetation increases the risk of severe wildfires.

This work presents an eight-year monitoring of soil surface compaction that includes unburned and burned areas and two stages of abandonment: (1) lands abandoned 8-15 years prior to fire and occupied by dry grassland with young *Pinus halepensis*, and (2) old crops (>35 years of abandonment) colonised by a mature pine forest. The study area is located near the Guadalest reservoir (Alacant province, E Spain). Soil surface compaction (0-1 cm mineral soil depth) was assessed by means of a cone penetrometer for top layers.

The analysis of unburned areas showed that pine forest always presented smaller values of soil surface compaction than more recently abandoned fields.

After burning, both stages of abandonment showed a remarkable increase during the first year, although the later dynamics was quite different. In the case of recently abandoned lands, soil surface compaction values returned to those obtained in unburned plots in the short term. In contrast, burned pine forest showed higher values than unburned pine forest until the seventh year after the fire.

These results indicate that old crops colonised by pine forest are more vulnerable to fire than recently abandoned fields.

Land evaluation for agricultural purposes - Bulgarian system Evaluation scales according to winter wheat requirements

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The methods and approaches for evaluating the lands in Bulgaria according to the winter wheat requirements are demonstrated here. The Bulgarian system is using parametric method and uses important characteristics of the land – soil, relief, and climate according to the pre-developed scales. A high satisfactory level is reached about the adequacy of the relative evaluation.

The Bulgarian system for evaluation of lands supposes working with pre-set algorithms and evaluating scales (based on these algorithms), map material, etc.

The structure of the system itself supposes periodic update based on newly acquired data, changes in the hybrid composition of the cultures, developing on more accurate methods for research, etc. The scales shown in this work are part of the current updated contingent.

A good premise for adequate work during the development and usage of the corresponding methods for evaluation, is the presence of a database both of the soil (done with large scale soil mapping) and of the correct long term climate data of Bulgaria, covering the whole country.

The purpose of the current development is to show the algorithms of the Bulgarian land evaluating system during the evaluation of agricultural lands according to the requirements for winter wheat.

For this reason seven main evaluating scales, accompanied with short examples, have been developed for the estimating of the winter wheat.

**Land use based identification of agricultural factors for improving
sustainable land resource management in Northern Thailand –
A Case Study in the Chiang Mai Province**

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This paper aims to identify the land use factors benefiting sustainable land management in term of environmental conservation in northern Thailand. For evaluating the impacts of land use on environment, use of chemical fertilizer and pesticide, as well as land use structure and diversity are taken into account. The Farmers' income, land tenure and farming scale have been selected to recognize their influence on the agricultural sustainability.

For evaluating the impacts of land use on environment, four parameters, namely use of chemical fertilizer, use of chemical pesticide, land use structure and land use diversity are taken into account. The land use type in agriculture is categorized according to the cultivated products. For comparison of the land use diversity in different periods, the Shannon-Weaver Index has been calculated according to Farina (1998). The farmers' properties, income, land tenure and land area of the holdings in agricultural sector have been selected to recognize their influence on the four land use related parameters mentioned above. The analyses are conducted by statistical method, in case that the dataset could satisfy the conditions. Otherwise, the qualitative and quantitative comparisons have been carried out.

The results have shown a rapid increase in use of chemical fertilizer and pesticide during the past four decades. Meanwhile, increase in land use diversity has been observed. Land use change, especially the increase of the land use types vegetable-herb-flower-ornamental plant and permanent crop, has enhanced the demand for fertilizer and pesticide. Among the farmers' properties, the amount of chemical fertilizer used per unit area in large-scale farming is lower than that in small-scales. But the large-scale farming might consume more pesticide than the small-scales. A significant negative correlation could be observed between the proportions of the holdings possessing land and the holdings used the fertilizer.

Managing crop system and land use with orientation towards selecting new strains and varieties of crops and fruits with lower demand for fertilizer and higher resistance against the disease and pests, balancing large- and small scale farming, as well as insuring land tenure and economic incentives are suggested as effective measures for improving the sustainable agriculture.

ForStreams – Icelandic study on the effects of afforestation and revegetation on streamflow, aquatic ecosystems and water quality

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In the Icelandic FORSTREAM research project we study the effects of afforestation and revegetation on aquatic ecosystems, water quantity and water quality. The afforestation and revegetation have increased in Iceland in recent years, and further increase is anticipated. It is essential to gather further knowledge on possible changes in the vegetation cover affects the water and aquatic ecosystems. The water is one of Iceland's most important natural resource. It is used for hydropower production, for industrial and domestic use, for fishing and brooks, rivers and lakes are important habitats for many freshwater organisms. The effects of a change in vegetation cover on aquatic biodiversity, primary production and biogeochemistry of catchments has not been studied much in Iceland. Two M.Sc. theses will be produced on these effects within the FORSTREAM project, which will take place at both western and southern Iceland during 2007-2009. The project is a combined effort by the Agricultural University of Iceland, University of Iceland, Institute of Freshwater Fisheries, Iceland Forest Service, Soil Conservation Service and MATÍS. The project is also Iceland's contribution to a Nordic/Baltic study, entitled CAR-ES (Centre for Advanced Forest Research on Ecosystem Services).

Cone penetration resistance in an Oxisol under different land uses in Western São Paulo, Brazil

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In general, Oxisols found primarily in the intertropical regions of the world are characterised by moderate or low organic matter contents and low nutrient reserves. Despite low fertility status, Oxisols can be quite productive with inputs of lime and fertilizers. Oxisols have very good physical characteristics for plant growth: soil friability, porosity, permeability, and depth, all of which facilitate good root development and this in spite of a low water holding capacity. Soil compaction has been a very common problem on Brazilian Oxisols mainly under conventional tillage systems, affecting growth and yield of the crops as well as soil and water conservation. Although nowadays no-tillage is most widespread, compaction problems may remain. The objectives of this study were to examine both, the statistical differences and the spatial variability of cone penetration resistance in an Oxisol under three different land uses, maize, pasture and mango orchard. Penetration resistance and soil moisture content were measured at 84 points on 100 m x 100 m plots under each of the three soil uses. Measurements were taken from 0-15 cm, 15-30 cm, 30-45 cm and 45-60 cm depth. The nested sampling scheme combined a fixed grid with 64 points and random transects at shorter distances with 20 points. Mean soil penetration resistance was significantly lower under mango orchard. Soil under pasture showed the highest mean cone penetration values, which could be attributed not only to tillage effects but also to both, lower soil water content and texture differences when compared with other land uses. A compacted layer was observed at the 15-30 cm depth under maize and pasture. Geostatistical analysis showed in general no spatial dependence or a weak spatial dependence of penetration resistance at the studied scale. This notwithstanding the usefulness of spatial distribution analysis was discussed.

Change of distribution of soil phenolic matter along profiles of soils with different use

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Soil phenolic matter (SPM) constitutes an important compartment of the soil organic matter (SOM). However, a very few studies on their different forms and on their distribution in soil is available. The present paper deals with an investigation of experimental pedology aimed at evaluating the distribution of phenolic matter as a possible indicator of soil use impact. The investigation was carried out on 7 soil profiles (Andosols, Calcisols, Cambisols, Fluvisols, Lixisols, Podzols) with different land use: mountain pasture, grass, cereal, oak, chestnut, pine and eucalyptus wood. Three main SPM fractions were categorized: i) the “total” (SPMt, extraction by 0.1M NaOH), the “soluble” (SPMs, extraction by deionized water) and that with “high” (SPMh, as SPMt-SPMs) affinity with soil body. The SPMt content dramatically varied from 0.012 to 13.136 g kg⁻¹, averaging out at 2.164. The SPMh content, ranging from 0.001 to 13.080, and averaging out at 2.134 g kg⁻¹, largely contributed to the total SPM amount, whereas the SPMs content ranged from 0.005 to 0.161 g kg⁻¹, averaging out at 0.030. The SPM content is usually larger in surface A horizon than in deep B horizons, albeit illuvial/cheluvial horizons (A2, Bhs, Bs) show higher SPMt/SOM% and SPMh/SPMs ratios. The amount of SPMt (g kg⁻¹) in surface horizons (A, Ah, Ap) was significantly depending on soil use and vegetal cover, decreasing as oak (13.136) > chestnut (5.925) > eucalyptus (4.909) > mountain pasture (3.585) > grassland (0.108) > mixed wood pine-eucalyptus (0.084) > cereals cultivated soils (0.068). A similar trend was observed for SPMh and SPMs. The distribution of phenolic parameters along soil profiles also significantly varied according to the different soil use.

Impact of Land Use Change on selected Properties of Mollisols in the Entre Ríos Province, Argentine

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Pasture under native vegetation for extensive cattle rising has been traditionally a common land use in the Entre Ríos province (Argentine). However, in the last years increasing land surfaces have been incorporated to agricultural grain production. Moreover, cropping systems became more intensive, mainly because of the increase of soybean proportion in the rotations. After Vertisols, Mollisols are the most widespread soil type in Entre Ríos. Soils with a high physical quality are characterized by a suitable distribution of pore sizes and a high total porosity. The aim of this study was to assess soil use intensity effects on selected soil properties of Mollisols in a crop-pasture rotation experiment. We focussed on soil pore size distribution changes. Treatments included: 1) continuous cropping (CC), 2) crop-pasture rotation (CP), 3) permanent pasture (PP) and 4) native, never cultivated land (NV) as a reference. Soil samples were routinely analyzed for pH, C and N contents, extractable P, cation exchange capacity, soil physical properties (aggregate stability, percolation index, bulk density, and particle density) as well as pore size distribution by Hg intrusion and specific surface by N₂ adsorption isotherms. Significant changes in soil properties were recorded following the different land uses, which indicate that Mollisols are susceptible to physical degradation by land use changes. Natural vegetation, permanent pastures and pastures rotated with crops maintain higher storage porosity (50 – 0.5 µm) than continuous cropping. Natural vegetation and pastures also maintain a very high organic matter content contrasting with declined levels following continuous cropping. Soil storage porosity was correlated positively with organic matter content and aggregate stability. Avoiding continuous cropping by adoption of crop-pasture rotations is an adequate management practice for maintaining or even promoting the structure stability of the studied Mollisols.

Micro-plot scale overland flow generation and soil erosion in two recently burnt eucalypt stands in north-central Portugal: measurement and modeling results for simulated and natural events

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The work to be presented is being carried out in the framework of the EROSFIRE project (POCI/AGR/60354/2004), funded by the Portuguese Foundation for Science and Technology (FCT). In a nutshell, the project wants to evaluate the suitability of rainfall simulation experiments (RSE's) to assess and model soil erosion hazard in recently burnt forest stands and, more specifically, commercial Bluegum plantations as the prevalent forest type on the north-central Portuguese hills and mountains. To this end, a total of six study sites were selected to carry out RSE's at various occasions following wildfire, on the one hand, and, on the other, to monitor runoff and erosion of bounded plots of the same dimensions as the RSE-plots (0.28 m²) as well as of unbounded, slope-scale plots. MEFIDIS was chosen as the principal tool for modelling runoff and erosion under simulated and natural rainfall at the micro-plot scale, and for scaling up these results to individual hillslopes. Ultimately, the slope-scale MEFIDIS results are to be evaluated against those of one or more, less complex models, in particular USLE for having been applied for the nation-wide map entitled "Soil losses after the forest fires of the summer of 2003".

The proposed presentation will focus on the results obtained for two neighbouring Bluegum stands during the first year following a wildfire in early July 2005. The main difference between the stands is their pre-fire land management, one site having been ploughed in downslope direction and the other lacking evidence of mechanical ground operations. Between September 2005 and July 2006, a total of 32 RSE's were carried out using a portable simulator following the Cerdà et al. (1997) design. This was done in four field campaigns, each campaign involving two pairs of RSE's at each site and each pair of RSE's involving one high- (40-45 mm/h) and one extreme-intensity (80-85 mm/h) experiment on two adjacent plots. During the second half of September 2005, both sites were equipped with two pairs of neighbouring micro-plots, which were then monitored at weekly intervals till early October 2006.

The RSE's at both sites produced high runoff coefficients in September 2005 (median values of 70-80 %), which then tended to decrease with time after fire, most markedly so at the ploughed site. The sediment losses produced by the RSE's also tended to decrease with time after fire but the most conspicuous phenomenon was the contrast between a few high (80-100 g/m²) versus mostly low values (< 20 g/m²). These high losses all occurred during the first two campaigns, i.e. in September and November 2005. Like the RSE's, the erosion plots revealed runoff and erosion to vary strongly though time, with a clear suggestion of the role therein of soil water repellency. Overall differences between the two sites, on the other hand, are relatively minor, with median runoff coefficients over the entire 12-month period of about 25 % and corresponding sediment losses of 50-55 g/m². Initial MEFIDIS results for RSE's as well as concurrent natural events are encouraging, especially with respect to runoff generation, but are currently being reviewed.

Effect of canopy cover in macro and micro aggregation in a Mediterranean forest soil burned with different fire intensities

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Stability and distribution of macro ($\phi > 250 \mu\text{m}$) and microaggregates ($\phi < 50 \mu\text{m}$) of a Mediterranean forest soil were studied before and after experimental fires of different intensities, in two environments: under canopy soil (UC) and bare soil (BS). In 1995, two experimental fire treatments based on the addition of different biomass amounts were applied on a set of plots in the Permanent Field Station of La Concordia, Valencia, Spain. Three plots were burned with high fire intensity (T1), three with moderate intensity (T2) and three unburned plots were used as control treatment (T3).

Before fire, macroaggregates mean weight diameter (MWD) and stability (SMS) in UC were significantly higher than in BS. Microaggregate Mean Diameter (MMD) was significantly higher in BS than in UC. In both studied environments, fractions of 32.5–16.3 and 16.3–8.2 μm were the more common, and statistical significant differences in the Microaggregate Stability (MSA) between them were not found.

One month after the fire, all soil treatments showed increased stability of macroaggregates in UC as well as in BS (statistically significant differences at $p < 0.05$). In UC, MWD decreased increasing MMD. Contrary, in BS the possible re-aggregation of microaggregates increased the MWD decreasing the MMD. Statistical significant differences in the MMD of soils between environments disappeared in the first month post-fire, very possibly, because of their MSA values (the lowest measured during the study period). Main changes in microaggregate stability were measured in BS on T1. In general, a decrease on SMS and MWD values were measured four months after fires, particularly in UC on T1. Erosive rainfalls occurred in the second month post-fire could have caused the breakdown of less stable macroaggregates. MMD of these soils also decreased but their MSA reached the pre-fire values enhanced, probably, by the rise in the stability of microaggregates $< 1.0 \mu\text{m}$.

In the Mediterranean soil studied, the presence or absence of vegetation seemed to determine the changes on its aggregation patterns after the impact of fires. Under canopy soils were characterized by aggregates of lower size but more stable (macro and micro) after fires than before them. In bare soils, particularly those burned with high intensity, microaggregates showed very low stability and appeared, possibly, re-aggregated forming aggregates more stable than before the fire. These increases could be considered as a temporal enhancement of their structure. However, reduction of the shielding effect of vegetation cover left soils surface unprotected against raindrop impact triggering the risk of degradation processes.

Effects of temporal change on soil stability in an alpine catchment (Urseren Valley, Switzerland)

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Global change (as a combination of climate and land use change) poses a risk to stability of alpine soils, and may enhance landslide hazard. The occurrence of landslides depends on static catchment characteristics (e.g. geology, topography etc.), as well as triggering factors that are variable in time (dynamic factors), such as event characteristics and land use. However, in literature the effects of temporal change are still discussed controversially and most statistical landslide prediction models rely on static catchment characteristics alone and do not consider temporal change. In this study, we aim to assess the additional influence of dynamic factors on landslide susceptibility and on the validity of commonly used statistical landslide models. The Urseren Valley (Central Swiss Alps) was chosen as study area due to the evidence of climate and agricultural change. To assess the influence of catchment characteristics on landslide hazard, we set up a logistic regression model using 20 static predictor variables. The additional impact of dynamic risk factors was evaluated with historic data (aerial photographs and meteorological time series). We found that geology, slope and stream density were the most significant static predictors and could explain 70% of the landslide variation. However, the area affected by landslides increased by 92% from 1959 to 2004, which highlights the crucial role of dynamic landslide triggering factors. Furthermore, more recent landslides (since 2000) could only in part be predicted, which confirmed our proposed hypothesis that the validity of statistical hazard models may worsen over time. Discrepancies between predicted susceptibility and observed landslides mainly occurred in areas that have undergone land use changes. Consequently, slopes, that have formerly been classified as only “medium” landslide susceptibility may nonetheless have a high probability to fail under changed management practice. Spatial information of the impact of land use on landslide susceptibility could be extracted from historical data, and explain 85% of the new observed landslides since 2000.

Soil degradation of forest lands under udic soil moisture regime of Iran

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This study was investigated on four mountain landforms consisting granite, phyllite, basaltic andesite and andesitic basalt parent materials located in 10 km west of Langaroud area. Each site had forest and tea with two plots including one representative profile and three locations for soil surface sampling with distance 30 m from the profile. The experimental design was done as factorial experiments with randomized complete blocks with three replications. Results indicated that cation exchange capacity, pH, organic carbon (O.C), humic acid, exchangeable bases excluding Na (highest mean value in andesitic basalt), bacteria and fungi population were decreased ($p < 0.01$) in soil surface horizon under tea cultivation, however, bulk density, exchangeable acidity (Al+H) and fulvic acid content (in granite) increased significantly ($p < 0.01$). Furthermore, a negative correlation ($p < 0.01$) was found between pH values and fungi population ($r = -0.616$) as well as fulvic acid content ($r = -0.874$) but positive correlation ($p < 0.01$) with population of bacteria ($r = 0.899$). Higher carbon dioxide volatilization (respiration) was related to the forest of basaltic andesite. By decreasing pH value, fulvic acid content was increased much more than the fungi population. Equations are as follows: $CEC = 15.6 + 1.7K + 1.1Ca + Mg - 0.7 \text{ Fungi}$ and $Al+H = -14.4 + 1.8 \text{ (fulvic acid)}$. Other regression equations are: $pH = 4.43 + 0.45 \text{ (bacteria)} - 0.132 \text{ O.C} - 0.122 \text{ (fungi)} - 0.41 \text{ fulvic acid}$; and $O.C = -14.7 + 0.08 \text{ humic acid} + 0.06 \text{ clay} - 0.15 \text{ bacteria} + 0.22 \text{ fungi} + 0.09 \text{ fulvic acid}$; Also two others are: $\text{Fungi} = 13.7 - 1.36pH - 0.5CEC$ and $\text{Bacteria} = -60 + 17.6pH - 2.3 \text{ O.C}$.

Lower amount of clay and CEC was related to granite parent material whereas higher amount to andesitic basalt. Classification of these soils changed from Typic Hapludolls (andesitic basalt) and Typic Udorthents (granite) under forest to Typic Dystrudepts and Typic Hapludalfs under tea plantation, respectively. It is supposed that decreasing the CEC under tea cultivation is partly attributed to lower organic matter as well as blocking the charge sites of the clay fraction by aluminum (Al).

Post-fire changes of Soil Water Retention Capacity in a Mediterranean shrubland soil environment, under canopy and bare soil

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Fire recurrence on a recovering Mediterranean shrubland, can affect greatly its evolution and soil surface hydrological response. The thermal impact on soil surface layers can induce changes in physical and chemical soil processes and characteristics, such as aggregate stability, bulk density, infiltration, soil water retention capacity and, hence, runoff response and soil losses.

In this work, the variability of Soil Water Retention Capacity (SWRC) induced by a repeated fire (2003), was assessed in a Mediterranean soil and on two environments, under canopy (UC) and bare soil (BS). The study was developed in the experimental field station of La Concordia, in a set of nine erosion plots (80 m²) established in a SSE oriented hillside, in Valencia (Spain). The soil representative of the area belongs to Renzic leptosol type.

In 1995, a set of experimental fires was carried out. Two fire intensity treatments (high and moderate) with three plots each were obtained, the remainders were left unaltered. During 8 years the plots were maintained undisturbed. In 2003, experimental fires were performed again in the previously burned plots, to simulate the incidence of repeated fires. These last fires reached low intensity in all burned plots.

From 2003 to 2006, and twice a year (winter/summer), the plots were sampled taken a total of 36 soil samples each time (12 per treatment), of the first 5 cm. In each plot and sampling, four samples were taken two under canopy (UC) and two on bare soil (BS). The SWRC was calculated by Richard's method, using the pF2 as field capacity and pF4.2 as the permanent wilting point.

Before 2003 fire, statistically significant differences between environments (UC/BS), in each treatment, were observed. Fire impact homogenized values of SWRC in UC and BS environments, at least, until 3 years after burning. While, in control plots significant statistical differences among UC and BS sites were obtained, mainly in summer samplings. Just after fire, SWRC in the burned plots decreased $\approx 10\%$ below control values. However, one month after fire, these differences were attenuated. SWRC showed that fire can be considered a key degrading agent of soil hydrological properties.

Modelling and verification of soil erosion in steep alpine environments

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We aim to quantify soil erosion on plot scale at variable land use sites with different methods in an Alpine ecosystem. The investigated land use types were grassland; pasture with and without dwarf shrubs. For the direct measurement of erosion rates we installed sediment traps in July 2006. From April to November 2007 the average monthly erosion rate measured by sediment traps was 2.5 kg ha⁻¹ for meadow, 4 kg ha⁻¹ for pasture with dwarf shrubs and 18 kg ha⁻¹ for pasture without dwarf shrubs. Thus, our preliminary results indicate that land use significantly influences erosion. While meadows seem to be generally less prone to sheet erosion than pastures, dwarf shrubs obviously reduce sediment transport in the pastures. The latter is most likely due to the hindrance of transport of soil particles over longer stretches by dwarf shrubs. Temporally spoken, maximum erosion rates occur in June, when vegetation is still little, whereas minimum erosion rate occur in autumn. However, measured erosion rates seem to be very low in contrast to visible damages. We explain this finding with the high heterogeneity of the alpine erosion processes. Hence, we installed 10 sediment cups with a diameter of 6 cm at each plot. Our hypotheses was that erosion takes place at small scale (cattle trails), but is not observable when entire slope segments are observed with one sediment trap down slope. Measurement results of the sediment cups demonstrate that erosion takes place on the micro scale while only little or no sediment was detected by the sediment traps.

Beside our experimental efforts we tested the Water Erosion Prediction Project (WEPP) model using our dataset of 2006 and 2007 for one plot (pasture without dwarf shrubs). The results were evaluated against sediment trap measurements. Within this project, WEPP was firstly applied to steep alpine environments. A sensitivity analyses showed that slope and intensity of precipitation are the most sensitive parameters while canopy closure and soil texture are insensitive.

The effect of land use and soil characteristics on gully formation in an arid ecosystem, Southwest of I.R.Iran

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Human impact on land degradation has been reported by many researchers in recent years. This paper presents the results of several researches were conducted on gully erosion in the south west of Iran. Historical evidence such as topographic maps and areal photos with different serial times and scales, extensive field surveying and soil sampling were used in a five year period. The area of different land uses was measured on the topographic maps. The vegetation density was measured in the field using 1 sq.m quadrats. Statistical analysis was performed using regression method in SPSS software.

The results of this research indicated that gully erosion existed in a limited area on the sodic soil in the past four decades. Gullies formed on the croplands and alluvial plains around roads. They are 5 meters wide and 3 meters deep. After the urban development and rangeland degradation from four decades before, gully erosion extended very rapidly. Historical evidence indicated that the area of gully erosion increased up to 3 folds. Most of the important gully sites were located near populated area and degraded croplands.

Statistical analysis indicated that two variables, area of bare land and length of roads, were the most important factors controlling gully area in this part of Iran. In some regions, the area of bare land and in the others the length of roads played as the most important factor controlling gully erosion.

Comparison of the effect of vegetation density on gully erosion in a homogenous soil indicated that gully erosion appeared where vegetation cover decreased below 20 percent. It implies that with increasing vegetation cover higher than 20 percent on the degraded lands, it is possible to mitigate gully initiation and development.

The results of another research with flume experiment on different land uses including pasture, native rangeland and cropland indicated that land use change: from rangeland to cropland increased the chance of gully formation. Exclosure of rangeland had a significant impact on preventing gully erosion in an arid ecosystem with sandy loam soil.

Keywords: land use, soil, gully formation, arid ecosystem, Iran, human impact, land degradation

Variability of sediments deposited in riparian forests with different stages of development

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Agricultural practices in the state of São Paulo – Brazil, are directly responsible for the suppression of the natural vegetation cover and soil degradation. The natural vegetation was substituted by coffee, pastures, citrus and sugar-cane crops, over centuries of occupation and land use. The native forest restoration prevents soil erosion and reduces environmental impacts. Riparian forest traps sediments transported by „splash” and runoff. Sediment deposition in riparian zones depends on rainfall, geomorphology, original soil characteristics and management. Sediment distribution paths in riparian zones reflect the deposition dynamics and the type of deposition event. Three transects located in riparian forests with different stages of development were chosen in order to study sediment deposition processes in the county of Iracemápolis, state of São Paulo, Brazil. The riparian forests presented the following stages of development: a) natural degraded riparian forest, b) 16 year old restored riparian forest, and c) 7 year old restored riparian forest. In order to study the deposition processes macro and micromorphological analyses, as well as particle size distribution using Folk & Ward parameters, were done. Soil samples were dispersed with sodium hexametaphosphate and water. This last technique was done to simulate field transport conditions. The particle size distribution results, together with the field and laboratory morphological analyses, showed an irregular and non-uniform sediment deposition. This deposition process suggests the occurrence of high intensity erosive events that produce high amount of sediments and runoff characterized by a turbulent flow. Land use changes significantly affect this type of deposition. The great variability in the sediment physical attributes is a function of the deposition dynamics, slope angle and forest cover. Sediments deposited inside the different riparian forests were all concentrated in the upper portion of the riparian forest. The deposition width varied according to the development stage of the riparian forest. In the restored riparian forests sediment deposition was dislocated 27m upslope inside the forest when compared to a non restored riparian area.

Protection from soil erosion through calcium phosphate precipitation

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An environmental friendly method to protect surface soil from erosion has been developed. The method involves in situ precipitation of a sparingly soluble salt namely calcium phosphate, which binds together the loose soil grains. The issues that the proposed method has to face are, firstly, to enhance soil's strength against strains of raindrops' fall and reduce the amount of detached grains, which are washed away by runoff. In addition sufficient infiltration of water and aeration of soil should be maintained past the salt deposition. The anticipated gradual dissolution of the deposited phosphate salt with time is expected to fertilise soil, enriching it with P, Ca and K ions, which are important nutrients for the growth of plants. The polymorph of calcium phosphate investigated with respect to soil deposition was dicalcium phosphate dihydrate (DCPD). A series of experiments had been done prior to investigate the kinetics of the precipitation of DCPD in the presence of soil in a batch system and the optimum conditions of precipitation were chosen so that DCPD was precipitated spontaneously by mixing KH_2PO_4 and CaCl_2 in soil environment. The parametric investigation included direct visual observations of crystal growth within a glass micromodel in order to specify whether nucleation of DCPD crystals is initiated selectively on the soil grains. The information obtained was applied in an indoor test land plot, having total area of 1m^3 , filled with crusted and sieved top soil from a Greek agricultural region (43% sand, 46% silt, 11% clay). The solutions were sprayed on soil, which was then left to obtain its natural moisture. The method was tested under simulated rainfall of different intensities. The splash, runoff and infiltration rates and the improvement of soil shear strength were measured. Results of the present work showed that the precipitation of DCPD is a promising application against erosion phenomena.

The contribution of biogeotextiles to sustainable development and soil conservation in European countries: The BORASSUS Project

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Field and laboratory experiments has shown that geotextile mats made from palm leaves are an effective, sustainable and economically viable soil conservation method, with huge global potential. The three-year (2005-08) EU-funded BORASSUS Project (Contract Number INCO-CT-2005-510745) is evaluating their long-term effectiveness in controlling soil erosion and assessing their sustainability and economic viability. These experiments are in progress in 10 countries, both in the 'industrial north' (in Europe) and in the 'developing south' (Africa, South America and South-East Asia). This paper discusses the significance of geotextile palm mats in European countries (Belgium, Hungary, Lithuania and the U.K.).

The geotextile mats were effective in reducing splash erosion, runoff and soil erosion on arable sloping land in Shropshire, U.K. The use of Borassus-mats on bare soil reduced soil splash height by ~31% and splash erosion by ~42%. The application of Borassus-mats as complete cover on bare soil reduced runoff by ~49% and soil erosion by ~75%. Borassus and Buriti mats as 1 m buffer strips reduced runoff by ~56 and 34%, respectively, and soil erosion by ~83 and 77%, respectively.

Results from selected types of vineyards in Hungary suggest that the geotextile mats are effective in reducing soil erosion, particularly during intense precipitation leading to high runoff. The geotextiles mats are also helpful in maintaining moisture and temperature levels in the surface soil at levels particularly conducive to the growth and establishment of young plants. Geotextile mats were effective in encouraging the establishment and growth of natural vegetation, thereby reducing erosion in roadside slopes in Lithuania.

Simulated experiments in controlled conditions in Belgium suggest that palm-leaf geotextiles are effective in increasing infiltration rates and reducing interrill runoff and erosion rates on medium (i.e. 15%) and steep (i.e. 45%) slope gradients.

Effectiveness of geotextiles mats when used as technical materials for the construction industry in ground strengthening was investigated. Generally, the tensile strength of the Buruti mats was approximately twice that of the Borassus mats. The tensile strength of the palm-leaf geotextile mats is influenced by the mat strip formation pattern.

Research and development activities of the Project have improved our knowledge on the effect of palm geotextile mats on the micro- and macro- soil environments and at larger scale through controlled laboratory and field experiments in diverse environments.

Evaluation of erosion hazards in a semi arid area of Morocco

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The assessment of soil erosion hazard is an important aid to land evaluation and land use planning. The importance of erosion and erosion factors studies and the proposition of land and water management methods to reduce soil loss and increase soil fertility should interest all Moroccan regions.

A methodology based on the use of GIS techniques and the Universal Soil Loss Equation (USLE) using the rainfall erosivity, the slope and the soil erodibility factors; was realized for the Ben Ahmed region and has permitted the establishment of land zoning by producing the erosion hazard, the slope and soil erodibility maps. The surface evaluation showed that 40% of the land has a moderate to very high erosion risk. 88% of the soils have in deed a moderate to high erodibility.

The study shows also that:

- it enables a regional maps of erosion hazard to be constructed relatively quickly using locally available data.
- it can provide regional map of erosion hazard at a more detailed scale, which can be used in the conservation planning programmes.

Rôle de la variation spatiale et temporelle des états de surface SUR la genèse des écoulements sur les sols en milieu cultivé méditerranéen CAS du Bassin versant d'el gouazine (Tunisie centrale)

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Les milieux cultivés méditerranéens présentent une diversité de climat et de sols qui impliquent une grande disparité au niveau du comportement hydrologique et des potentialités agricoles. La variation spatiale et temporelle des états de surface (EDS) est considérée comme une information capitale pour la compréhension de la genèse des écoulements à l'échelle de la parcelle ou des bassins versants (Corban, 2006). L'étude hydrodynamique des sols sous pluies simulées en Afrique de l'Ouest, montrent l'influence de 3 variables sur le comportement des sols à l'infiltration (Casenave et Valentin, 1989): le sol, la végétation et l'organisation superficielle.

L'objectif de ce travail est d'étudier le fonctionnement hydrologique des sols cultivés de la dorsale Tunisienne et l'établissement d'une typologie des EDS des sols cultivés méditerranéens (description, typologie, hydrodynamique dans le temps ruissellement, infiltration et érosion).

L'étude s'applique dans 4 bassins versants (B.V) représentatifs des agrosystèmes de la dorsale tunisienne, répartis selon le climat, les sols et les occupations: Kamech au Cap Bon, Sbahia près de Zaghouan, puis El Hnach près de Siliana enfin El Gouazine près d'Ousseltia. Ce travail concerne les campagnes de mesures effectuées sur le bassin versant d'El Gouazine.

Le travail se base sur:

1. l'étude de la variabilité spatiale et temporelle des propriétés de surface des sols de B.V.
2. le développement, d'une méthodologie pour la caractérisation rapide des EDS des sols cultivés et leur variation durant l'année enfin la mise au point d'un modèle hydrologique.

Pour ce faire nous avons adopté la typologie des EDS élaborée par Andreiux et al. (2001) et validée pour le vignoble languedocien. Cette typologie est adaptée aux sols cultivés de la dorsale tunisienne. La démarche consiste à caractériser les différentes variables des EDS de parcelles choisies mettant en évidence le rôle spécifique de chacune sur le partage entre ruissellement/infiltration. Les mesures d'infiltrabilité sont assurées par simulation de pluies.

Les sites testés:

EG1 des sols peu évolués sablo-argileux en parcours mixte et herbacé et cultivé

EG2 sur un sol calcimagnésique carbonaté, caillouteux non cultivé et un site cultivé (EG21).

EG3 en amont du bassin versant, constitué par une rendzine caillouteuse sur croûte calcaire.

Cette étude confirme une fois encore l'importance des EDS sur la capacité d'infiltration des sols. Elle aboutit à l'établissement d'une première typologie des EDS définis par leurs propriétés hydrauliques. Sur le B.V d'el Gouazine, on a pu distinguer 7 grand types d'états de surface sur trois types de sol qui se différencient par la pierrosité, croûte, végétation, mottes.

Sur le site EG1 la caractérisation hydrodynamique met en évidence l'influence déterminante du facteur croûte structurale, les chaumes y montrent un comportement hydrodynamique particulier en effet le ruissellement est rapide et la charge est importante 4.5 à 6 g/l par contre pour les sites EG2 ,EG3 on voit l'effet des variables pierrosité et végétation, la charge solide pour les chaumes n'est pas importante: maximum 1g/l pour les rendzines et 0.4g/l pour EG2.

Pour le labour sur le site EG1 les sols sont à faible stabilité structurale ce qui entraîne une fonte précoce des mottes, la charge solide croit linéairement jusqu'à formation des croûtes enfin de ruissellement d'où stabilité à 2g/l. Sur les sites EG2 EG3, les labours ont une meilleure stabilité au début à cause de la végétation, du type de sol, de la pierrosité, la charge solide y est plus faible avec une certaine continuité.

Ainsi sur le site d'El Gouazine, on a mis en évidence l'influence déterminante des 4 facteurs principaux: croûtes, pierrosité, mottes et végétation. Ce travail a également conduit à l'élaboration d'une base de données des EDS et de leurs propriétés hydrodynamiques du bassin versant. Elle est constituée de 90 caractérisations EDS et de 4 campagnes de simulations de pluies (190 averses). L'hétérogénéité spatiale et l'évolution des états de surface du sol (EdS) se traduisent par une forte variabilité des propriétés hydrodynamiques des sols.

Wind erosion in the Czech Republic

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The influence of shelterbelts on the wind erosion was studied in the chosen areas of the Czech Republic.

Measurements of horizontal and vertical wind velocity profiles were done during the period of 2005–7. Three chosen shelterbelts of Southern Moravia, Czech Republic, were used for the analyses – locality of the areas of Dolni Dunajovice, Micmanice and Sucha Loz.

The measurements of horizontal wind direction and velocity were done in the same terms as the measurements of vertical wind profile. The sensors (anemometers) were fixed to posts in the high of 2 meters above the soil surface. The distances of the posts from the windbreak were 50, 100, 150 and 200 meters on the windward as so as leeward side. The momentary values of wind velocity were automatically registered in the fivesecond-measurement step into the datalogger memory.

In the case of measurements of air circulation vertical profile, the wind velocity in the heights of 0,5; 1,0; 1,5; 2,5 and 5,5 meters above the soil surface was measured. The posts with the sensors were situated 50 meters from the windbreak on the windward and leeward side. Momentary values of wind velocity were again automatically registered in the fivesecond-measurement step into the datalogger memory.

At the same time of the wind direction and velocity measurements, the soil sampling was done. The soil samples were used for soil humidity analyses and for the soil structure determination.

The considerable effect on the air circulation was found out through the ambulatory measurements at the chosen windbreaks, especially on the leeward sides of the shelterbelts. In average, the wind velocity was lower on the leeward than windward. The influence of the shelterbelts on soil loss was found out from the soil analyses.

Use of a GIS-interpolation method (ANOVA) for modelling and mapping soil-water erosion processes in Lebanon

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Soil erosion by water represents a serious threat to the natural and human environment in Mediterranean countries, including Lebanon which represents a good case study. This research proposes a conditional decision-rule interpolation based model to predict the distribution of multiple erosion processes (i.e., sheet, mass and linear) in a representative area of Lebanon from the measured erosion signs in the field (root exposure, earth pillars, soil etching and drift, and linear channels). First, erosion proxies were derived from the structural OASIS classification of Landsat TM imageries combined with the addition of several factorial erosion maps (e.g. slope, drainage) under a GIS environment. Secondly, erosion signs were measured in the field, and interpolated by the statistical *moments* (means and variance – ANOVA model) in the defined erosion proxies, thus producing quantitative erosion maps (tons/ha) at a scale of 1:100000. Seven decision rules were then generated and applied on these maps in order to produce the overall decisive erosion map reflecting all existing erosion processes, i.e. equality, dominance, bimodality, masking, aggravating, dependence and independence. The produced erosion maps are ranging between 0 and more than 1.8 tons/ha for sheet erosion, and 0 and more than 10.5 tons/ha for mass and linear erosion. They are fairly matching with coincidences values equal to 43% (sheet/linear), 48% (sheet/mass) and 49% (linear/mass). The overall accuracies of these maps were estimated to be 76% (sheet erosion), 78% (mass erosion) and 78.5% (linear erosion). The overall decisive erosion map with fifteen classes corresponds well to land management needs. The model used is relatively simple, and may also be applied to other areas. It is particularly useful when GIS database on factors influencing erosion is limited.

Keywords: water-soil erosion; conditional rule-based model; spatial interpolation; erosion proxies; GIS; field erosion signs; land degradation; Lebanon.

Influence of *Mahonia Aquifolium* population on erosion control in a mountainous area in Hungary

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After the regime changes of 1989 in Hungary, many farm owners faced problems of small sized farms (>1 ha) and lack of various resources such as farm equipments and machinery, well functioning trade market, etc. This led to many farms with great horticultural backgrounds to be abandoned, especially in mountainous areas where erosion control is essential. Drastic changes can occur on soil through property abandonment. We must take into consideration the local socioeconomic aspects as well as the problem of soil degradation as this will be a motivating factor towards preservation initiatives. Under horticultural management, *Mahonia aquifolium* was tested to determine its efficiency in water erosion control in mountainous conditions in Hungary. Surface runoff and soil loss were examined in 6 different plots; four cultivated and two controlled. The four cultivated plots had four different age brackets of *M. aquifolium* population; 4 years old in the 210m² area, 12 years old in the 340m² area, 20 years old in the 1656m² area and 25 years old in the 910m² area. These were also divided into two different land use types; longitudinal and perpendicular cultivation. Grassland and bare soil represented the two types of controlled plots. The slope angle of all fields varied between 13 % and 15 %. Soil loss and water runoff were measured after every rainfall event. The mechanical protection offered by its persistent, evergreen foliage and its litter covers, better protects the soil physical and chemical parameters when compared to the bare surface. The older population of *M. aquifolium* shows visible evidence of the soil accumulation at the root and stem part of the plant.

Keywords: erosion, runoff, mountainous agroecosystem, *Mahonia aquifolium*

Using fallout Cesium-137 to understand soil redistribution over agricultural landscapes

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While it is recognized that soil erosion is highly variable in space and time, studies of the redistribution of soil within a field or watershed are limited. Our studies focus on the use of fallout Cesium-137 to understand pattern of soil movement on the landscape. It is often assumed that eroding soils results in soil losses from agricultural fields; however, our studies indicate that most of the eroding soils are subsequent redeposited within same field. These studies also investigated the relationship between soil redistribution and soil organic carbon (SOC) patterns in agricultural fields. Cesium-137, soil redistribution, and SOC redistribution in agricultural fields were significantly correlated. Hillslope areas had significantly more soil and SOC loss than soils in toe slope positions (deposition). Soil erosion increased as gradient slope increases and soils on concave slopes had higher SOC than soils on convex slopes. These data suggest that soil redistribution patterns and topographic patterns can be used to help understand soil erosion and SOC redistribution patterns on agricultural landscapes. The strong significant relationships between the patterns of soil and SOC redistribution patterns in agricultural soils suggest that they are moving along similar physical pathways in these systems. Our study also indicates that geomorphic position is important for understanding soil and SOC movement and redistribution patterns within a field or watershed. Such information can help develop and implement management systems to increase SOC and reduce soil loss in agricultural ecosystems.

Conservation tillage systems – Soil-nutrient-and herbicide loss in lower Austria and the Mycotoxin problem

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Through the cultivation of corn, sugar beets, sunflowers, soybeans, potatoes, vineyards and fruit there are 450,000 hectares of farmland at risk of potential soil erosion in Austria. For this reason measures through the Austrian Program of Ecological Farming and a change in the mindset of farmers are being called for; not only for economic reasons but also ecological considerations to implement measures to prevent soil erosion. The increasing industrialization of farming in developed countries is pushing the norm toward large machines. This equipment is being increasingly found in arable farming areas of Austria and is implemented through collective or group farming. That leads to increasingly heavier loads being transported over the fields, causing an increased frequency in use of intensive tilling measures. The load capacity of arable farmland is therefore excessively stressed and through deep loosening of the soil measures the structural unbalance trying to be repaired, but success seems doubtful.

For this reason, the estates of technical agricultural schools in Lower Austria have been researching tilling methods for more than two decades (from 1994 on). Mulching and direct drilling are being successfully tested alongside conventional methods. Results from measuring erosion, together with the University of Agricultural Science, Department of Hydraulics and Rural Water Management, show reductions in soil erosion from mulching at 70 percent and through direct drilling at 83 percent. Similar tendencies can be seen by nutrient and pesticide loss. The change in yields through mulch tilling and also direct drilling are not significant, only because the wrong tilling methods for the given Mycotoxin levels are being pursued.

Keywords: erosion, tilling methods, mulch drilling, direct drilling, Mycotoxin

A recent history of Mediterranean wildfires and their influence on soil erosion

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Wildfires are one of the most threatening environmental hazards in Mediterranean areas, which – apart from the threat to human welfare and lives – produce a general deterioration of ecosystems affecting directly to landscapes patterns and structures, the hydrological cycle and the alteration of the soil erosivity.

In order to assess the impact of wildfires on soils, a spatial and temporal analysis of recent wildfires history, between 1993 and 2005, is undertaken using Geographical Information Systems techniques. Data consisted on map inventories of burned areas for each year of the time series; a reference moment of land use-cover distribution (based on aerial photogram interpretation for the year 1991) and two maps of soil erosion following USLE methodology: one simulating the pre-wildfire condition (actual erosion) and the second scenario simulating the post-fire situation with no vegetation cover (potential erosion).

Combination of different thematic layers have been undertaken in order to assess (1) the spatial and temporal dynamics of burned areas, (2) their comparison with the land cover map to estimate the cover type that has been lost through time and (3) the calculation of soil erosion losses assuming pre and post-wildfire vegetation conditions.

The methodology has been applied to the Autonomous Region of Valencia (SE Spain), a territory of 2.3 millions hectares. Results show that in the 13 year period almost 10% of the Region has been burned, and that only less than 2% of the total area has experienced a second fire event, being negligible zones with a third fire incidence. In terms of soil covers, most fires have occurred on natural areas (91% of the surface). Of those, 40% can be understood as climax autochthonous vegetation formations.

Soil erosion rates also show an important increase between the simulation scenario for 1991 and the scenario with no vegetation cover conditions. Although that should be taken as a first approach result, the dramatic increment of the erosion rates suggests the need of further detailed research taking into account the pre and post-fire scenarios.

Soil conservation using palm-mat geotextiles on loamy sand soils in the United Kingdom

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Geotextile-mats constructed from *Borassus aethiopum* (Borassus Palm) and *Mauritia flexuosa* (Buriti Palm) leaves have the potential to decrease soil erosion. In the U.K., field experiments are being conducted on the effectiveness of employing palm-mats to reduce soil erosion at Hilton, east Shropshire (52.033°5.7' N, 2.019°18.3' W) since 2002. The soil is loamy sand with 1.9% soil organic matter content. Twelve plots (each plot measuring 1.0 x 1.0 m; 6 plots were completely covered with Borassus mats, and the other 6 plots were bare) were established to study the effects of geotextile-mats on splash erosion. Soil splash was measured during 10/06/02-09/02/04 (total rainfall = 1038 mm) in each plot. Eight runoff plots (10 x 1 m on a 15° slope) were used, with duplicate treatments: (i) bare soil; (ii) grassed, (iii) bare soil with 1 m Borassus-mat buffer zones and (iv) completely covered with Borassus mats. Runoff volume and sediment yield were measured after each substantial storm from 25/03/02-10/05/04 (total rainfall = 1320 mm). Results indicate that palm-mats on bare soil significantly reduced total soil splash erosion by ~50% over bare soil (34.2 g m⁻²). Total runoff from bare plots was 3.58 litres m⁻² and total sediment yield was 8.58 g m⁻². Geotextiles as buffer strips reduced runoff by ~36% and soil erosion by ~57%. Total soil loss in the completely covered plots was only ~16% less than the buffer zone plots. To confirm the results, another set of runoff experiments have been in progress at Hilton, with an additional treatment (bare soil with 1 m Buriti-mat buffer zones) over the earlier experiment. Results (08/01/07-24/08/07; total rainfall = 702 mm) indicate that total runoff from bare plots was 21.2 litres m⁻² and total sediment yield was 2302 g m⁻². Borassus and Buriti mats as 1 m buffer strips reduced runoff by ~ 86 and 61%, respectively, and soil erosion by ~93 and 98%, respectively. Buffer strips of Borassus mats are as effective as complete cover of the same mats. Thus, Borassus-mat (buffer strips) cover on vulnerable segments of the landscape is highly effective for soil and water conservation on temperate loamy sand soils.

Magnitude and dynamics of runoff and sediment transport in the Geba River Catchment, Northern Ethiopia

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The Northern Ethiopian Highlands are a fragile environment, characterised by steep slopes, intense rainfall and a sparse vegetation cover. The extreme poverty, stagnating technology and high population and livestock densities induce serious soil erosion and degradation problems in these Highlands. This not only leads to lower crop yields but also has important off-site consequences: the life expectancy of many dams and reservoirs (used for power generation or water supply in the dry season) is threatened by massive sedimentation. Although these problems demand for a thorough solution, not much is known about the magnitude and dynamics of sediment transport in the Northern Ethiopian Highlands.

Therefore, an intensive measuring campaign was conducted during the rainy season of 2006 in ten subcatchments of the Geba (drainage area: 5180 km²), a tributary of the Tekeze. The catchments had drainage areas between 120 km² and 4330 km² (mean: 1068 km²) and represented a rather variable range of environments. Annual rainfall ranges from 700 mm to more than 1200 mm.

The estimated area-specific sediment yields (SY) varied between 400 and 2500 ton/km²/yr (average: 1404 ton/km²/yr). These values were obtained with rating curves, based on manual discharge and suspended sediment concentration measurements. The error on these yields was assessed by Monte Carlo simulations and varied between 6 and 48 %. In some cases, however, the uncertainty is larger, since our sampled population was not always fully representative for all the events. A dominant part of the sediment is transported during short but intense flash floods at night. Sampling these events is very difficult and often even dangerous. A few flash floods were, however, monitored in detail. The results showed a clear positive hysteresis effect.

To explain variation in SY between the catchments, a semi-quantitative model (FSM) was adapted. Topography, soil cover, lithology and the presence of gullies explained a large part of the observed variance (63%). Insufficient information on soil and water conservation practices (SWCP) was available. Nevertheless our results strongly indicate that SWCP might be a relevant factor in explaining SY. Although further refinement is needed, semi-quantitative models seem a promising tool for predicting SY in a cheap and efficient way when no detailed data is available.

Best management practices for controlling erosion and sedimentation during electrical transmission line construction on Steep Terrain

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Duke Energy Corporation, based in Charlotte, NC, USA, is building a 161,000 kV transmission line in the North Carolina mountains. Elevations range from 360 meters to 1695 meters. The terrain is rugged, with slopes of access roads to the tower sites frequently exceeding 25%. Furthermore, the physical setting is rich in aesthetic quality with forests, streams, and lakes. Duke Energy is utilizing a variety of Best Management Practices (BMPs) to comply with state laws and, more so, to demonstrate good environmental stewardship by minimizing the adverse impacts of soil erosion and sedimentation on the natural resources and scenic beauty of the area.

The primary BMP used on land-disturbed sites throughout the transmission line corridor is revegetation by seeding of grass/legume mixtures. Newly seeded areas are mulched with straw and excelsior blankets. Sediment control on the access roads is achieved through water control structures and sediment traps. These measures also prevent sediment contamination of pristine bodies of water. A combination of BMPs is often required to stabilize slopes and minimize off-site impacts. Security measures, e.g., gates, fences, are used to restrict public access to the transmission line right-of-way, thus avoiding damage to the access roads and installed BMPs.

Wetlands are critical environmentally-sensitive areas in the transmission line corridor. Permission to build towers in wetlands is obtained through mitigation. High-density polyethylene (HDPE) mats are used to transport heavy equipment into wetlands for construction purposes. The mats are removed when construction is completed. The natural vegetation restores itself in the previously matted areas.

Soil erosion and the possibility of its control in the watershed of the water reservoir “Prvonek”

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The reservoir “Prvonek“ was built for water supply of the towns Vranje, Vranjska Banja-Spa, Bujanovac and the surrounding villages in south-east Serbia.. The dam construction on Vranjsko-Banjska River, about 9 km upstream of Vranjska Banja- Spa, was finished in 2003. The Vranjsko-Banjska River watershed upstream of the reservoir is in the hilly-mountainous area of south-east Serbia, known for its intensive processes of water erosion. As the consequence of erosion, great quantities of sediment from the watershed reach the hydrographic network of the Vranjsko-Banjska River and threaten to reduce significantly the designed volume and the life of the water reservoir. Also, the deposited sediment in the water reservoir causes a series of damage, which can be defined as ecological risks, e.g.:

- mechanical pollution of water caused by turbidity, leading to eutrophication of the lake,
- chemical pollution of water, because various chemical substances get into water with the suspended sediment: biogenic elements, organic matter, mineral and organic fertilisers, pesticides etc.

This paper presents the study results obtained during the period 2003 - 2005 aiming at the assessment of the state of erosion in the watershed, sediment transport as well as the possibility of erosion control and the reservoir protection against silting up and all other damage caused by sediment. The study shows that correctly selected and performed ECWs can reduce significantly the intensities of erosion in the watershed of the reservoir “Prvonek“, and thus also reduce the deposition of sediment in the reservoir and reduce to a minimum the potential damage.

Keywords: soil erosion, sediment transport, water reservoir, damages, erosion control

Use of ^7Be measurements to investigate the effectiveness of woody trash barriers in reducing sediment loss after forest clearcutting and their optimum spacing

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The export of forest products from Chile has increased by 69% during the last five years and now accounts for approximately 10% of Chilean exports. As a result, the forestry economy in the country is characterised by intensification and expansion of plantations. This situation has increased awareness of soil erosion problems and encouraged the forest companies to promote soil conservation practices. In order to support the provision of improved guidelines for the design and use of woody trash barriers installed along contour lines to reduce soil erosion and sediment loss, a study has been undertaken to assess the efficiency of such trash barriers and to establish the optimum spacing for the barriers.

The study site is located within a harvested forest area situated in south-central Chile of Valdivia (39°44.5'S, 73°10'W; 2300 mm y⁻¹ rainfall). Attention focussed on an area exposed to highly erosive precipitation events immediately after final forest clearcutting and the installation of trash barriers. Measurements of the cosmogenic radionuclide ^7Be ($T_{1/2} = 53$ d) in soil were successfully utilised to investigate the influence of barrier spacing on the effectiveness of the barriers in reducing erosion and sediment transfer towards streams. Soil redistribution associated with a period of heavy rainfall was investigated on three plots 7.5 m wide and respectively 15, 30 and 45 m long, oriented parallel to the predominant direction of surface runoff and bounded up- and downslope by woody trash barriers. The period of heavy rainfall (650 mm in 39 days) occurred between May and June 2006, and was preceded by a prolonged period with low rainfall. The results of the study indicate that a separation of 15 m between barriers is the most effective in reducing the net erosion and sediment delivery ratio (0.09 kg m⁻² and ~20%, respectively), when compared to spacings of 30 and 45 m (0.3 kg m⁻² and ~30% to ~80%, respectively). The results obtained using the ^7Be technique were validated against direct measurements of soil loss or gain obtained using erosion pins.

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Selection of important soil quality attributes through principal component analysis in north –western tract of India

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Runoff and soil losses vary from 35-45 per cent and 25-225 t/ha /yr respectively in north-western tract of India. Erosion on cropland thus degrades the productivity of soils both qualitatively and quantitatively. The selection of important soil quality attributes shall prove useful in devising the appropriate technology to reduce the menace of erosion in a short span of time. Keeping these points in view, one of the mathematical techniques employed is principal component analysis to select important soil quality attributes. The soil samples were collected and analyzed representing point location or soil depths 0-5, 5-10, 10-15 , 15-30 and 30-60 in fenced and without fenced treatments replicated thrice at Zonal Research Station for Kandi Area , Ballawal-Saunkhari, Hoshiarpur. The variables were checked for multivariate normality and homogeneity of covariance matrices. The variables were grouped into chemical and physical categories. Multiple analysis of variance was the first step used to determine whether there were significant management effects on at least one of the chemical and physical variables assessed. After this criterion was met, analysis of variance (ANOVA) of individual parameters was done. The variables for which management F-Statistics was significant at $P < 0.05$ and that had $CV < 50$ were retained for further analysis. The retained chemical and physical variables were then assessed using principal component analysis for further screening .The number of components was determined by the eigenvalue one criteria and the factorial analysis was found to be significant at 5 per cent of the total variance. The 92 per cent of variance (proportion) was explained by the first two components on selected seven chemical attributes of soils. The principal component one and two explained 55 per cent and 36 per cent of variance respectively. The rotated scores of principal component one positively related are: organic C, total N, available P and citric acid soluble K. However, first four principal components explained 78 per cent of the total variance in physical attributes of soils .The principal component one related positively with total porosity, penetration resistance and saturated hydraulic conductivity and negatively with bulk density. The principal component analysis indicated that the most useful indicators to assess the soil quality in relation to soil erosion are in the area are: organic C, total N, bulk density and the porosity.

Amenagement et techniques traditionnelles de conservation de l'eau et du sol dans le Nord Ouest Algerien

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L'érosion, phénomène bien connu en Algérie, est un vieux problème où l'homme s'est entraîné à en réduire les effets néfastes depuis bien longtemps. Les zones de montagnes qui constituent un enjeu socio-économique important restent les plus touchées par ce phénomène érosif. Ainsi les équilibres entre la végétation, le sol et l'eau se trouvent perturbés. Le défrichement, le surpâturage, la mise en culture des terres en forte pente et les séquelles de la colonisation sont autant de facteurs liés à l'homme qui ont accentué le phénomène de dégradation.

Environ 6 millions d'hectares sont exposés aujourd'hui à une érosion active avec pour conséquence une baisse chronique des rendements agricoles, des inondations et une réduction des ressources hydriques. La subsistance des populations est de plus en plus menacée par l'accélération de ce phénomène. L'homme a accumulé depuis longtemps les traces de sa lutte contre l'érosion, la dégradation des sols et le ruissellement, en vue d'améliorer la gestion de l'eau et la fragilité des sols. Les méthodes traditionnelles apparaissent aujourd'hui comme étant strictement liées aux conditions socio-économiques.

Nous avons voulu dans ce travail, faire un diagnostic de quelques techniques et aménagements antiérosifs traditionnels représentatifs de la région du point de vue du comportement physique (stabilité, fiabilité), de l'efficacité antiérosive, de la production agricole, de la gestion des eaux et de l'impact socio-économique vis-à-vis des populations rurales.

Une centaine d'aménagements traditionnels répartis à travers le Nord-ouest de l'Algérie en montagne et en plaine ont fait l'objet de cette étude. L'approche méthodologique repose essentiellement sur des observations, des enquêtes directes sur site ainsi que sur l'analyse qualitative et quantitative des techniques et méthodes traditionnelles utilisées.

Après plus de 15 années d'observation sur les différentes techniques traditionnelles représentatives de la région, ce sont surtout les structures en pierres sèches agencées (murets, terrassettes, ...) souvent associées à une végétation fourragère ou arbustive délimitant de petites parcelles (moins d'un hectare) continuellement exploitées (3 à 4 saisons) avec une gestion ingénieuse (fumier, "mulching", culture en billon, utilisation de semences et variétés locales adaptées, mécanisation réduite) qui ont le meilleur comportement. Ceci explique la pérennisation de ces techniques et leur extension à des zones aux conditions parfois extrêmes (très fortes pentes).

D'autre part, certaines techniques de gestion des eaux superficielles en montagne et en plaine ont montré un rôle positif à plus d'un titre:

- maîtrise des écoulements superficiels (canaux d'irrigation, séguia,...)
- stockages des eaux superficielles (madjen, sed, jeboub,...)
- dérivation des eaux de crues
- amélioration de l'infiltration.
- amélioration de la fertilité (utilisation du fumier,...)

Il apparaît clairement qu'il est aujourd'hui nécessaire de privilégier, dans le cadre des nouvelles stratégies de conservation de l'eau et du sol, toutes ces techniques ancestrales qui ont prouvé leur efficacité à travers le temps, mais surtout celles que les agriculteurs en montagne comme en plaine ont adoptées, adaptées et maîtrisées.

Mots clés: Algérie, Techniques antiérosives traditionnelles – Montagne

Measurements and analysis of sediment transport capacity in shallow overland flow

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Sediment movement on upland areas is a highly complex process influenced by many factors of a hydraulic, surface topography, and sediment property nature. For several years, research has been underway to better understand the micro-mechanical nature of sediment movement in shallow flow. Experiments have been conducted that consist of measurements of particle velocity and particle concentration on the mode of transport and the corresponding associated transport rates. Results show that the sediment movement is not a random phenomenon but occurs in a highly organized manner ranging from saltation of sediment particles at very low concentrations to movement in a sediment wave like pattern. These waves may transgress into meanders depending on the channel bed conditions and grain addition rate into the stream. Sediment measurements indicate a sudden loss in transport capacity during the transition from saltation to bed configurations. This paper discusses the experimental findings from a steady state flow regime to which sorted sediment was added at a controlled rate at the upstream of a 7 m long and 10 cm wide channel of about 1° slope steepness. The experiments were complemented with an analysis of two-layered flow regime using the continuity and momentum equations. The bottom layer consists of sediment-laden flow, the top layer of clear water. An expression was derived for the critical concentration at which sediment waves, that have formed following saltation, transition into a meander. Reasonable agreement was obtained between predicted and observed solid concentrations.

Predicting runoff for a RUSLE2 ephemeral gully calculator

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RUSLE2 provides robust estimates of average annual sheet and rill erosion from a wide range of land use, soil, and climatic conditions, but it cannot calculate channel erosion including ephemeral gully erosion. Estimation of ephemeral gully erosion within RUSLE2 has been identified as a priority need by user agencies. The RUSLE2 climate databases currently include only monthly averages for precipitation, temperature, and erosivity density (erosivity per unit rainfall), plus the location's 10-yr 24-hr precipitation depth ($P_{10y,24h}$). RUSLE2 uses this storm depth along with daily curve number estimates (a function of soil hydraulic class, soil biomass, soil consolidation, soil roughness, and soil residue cover) to compute runoff controlling sediment transport and deposition, contour failure, and backwater ponding upslope of barriers and buffer strips. Because routing runoff from a $P_{10y,24h}$ event downslope and through a channel every day would lead to excessive sensitivity of ephemeral gully erosion estimates to tillage frequency, we sought a smaller appropriate storm size. Index precipitation depths were adjusted until annual RUSLE2 runoff estimates matched the average of thirty-year AnnAGNPS runoff simulations developed using climate data from 26 U.S. locations (annual precipitation from 191 to 1420 mm) for each factorial combinations of four soils (soil hydrologic classes A, B, C, and D) and four managements (tilled fallow, tilled maize, no-till maize, and pasture). Surprisingly, a single storm size for a given soil and management combination resulted in a reasonable match across all locations. For example, scaling daily runoff from tilled maize by the RUSLE2 erodibility ratio yielded index precipitation depths across all 26 locations for the given soil hydraulic classes of (mean \pm SE): A – 26.6 \pm 0.9 mm, B – 17.9 \pm 0.5 mm, C – 15.8 \pm 0.3 mm, D – 13.2 \pm 0.3 mm. Several alternative RUSLE2 scaling methods, seasonal adjustments to the RUSLE2 curve number, and a simple water balance are being considered as ways to improve the monthly location-specific pattern match of RUSLE2 to AnnAGNPS runoff estimates. With the assumption that all monthly runoff will occur during one hour on one day, RUSLE2 will calculate average annual ephemeral gully erosion as the sum of erosion from 12 runoff events per year whose sizes are estimated from the existing RUSLE2 databases and whose sum approximates local average annual runoff.

Effects of polyacrylamide and gypsum on soil erosion and sediment transport

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This study evaluates the effectiveness of two popular soil amendments of gypsum and polyacrylamide (PAM), in minimizing soil erosion from one soil and one overburden (spoil) material of a mine rehabilitation site in Central Queensland. The treatments included an untreated soil (control), a gypsum application rate of 10 t/ha, an dry anionic PAM application rate of 40 kg/ha, and combined application of both amendments (PAM+gypsum) at the same rates above, all replicated three times. Rainfall experiments were carried out in the Griffith University's rainfall-runoff simulation facility on 9% slope, at the mean rainfall intensity of 120 mm/h and the duration of 30 minutes. Runoff and sediment samples were collected at certain time intervals during the experiments.

Total soil loss from the treated soil and spoil were significantly lower than for control. Total soil loss for soil were reduced by 37%, 42%, and 73%, respectively for gypsum, PAM, and PAM+gypsum treatments, compared to the control. Furthermore, total soil loss for spoil were reduced by 38%, 49%, and 69%, respectively for gypsum, PAM, and PAM+gypsum treatments, compared to the control. Results indicate that the use of gypsum, PAM, and the combination of both significantly reduce soil erosion from the soil and spoil from the mine rehabilitation site but the combination of the two gives the best results for both soil and spoil. The improved surface conditions on the treated soil and spoil contributed towards the reduction of soil loss. The soil amendments were also effective in maintaining a well-aggregated soil surface that minimizes detachment. The application of soil amendments on the slopes prior to the establishment of vegetation may be an effective way of reducing erosion and minimizing the offsite consequences of sediment transport prior to the establishment of a viable vegetation cover. These amendments appear to increase soil moisture thus helping the establishment of the vegetation cover as well.

Researches on regularities of water erosion in the mountain and hilly region of Jilin Province

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Based on the information provided by landsat TM remote sensing technique, combining the remote sensing information with geographic data, synthetic analysis with principal factor analysis, indoor interpretation with field checking, this study investigated the factors that affect water erosion disasters, find the principal factors that affect water erosion modulus with linear model theory. With parent material, effective soil layer thickness, soil type, landform type, slope gradient, length of slope, land-use type and vegetation coverage being independent variables, each of which served as qualitative factor, the above independent variables were respectively divided into 4, 4, 6, 5, 4, 4, 7, 6 levels. With water erosion modulus being dependent variable, the present writers, through further calculation, obtained linear model formal equation solutions and the hypothesis test results about the effect of each factor on water erosion amount. The results showed that among the earth surface factors that affect water erosion modulus in Jilin Province, the relationship between the three factors – parent material, land-use type, and vegetation coverage – and water erosion modulus, came to the remarkable degree at the level of 0.05. The increasing order of water erosion modulus in different parent materials was: rock<rock and clod <clod<loess. Among different land-use types in Jilin Province, the water erosion modulus of bare land was 6500 t/(km²·a) compared with which, the water erosion modulus of coniferous forest, broad leaved forest, mixture forest, shrub, grassland and cultivated land, being 250, 1440, 2366, 3446, 1188, 2917 t/(km²·a) respectively, decreased by 96.2, 77.8, 63.6, 47.0, 81.7 and 55.1%. With the increase of vegetation coverage, the water erosion modulus decreased remarkably. The soil and water conservation benefit of cultivated land coverage was equal to that of 30%-50% vegetation coverage. The formal equation solutions of factors could predict water erosion modulus at different sites, multiple correlation coefficient being 0.975. The study provides theoretical basis for preventing and controlling water erosion disasters in Jilin Province.

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Keywords: Soil and water losses, Water erosion amount, remote sensing technique, Mountain and hilly region, Jilin Province

Predicting vegetation buffer efficiency in reducing runoff transport of sediments and nutrients

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Vegetative buffer strips are widely used as a conservation measure to reduce erosion and transport of sediments and associated pollutants across landscapes. Buffers generally reduce sediment and pollutant loads through a combination of deposition and infiltration processes. The physical processes involved in sediment deposition by a stiff Vetiver grass buffer strip at low flow rates were examined in a series of experiments carried out in a 1x6m flume of a rainfall simulator. Experiments were carried out using sub-critical flows on three different soils introduced to flow path as slurry upstream of the Vetiver strip at 1, 3 and 5% slopes. Water and sediment profiles were measured at different time intervals while experiments were in progress. The strip caused a region of increased flow depth (backwater), upstream of the buffer, which increased in depth and decreased in length with increasing slope. As slope increased, sediment was deposited closer to the grass strip, moving into the grass strip at 5% slope. The buffer strip was less effective in reducing sediment transport as slope increased and differences between slopes were significant. These experiments quantified the reduction in sediment and particulate-sorbed nutrients from overland flow and data were used to test the newly developed model of GUSED-VBS (the Griffith University Soil Erosion & Deposition model-Vegetated Buffer Strip) for assessing and predicting buffer efficiency for sediment and sorbed nutrients. This model couples the hydraulics, sediment deposition and topography in order to predict water and sediment profiles upstream of a buffer strip with time. Unlike other models, GUSED-VBS simulates the evolution of the deposited layer by dynamically adjusting the bed elevation, the water profile and the flow velocity as a result of sediment accumulation. The model successfully predicts water and sediment profiles while masses of deposited sediment and sorbed nutrients (P, N) were generally simulated within 20 % of measured values. Further model development is in progress, which will incorporate infiltration to provide a coupled overland/vadose approach to simulating flow through vegetative buffers.

Gully erosion in relation to Land degradation in foothill region of Jammu, North India

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In view of great variation in steepness of this slope ranging from slightly gentle (1 to 2%) to steep slope (30% or even more) in Jammu and Kashmir state in North India, erosion is the major problem of soil husbandry. Soil erosion is creating great damage in the foothills of Siwalik belt of Jammu and Kerawas of Kashmir as well as in the middle and inner Himalayas, and trans-Himalayas. Even in a slope of 2 to 3 per cent in clay loam soil with 1400-1500 mm rainfall, there is loss of 106.5 tonnes (t) ha⁻¹ year⁻¹. In all the six districts of Jammu region, the damage to soil because of water erosion is considerable, especially in the tracts lying under Outer or Siwalik Himalayas, most of which occurs during south west monsoon season. The foot hills of Pir Panjal Himalayas and north Kashmir ranges have eroded to such an extent that top rich soil which supports vegetation has since been washed away, and what is left behind, is the unproductive mass of gravels, stones and pebbles. There is heavy formation of rills and gullies in these areas.

The cold arid zone of Ladakh and Warban region of Doda district have also a serious problem of soil erosion. The glaciers while moving from the perennial snow capped mountain peaks, bring with them a lot of refuse, wreckage and scattered bits which cause considerable soil erosion. Glacial erosion is reflected by furrowing, abrasing, cutting and scouring action of land mass. During hot season, the glaciers on melting create flash floods in the rivers, causing great damage to the sides of the river beds. The frequent occurrence of "U" shaped gullies in the Ladakh region reflects active nature of soil erosion. In addition to rill and gully erosion, the glacial erosion accomplished by plucking, grooving, scratching and chiselling is quite prevalent in higher Himalayas, particularly in Ladakh region and parts of Doda district of Jammu.

The soil erosion has converted most of the fertile soils of Jammu and Kashmir into barren, fallow and degraded lands. Recently about 32 per cent of the total geographical area of Jammu and Kashmir is found to be highly degraded. In fact, soil erosion is at once cause and effect of the depletion of the forests. The erosion of the top soil besides declining the soil fertility and crop productivity also results in a multitude side effects such as siltation or sedimentation in the water reservoirs, threats to means of communication owing to floods and increased run off with less infiltration and percolation. The topsoil carried off by the run off indeed chokes the rivers and creates floods. Excessive soil loss then results in premature sedimentation or siltation of water storage reservoirs. As for example, life span of Jyotipuram Dam in Reasi on the river Chenab has considerably reduced.

The most damage of all is the way the erosion of top soil and vanishing the vegetation, reduces the amount of water which would otherwise percolate into the soil and later on charge vital ground water acquires. There is urgent need to control soil erosion especially rill and gullies not only to improve agricultural production but also to manage the natural resources for the generations to come. This can only be possible through awareness of the local people, farmers and stakeholders about the consequences of erosion and cheap and feasible measures for controlling the erosion.

The Urban soil erosion control: A review

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Urban Soil erosion has been increasingly identified as a significant source of sediment and other suspended solids in surface runoff in many cities of the world. Sediment has been identified as the number one pollutant of surface waters. Numerous water-quality problems in urban aquifers and streams are associated with excessive sedimentation. This paper reviewed the advances in the urban soil erosion control home and abroad. The types and the properties of urban soil and water losses were concluded as well as the harms of soil and water losses occurred in cities. The factors that caused urban soil and water losses were analyzed. Finally, we put forward the technologies and practices to control the soil and water losses and made a prospect for the future research.

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Keywords: Urban soil erosion control, Review

A new methodology for velocity estimation in sheet and rilled overland flow using modified Manning's Roughness Coefficient

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Manning's roughness coefficient for flow over bare soil is needed in order to determine other hydraulic parameters such as flow depth and velocity in overland flow, parameters needed to calculate streampower and shear stress in erosion process studies. A modified equation of Manning's n was developed to estimate flow velocity in shallow overland flow in experiments undertaken in a 5.8 by 1 m flume of the Griffith University Tilting flume Simulated Rainfall facility and adopted data from the literature. Even with the flow of water over a soil surface in which roughness elements are well inundated, and in less erosive situations where erosional bed forms are not pronounced, the magnitude of resistance coefficients in equations such as those of Manning, Darcy-Weisbach or Chezy vary with flow velocity (at least). Using both original laboratory and field data, and data from the literature, the paper examines this question of the apparent variation of resistance coefficients in relation to flow velocity, even in the absence of interaction between hydraulics and resulting erosional bed forms. Resistance equations are first assessed as to their ability to describe overland flow velocity when tested against these data sources. The result is that Manning's equation received stronger support than the Darcy-Weisbach or Chezy equations, though all equations were useful. The second question addressed is how best to estimate velocity of overland flow from measurements of slope and unit discharge, recognizing that the apparent flow velocity variation in resistance coefficients is probably a result of shortcomings in all of the listed resistance equations. A new methodology is illustrated which gives good agreement between estimated and measured flow velocity for both well-inundated sheet and rill flow. Comments are given on the predictive use of this methodology.

Keywords: Flow velocity, Manning's equation, Darcy-Weisbach, sheet flow, rill flow

Erosion process in Ski Centers of Serbia

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Thanks' to investments in this tourism, on the territory of Serbia, start forth the new ski centers (Stara planina, Divčibare, Zlatibor - Tornik, Crni vrh). Parallel, with new ski centers, in Serbia, we have a several older ski centers like Kopaonik, Brezovica and Goc mountain.

Very sharp slope of terrene (near the 40%), large amount of precipitation (1000-1200 mm), adverse geological and pedological type of soil, displacement of biological cover (forest and grass), provoke erosion process (landslide erosion, small ridge, furrows and very deep gullies).

This paper will present erosion process at all those areas who once was an erosion areas, than cultivated, and for the very short time, influenced with men activities, became an areas with excessive erosion (deep furrows and gullies).

With good planning and landscape designing, with technical, biotechnical and biological erosion control structures, this areas will be protect by the erosion process and soil degradation.

Keywords: ski trail, erosion process, gully erosion

Numerical analysis of soil erosion and sediment yield of Alaki Chay basin and proposing fundamental approach for optimal management (Iran-Northwest Azerbaijan)

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The Alaki Chay basin with an area of 205 km² on the northwest of Tabriz city is located. There are vast extension of semi-resistant and unresistant litology formation such as marl, marly limestone, conglomerate with marl and sand, proclastic, and alluvial and alluvial in the basin. Due to the tectonically active high mountains (3000 and 3100 meter), and vast extension of potentially sensitive formation to erosion, intensive human activities, runoff led to intensive soil erosion and turbulence floods occurrence. The result of drainage system morphometric, basin coefficient shape and evaluation of sediment yield with Arnold, Arnoldus, Sepaskah, Furnier and...indicated the rate of soil erosion is very high in the basin. Annually sediment yield of basin 41121525 ton/hac/year and Average sediment yield of basin in per hectare evaluated 201.05 ton/hac and indicated rare of soil erosion via runoffs. Also the result of some climatic indices (such as Hydrothermal coefficient and soil wetness fluctuation), showed the basin very prone to gullification and runoff erosions. Related to increase of gradient caused decreased the superficial unresistant soil formation and then length and as well as number of Gully. There are negative significance with %95 confident and %46 correlation coefficient. In the warm seasons especially in summer stormy rainfall led to occurrence of flash drastic flood and often destroyed of villages and agricultural lands with reasonable damage. According to the climatic, geomorphology, tectonic condition, erosional systems and...some suitable methods and technique for management and decrease of soil erosion via runoff for Alaki Chay (Harzand chay) river basin proposed.

Keywords: unresistant formation, slope instability, soil erosion, basin management

Classification of gully erosion based on morphoclimatic and soil characteristics in the Northeast of Iran, Golestan province

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Designing control measures to mitigate gully erosion requires understanding and recognition of dominant processes acting on gullies and classification of gullied regions based on their morphoclimatic and soil characteristics. In this research, gully erosion with an area larger than 5 sq.km was recognized using historical evidence and field surveying. The climate of regions affected by gully erosion was determined by modified De-martons method. In each climate zone, two regions were selected and in each region at least three representative gullies were selected to measure fifteen variables. The variables include gully length, top and bottom width, depth of headcut, area of gully erosion, elevation above sea level, average annual rainfall, clay, silt, sand, SAR, Ca, EC and slope. Cluster analysis using average method was used to classify the regions affected by gully erosion. In order to compare similar groups of gullied regions, variance analysis and mean comparison were used in the SPSS software.

The results of this research indicated that six regions were affected by intensive gully erosion in Golestan province. The gullies were formed dominantly in cold and mild arid and semi-arid climates. The soil texture was dominantly silt loam. The depth of the gullies varied between 1 and 8 meters. The view plan of the gullies was linear and their headcuts view plan were rounded and digitated.

The results of cluster analysis classified gullies into three groups. The first group included the regions number 1 (Alagoul) and (Hajighosan) with the similarity level larger than 97 percent. Second group included the regions number 2 (Damagh) and 6 (Tamarghozi) with the similarity level larger than 95 percent. The third group involved regions number 3 (Maraveh-tappeh) and 4 (Arabgrahaji) with the similarity level larger than 57 percent. The important factors for separating homogenous regions include elevation above sea level, particle size (sand) and chemical soil properties such as Ca and Ec. The third group had longer, wider and deeper gullies in relation to other groups although there was no significant difference between them. The geology of the third group was loess and its land use was poor rangeland. This results indicate that overgrazing on Loess hilly areas in Golestan province produce more surface runoff and intensive deeper and wider gullies.

Keywords: gully erosion, morphoclimatic, soil, characteristics, Iran, Golestan, control measures, overgrazing

Assessment of the impacts of natural geotextiles on concentrated flow hydraulics and erosion processes

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Rills and gullies, caused by concentrated flow erosion, represent an important sediment source in many environments. Applying geotextiles on the soil surface is the most effective method to control erosion until a critical vegetation cover has been established. However, little is known about the impacts of (palm) geotextiles on the hydraulic, hydrologic and erosion characteristics of concentrated flow for a range of environmental conditions. Therefore, the objective of this study is to assess the effectiveness of four natural geotextiles in increasing the hydraulic roughness of the soil surface under concentrated overland flow and in reducing soil detachment rates by concentrated flow on an erodible soil and for a range of flow shear stresses. This study is part of the EU-funded BORASSUS Research Project.

All experiments are conducted in the laboratory using a 2m-long concentrated flow erosion flume. The treatments included: one soil type (i.e. Tertiary sandy loam); four natural geotextiles (i.e. Borassus, Buriti, Bamboo and rice straw mats) and one bare soil surface; six flow shear stresses (i.e. 4-40 Pa). All treatments had two replicates, so in total 90 experiments were conducted. During each experiment flow discharge, mean flow velocity and flow width were measured. Sediment-loaded runoff samples were taken during 5 s every 10 s in order to determine sediment concentration and net soil detachment rate. Flow depth, Manning's n, Darcy-Weisbach f, shear stress, unit length shear force, stream power and runoff rate were calculated.

Results indicate that all natural geotextiles significantly reduce mean flow velocities compared to bare soil surfaces; mean flow velocities were reduced by 35-44% compared to a bare soil. Darcy-Weisbach friction coefficients, ranging from 0.06-1.75, significantly increased for all geotextile treatments compared to a bare soil treatment. Net soil detachment rate ranges from 0.003-0.05 kg m⁻² s⁻¹ and decreases significantly on geotextile covered soil surfaces.

Assessment of Potential Soil Erosion Rates in India for Optimal Planning and Utilization of Natural Resources

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Land degradation due to soil erosion is a serious problem in the republic India. Soil erosion is a complex phenomenon governed by a large number of factors, such as rainfall erosivity, soil erodibility, slope, land use and conservation measures. The potential soil erosion rates for India were estimated by employing universal soil loss equation (USLE) on a large data set at 10 x 10 km grid size and dense network of recording rain gauge stations (133 in number) in the country. The analysis revealed that 44.83% of the geographical area of India had erosion rates more than 10 mg/ha/year, while about 13.59% area of the country is in very severe category of erosion rates (> 40 mg/ha/year) requiring immediate attention. Regional analysis revealed that Southern and Western regions of the country are less prone to soil erosion problem as compared to Northern, Eastern and Central India. The statewide analysis indicated that more than 40% of the geographical area of all the hilly states of the country together falls under severe (20-40 mg/ha/year) to very severe (> 40 mg/ha/year) categories. Among all the states, Sikkim is most seriously affected where nearly 91% geographical area of the state is under these two categories of erosion classes.

The areas under different categories of soil erosion in the country as assessed during the years 1992 and 2006 revealed that the percent area under broadly accepted soil erosion tolerance limit (≤ 10 Mg./ha/year) has declined by 12% during this period. It implies that 12% more area of the country has degraded further beyond the permissible limits in the past 14 years due to mismanagement of natural resources. The increase in area under severe (20-40 Mg./ha/year) and very severe (> 40 Mg./ha/year) erosion categories by 5.46 and 10.09 per cent, respectively during this period is highly disturbing. This is a wake up call for the country to suitably address this gigantic problem on priority basis which otherwise may hamper the pace of economic growth in general and sustainable development in particular. Realizing its importance, Government of India initiated soil and water conservation programmes since independence following watershed management approach. A total 45.44 m ha area has been treated across the country till March 2006 with a total investment of Rs. 170,340 millions and it is envisaged to treat about 63 m ha area in the country by the end of XIII Five Year Plan (2017-2022) at a huge investment of about Rs. 630,000 millions with active participation of primary stakeholders.

Management of soil erosion for sustainable crop production in the Central Andes of Colombia

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Water erosion associated with smallholder agriculture in steep lands has typically been addressed through the promotion of barrier techniques of soil and water conservation. However, amongst resource-poor farmers on tropical steep lands these approaches have rarely been adopted or effective. They have proved to be incompatible with small farmers' livelihoods and perceptions of the nature of the problem, and unsuited to their resources and capacities. Farmers' perceptions about soil conservation are strongly rooted in concerns about productivity and returns to labour. They are rarely concerned about soil erosion itself but rather to issues such as land shortages, land tenure, market opportunities and family food security. Within this context, a research and extension project was developed during a two and a half year period (June 2001-December 2003) with a threefold objective: *i*) reconcile farmers' and conservationists' concerns related to minimizing soil losses and runoff; *ii*) gain a better understanding of erosion processes on Andisols in steep lands; and *iii*) test different soil and water conservation alternative technologies (SWCAT) including interplanted crops, direct drill (zero tillage), selection and integrative management of "noble weeds" and management of crop residues as protective cover. Research and technology transfer were used in an integrated participatory approach with components of land husbandry and agrodiversity. Slope of the experimental site ranges from 35 to 67%. Results showed that water erosion risk of Andisols in Andean steep lands depends more on management practices than on rainfall erosivity and slope *per se*. SWCAT largely prevented soil losses and increased sustainability production. Relative soil losses equivalent to the USLE C factor range from 1.00 for bare soil to 0.0028 for blackberry inter-planted with maize (*Zea mays*) and beans (*Phaseolus vulgaris*), permanent cover, direct drill, selected covers of "noble weeds" and management of crop residues. Outcomes were promising such that the ultimate objective of empowering resource-poor local farmers to practice and manage alternative soil management systems in steep lands showed excellent potential. Adoption of SWACT could help to reduce degradation of even steeper lands where slash and burn practices are employed with very serious effects on environmental degradation. Results showed that erosion control and farmers' needs can be achieved simultaneously with benefits to both people and environment.

Mitigation options for phosphorus and sediment (MOPS): tillage practices to reduce erosion from arable fields

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The Defra funded MOPS (Mitigation Options for Phosphorus and Sediment) project is investigating a range of tillage treatments with potential for mitigating sediment and nutrient losses from arable land associated with combinable crops. Field monitoring is being carried out over three field seasons on fifty-two unbounded hillslope length plots at three field sites in the UK (Herefordshire, Staffordshire, Leicestershire) with contrasting soil types (silty clay loam, sandy loam, clay). At each of the three sites, trial treatments have been selected which are appropriate for each soil type. The treatments investigated include tramline disruption, the use of crop residues, minimum tillage, contour cultivation, and the use of beetle banks as vegetative barriers. The results from the first two field seasons show that phosphorus and nitrogen losses at all three sites are principally sediment-associated (>76 %), and that control of erosion is therefore important in mitigating nutrient losses from arable land. Tramlines are the main route of sediment transfer from arable fields, and treatments which reduce runoff and erosion within the tramlines have been found to be effective in reducing sediment and nutrient losses. The use of crop residues also significantly reduced runoff and sediment and losses from arable land, typically by 30-60 %. No significant differences were found between the other treatments at $p < 0.05$, due to the variability in runoff and erosion between events. However, both minimum tillage and cultivation on the contour reduced erosion compared to conventional tillage and up and down slope cultivation, and the use of vegetative barriers across the slope also appears to be effective as this reduces the slope length and promotes contour cultivation. The results from the 2007-2008 winter field season are expected to provide further evidence to support the effectiveness of different mitigation options in reducing soil erosion from arable land.

Contribution to the discussion on the origin of bright patches in loessic areas with Chernozems (Case study: selected part of the Trnavská pahorkatina Hill Land, Slovakia)

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Bright patches on the surface of loessic hill lands with Chernozems are widely spread in the Danube Lowland. So far the water and partly wind erosion were considered to be the main processes responsible for their creation while the role of tillage erosion was strongly underestimated. The objective of our paper is to contribute to the discussion on the origin of these patches. We tried to assess the relationship between the spatial distribution of bright patches and relief. DEM and derived DTMs were created using tools of GIS. Bright patches were identified on the basis of aerial photographs and orthophotomaps and database (with characteristics of patches) was built. On the basis of these sources the features of 777 bright patches were described and the relationships to relief parameters, occurrence of archaeological sites, old and current land use pattern as well as geomorphic processes were investigated. The study suggests that considerable part of patches, especially those of them that have regular, long and narrow shape and are linked with terrain edges, were formed mostly by tillage erosion. The origin of the second group of patches that are small, irregular and chaotically dispersed, is much more complex; they were formed very probably by combination of more processes typical for morphogenesis of loessic hill lands.

Investigating and Proposing a Methodology for Preparing Erosion Types Map by Using Remote Sensing and Geographic Information Systems

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Erosion features mapping is one of the basic maps in erosion and sediment studies and watershed management programs. For preparing soil erosion features map, a study was conducted in Kan-Sologhan and Jajroud sub-basins in north-west and north-east of Tehran, Iran. At the first stage, working units' maps were prepared from integration of data layers including: A) plant cover, geology and slope B) land-use, geology and slope C) land-use, rocks erodibility and slope and D) land-use, rocks erodibility and land units' layers in Kan-Sologhan sub-basin. For comparing the efficiency of four working units' maps, 53 control points were investigated. Results demonstrated that working units resulted in A, B and approximately C are not suitable for differentiating soil erosion features. Polygons working units resulted in D included of six units in which 66.6, 73.3 and 71.4% of control points had the same intensities of erosion features in three units and had similar erosion features in other three units. At the second stage, D working units map was compared with three maps of E) land units F) rocks erodibility and G) image photomorphic units in a broader basin of Jajroud. Erosion features intensities in 314 control points were controlled and ground truth maps of surface, rill, gully, channel and erosion types were prepared. Erosion maps were crossed with different working unit maps. Results showed that the accuracy of image interpretation method for preparing surface, rill and channel erosion maps was 86.4, 81.0 and 88.0%, respectively. For preparing gully erosion map, image interpretation and integrated layers methods had same accuracy, but integrated layers method had higher precision. The area of working units with the accuracy more than 90%, in integrated layers method was higher than image interpretation method in preparing gully erosion map. Regarding root mean squared error, accuracy and precision, land unit and rocks erodibility methods are not suitable for differentiating soil erosion types. The least coefficient of variation, consequently, greatest precision was related to image interpretation and integrated layers methods. In general, the best method for providing erosion types map is photomorphic units' map that has been derived from satellite imagery. Integration of land use, rocks erodibility and land units layers for providing gully erosion map have preference as compared with photomorphic units map.

Keywords: Erosion features map, Accuracy, Precision, GIS and RS

Soil erosion, carbon and nutrient elements leaching control by reduced tillage on Chromic Luvisol

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Soil erosion is recognized as one of the most serious soil degradation processes on the territory of Bulgaria. About 64% of the country's territory and 78 % of the arable land is potentially exposed to risk of water erosion.

It is well known, that on the arable lands most effective erosion control can be realized by applying of different soil protection practices like strip farming, grassed buffer strips, conservation crop rotations and tillages. The aim of the study was to establish the possibility of some reduced tillage to decrease erosion, carbon and nutrient elements leaching at sorghum and oat growing. The experiment was carried out during 2005-2006 on moderate eroded Chromic Luvisol. In a crop rotation sorghum – oat two tillage treatments were studied: for sorghum a₁ - deep spring ploughing to 23-25 cm, twice disking to 10 –12 cm, two cultivations during vegetation, and a₂ – no- tillage in spring, one disking, two cultivations during the vegetation; and two tillage treatments for oat: a₁ – double disking, and a₂ – no-tillage. For soil protection during the autumn-winter period growing of peas-barley mixture as winter pre-crop for sorghum was involved. All cultivations were done across the slope.

Runoff plots were built up on the experimental crops and tillage treatments. In runoff N0-3 and in soil loss C content, total N, and total P were determined.

The results showed best soil protection of reduced tillage at sorghum growing in comparison with conventional one, but the runoff in variants with reduced tillage was higher. Leached away with the runoff NO₃ – N was insignificant at both crops.. Leached away C and nutrients at sorghum were almost 2 times bigger than those from the oat. Decreasing the quantity of soil loss, reduced tillage at sorghum decreased and the quantity of leached away C and nutrients.

Keywords: soil erosion, conservation tillage, carbon and nutrient leaching

The evolution of catchment gullies in Studinet and Simila watersheds, Eastern Romania, during the last 25 years

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Classical gullies having leaf like catchments of more than 300 hectares (up to 579 ha) and located in Studinet (9678 ha) and Simila (96521 ha) watersheds, Tutova Rolling Hills, Eastern Romania, have a special impact on geomorphology in the area and, more importantly, on local social communities. A certain number of them have been approached in their entirety (taking into account the gully within its watershed in a systemic manner) and the information regarding vegetation cover, land use, morphometric parameters and geology has been updated in 2007. Data acquired during the field survey and especially the results of measurements made by ultimate RTK GPS equipment have been compared with information gathered from digitized topographical maps dating back in 1982.

The relief of the studied watersheds was divided in several physiographic regions (areas having similar geology, geomorphology, land use, climatic conditions, etc.) and that helped us identifying the factors that control the morphology and dynamics of gullies.

Aspects regarding the mathematical modeling by taking into account the influence of local geology and land use are discussed and have been approached unlike the general trend in the literature. The results of the field survey seem to confirm the idea of an areal (lateral) extension model.

Success of SPAW and WEPP in simulating accumulation and melt of snow

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Lack of a method to properly account for snowmelt runoff and erosion in the Revised Universal Soil Loss Equation Version 2 (RUSLE2) hampers use of the model in areas where there is a period of melting of snow accumulated during the winter. Because RUSLE2 relies on input data sets to drive the erosion process, we sought models that could effectively estimate snow accumulation and melt and provide data from which snowmelt erosivity databases could be developed. The SPAW and WEPP models were tested for ability to model snow accumulation and melt events from daily weather data collected from selected weather stations in cold or high elevation cropland areas of the western US, the northern Great Plains, the upper Midwest and the north-eastern US. SPAW snow accumulation and melt is based on average daily air temperature, with accumulation occurring at 0 and melt at 0.5 degrees C, respectively. Snow depths predicted with SPAW with these default values are generally less than observed and the snow pack is predicted to melt before observed. Adjusting the default temperatures in SPAW allows for a much better match to the observed data. The default routine in WEPP is based on maximum daily air temperature, with accumulation occurring when temperatures are at 0 degrees C or below, and melt occurring when temperatures are above -2.8 degrees C and other conditions are met. Simulated snow depths also tend to be less than the observed, and like SPAW, snow melts more quickly than observed. Both SPAW and WEPP miss significant snowfall events in their simulations, usually when the daily minimum air temperature is just below freezing. Simulations run with a modified WEPP routine based on minimum air temperature not only captured these missing events, but also estimated snow depths closer to the observed values and prolonged the period of snow cover.

The RUSLE2 daily disaggregated weather data were then used in SPAW to develop daily snow water equivalent accumulation and melt values for the selected locations. For most cold or heavy snow areas, reasonable estimates of timing of the accumulation and melt of snow were obtained. By totaling daily snowmelt and rainfall erosivity values, this approach will allow development of RUSLE2 erosivity databases that will estimate both snowmelt and rainfall-caused erosion.

Assessment on Wepp Model applicability to the Loess Plateau Of China

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Soil erosion prediction model provides a powerful tool for national soil erosion survey and soil and water conservation planning. At present, there is little information for assessing WEPP (Water Erosion Prediction Project) model application on the steep landscape in the world, especially there is a gap for assessing applicability of WEPP model at different crops in China. This paper used field observed data of runoff and soil loss from 14 runoff plots (including six slope gradients of 5°, 10°, 15°, 20°, 25°, 28°; four slope length of 10, 20, 30, 40 m with bare and fallow surface; and four crops of soybean, buckwheat, millet and potato) under 62 single rainfall events for eight years to assess the applicability of WEPP model to steep landscapes of the Loess Plateau. The main results were as follows:

Three files of climate, slope gradient and length, and crop management for running WEPP model were established. Based on analysis of sensitivity between soil parameters and runoff and soil loss, effective hydraulic conductivity, soil critical shear stress, and rill erodibility of three soil parameters were calibrated. Testing calibrated results used Nash-Sutcliffe model efficiency (ME) found that calibrated results were reasonable.

The application of WEPP model at different slope gradients from 5-28° and slope lengths from 10 to 40 m with bare and fallow surface was assessed. The results showed that WEPP model has high simulated accuracy for event runoff and annual runoff, and event soil loss and annual soil loss. ME of the event runoff and annual runoff, and event soil loss and annual soil loss were more than 0.76. Simulated values of average annual runoff and soil loss were accepted, relative errors of average annual runoff were 5%~6%, and relative errors of average annual soil loss were 18%~21%. I30, PI30 and \sum PI30 had a great effect on simulated results by WEPP model. In addition, comparing to measured values, the changes of simulated runoff with an increase of slope gradient and length were not sensitive, but it were sensitive for soil loss simulation.

The application of WEPP model at different crops of soybean, buckwheat, millet and potato was assessed. The results showed that ME of event and annual runoff and soil loss at different crops reached to 0.51; related errors of average annual runoff and soil loss were 31.24% and 23.04%, respectively; which demonstrated that WEPP model could be used to simulate runoff and soil loss from steep croplands.

This research results not only broadens the scope of the WEPP application on the steep landscapes, but also provided methodology for developing Chinese soil erosion prediction model.

Keywords: WEPP, Runoff, Soil erosion, Application, Hilly-gully region of the Loess Plateau

Soil erosion modeling for two recently burnt eucalypt slopes: comparing MEFIDIS, MMF and USLE

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The work to be presented is being carried out in the framework of the EROSFIRE project (POCI/AGR/60354/2004), funded by the Portuguese Foundation for Science and Technology (FCT). Ultimately, the project aims at assessing the performance of the Universal Soil Loss Equation (USLE), in comparison to that of other current soil erosion models, for predicting soil erosion in recently burnt forest stands in Portugal. Formulated in a somewhat different way, the project wants to evaluate the application of USLE that underlies the “Soil losses after the forest fires of the summer of 2003”-map produced in 2003 by the Portuguese Water Institute (INAG). Model comparison will include, besides other USLE variants, the “Morgan, Morgan & Flinley”-model and MEFIDIS.

For logistic reasons, the project has concentrated its efforts on the commercial Bluegum plantations that currently dominate the hills and mountains of north-central Portugal. Four slopes covered with eucalypt trees were selected immediately following a wildfire in early July 2005, and two more following a wildfire in late August 2006. At each site, four unbounded, slope-scale plots were installed as soon as possible after the fire, and monitored at weekly intervals till July 2007 or, in the case of the 2006-sites, repeated disturbance. In addition to runoff measurement and sampling for laboratory analysis of sediment and organic matter concentrations, soil cover and topsoil characteristics like moisture content and water repellency were monitored at frequent intervals, using three to five sample points located along transects. More incidental ancillary data gathering included topography, fire-induced vegetation damage, soil profiles and soil properties like texture and organic matter content.

The proposed presentation will focus on two neighbouring Bluegum stands burnt in 2005 and on the first year following the wildfire. The main difference between the stands is their pre-fire land management, one site having been ploughed in downslope direction and the other lacking evidence of mechanical ground operations. Data analysis and especially modelling is still in progress but the results for the ploughed slope show low overall yearly runoff coefficients (1-2 % of about 1100 mm rainfall) and low overall soil losses (< 0.1 t/ha.yr). Whilst more or less standard USLE predictions far exceed these measured losses, those of INAG's variant appear to be considerably closer but their exact computation still requires confirmation.

Evaluation of efficiency of erosion control practices

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Natural conditions on the territory of the Czech Republic are suitable for the accelerated soil erosion which can be a danger. During the last 40 years drastic changes brought by intensive collective farming system and soil management have greatly affected soil losses and have caused acceleration of the erosion phenomena. At present, complex land consolidation is important method for solving of these erosion problems.

Optimum spatial and functional delimitation of soil erosion control practices in the landscape is one of the basic steps in land use planning. However there is no universal method how to choose and suggest the optimal soil conservation practices in certain area, as it depends on many various criteria according to the local conditions.

When solving soil erosion control in a certain area soil management and organizational practices themselves are mostly unable to restrict substantially a surface runoff. For that reason it is necessary to apply biotechnical soil erosion control practices (primarily of linear character) such as hedges, grassed infiltration belts, ridges with green growing, wind breaks etc. in case of sloping lands with excessive lengths of slopes, or (in case of wind erosion risks) in the large area with no linear vegetation.

When evaluating the efficiency of erosion control practices, the main efficient is most certainly grassing or forestation of the endangered parts. As this system cannot be applied in case of arable land as a whole, there must be used other soil conservation practices – organizational, agrotechnical and biotechnical. They cannot protect the soil from the erosion, but they can reduce the amount of soil lost. The efficiency of these practices can be evaluated by mathematical models and it can be evaluated by empirical data. The poster refers about both methods of evaluating of efficiency of soil conservation practices, applied in solving the research project of Ministry of Agriculture no. 000270490106 at the Research institute for Soil and Water Conservation.

Natural Vegetation Strips (NVSs) and conservation tillage for stabilization soil erosion

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The high rate of topsoil erosion on much of the sloping cropland of NW Syria has been a serious problem for decades. Visual evidences of severe soil loss of this nature can be found throughout the northwestern upland where olive orchards dominate the landscape and olive oil represents the most important cash income source for rural communities. However, olive yields in many orchards have been decreasing steadily over the last 20 years. Low return to labor has resulted in livelihood insecurity, increased reliance on off-farm labor, and out-migration. Field monitoring showed that tillage can cause a significant downslope movement of soil on slopes, namely tillage erosion.

The major reason for this decline is the severe land degradation taking place in this region. The replacement of mule tillage by the cheaper tractor tillage during the 1970's has resulted in accelerated land degradation. Mules used to plough along contour and did not disturb the soil too much. Tractor tillage, by contrast, disturbs the soil more, cut olive roots and, most importantly, is usually done up-down or diagonal direction. This not only moves down much more soil during every tillage run, but the tillage furrows are very conducive for water erosion. It is not exceptional to see that the parent material is surfacing, indicating the complete loss of surface soil layer

Tillage erosion is defined as the downslope soil redistribution on slope scale directly caused by the movement of a tillage tool through the topsoil. The extent of tillage erosion depends on factors like tillage implement, speed, soil type, slope, and passes frequencies. Tillage (especially up-and down tillage) usually increases water erosion.

Most farmers prefer to clean plough their olive orchards to increase rainfall infiltration and to control weeds. The challenge is therefore to develop a tillage system, which maintains the beneficial effects, while minimizing the harmful effects of tillage and water erosion. Natural vegetation strips (NVS) combines contour tillage with leaving a natural vegetation strip between the trees untilled. It is expected that NVS reduces tillage erosion and form an obstruction for water erosion. This low-cost soil conservation measure was discussed with farmers of Afrin District (NW Syria) and farmers considered it as a valuable option for fields where the tree placings are more or less along the contour.

Comparison of different capillary models to predict the hydraulic conductivity from the water retention curve

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The relative hydraulic conductivity relations of two contrasted soils, a clay and a sand, are predicted from their water retention curves using the expression of van Genuchten in combination with three capillary models: i) Burdine, ii) Mualem and iii) Fatt & Dykstra. Predicted conductivity curves are used to obtain the cumulative infiltration, $I(t)$, and infiltration rates, $q(t)$, according to Philip's quasi-analytical solution. The reference solution being obtained with the measured hydraulic conductivity. For the clay, $I(t)$ and $q(t)$ obtained with the first two models are severely underestimated. Moreover, the results of these two models are physically irrelevant, since the infiltration rate decreases to a value less than the saturated conductivity. On the other hand, the results obtained by the third model are very close to the reference, and do not show any physical anomaly. For the sand, $I(t)$ and $q(t)$ computed with the three models are compared with experimental data. In this case also, the first two models underestimate the observations, without any physical anomaly however. By contrast, the results obtained with the third model compare accurately with the data. Most probably, the systematic underestimation of the first two models is due to the derivative of the conductivity with respect to the water content which is infinite at saturation. The anomalies noted for the clay are likely due to the derivative of the conductivity with respect to the water pressure at saturation which is infinite in this case. Neither of these derivatives is infinite for the third model. The first two models give acceptable results for coarse graded soils, but they are not suitable for fine graded ones. On the other hand, the third model give satisfactory results for the two soils. The main disadvantage of this last model is that, unlike the first two ones, it cannot be expressed in a closed-form equation, which is a minor one when dealing with numerical and/or analytical solutions.

Refined Modeling of Infiltration Processes into the Upper Soil Layer

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Infiltration is an important factor when estimating the runoff formation and the soil water regime. Generally, rainfall-runoff models use simple infiltration models like SCS, Green-Ampt or Ostrowski. However, current effects principally from climate-change and intensive farming, challenge us to count with more detailed, reliable and physically accurate approaches for better water management. The deterministic and lumped rainfall-runoff model KalypsoNA (http://www.tu-harburg.de/wb/forschung/kalypso/na/na_modell.html) contains the approach of Ostrowski to model the infiltration rate. Considered for years state of the art, its main drawback is the linear behavior of infiltration with respect to soil moisture conditions. To enhance the computation of infiltration a more complex non-linear approach was introduced and adapted, following the principles of Richard's equation and taking Van Genuchten's unsaturated hydraulic conductivity. The study, at laboratory scale, is divided in two phases: one phase assessing the effect of only micropores and another including the presence of macropores. Results were validated against the results obtained with the existing model in KalypsoNA (Ostrowski method). Output data were analyzed after simulating a rainfall event in a column of 30 cm diameter and 80 cm height, with three different soil layers all characterized by fine sand-middle sand (I layer: 95% sand, 5% gravel; II layer: 97,5% sand, 1,3% gravel, 1,2% silt, III layer: 96% sand, 1,5% gravel, 2,5% silt). Infiltration rate was measured indirectly by determining the soil moisture changes with two pairs of TDR-Tensiometers in different soil layers. Main results, for the first phase, show that computed infiltration rate, follows low deviations (max. error of $\pm 10\%$ for most of the data), performing much better than the linear approach used before in KalypsoNA, and contributing to understand better the flow vertical pattern. This work provides guidelines on how this non-linear method can be extended at catchment level, followed by a sensitivity analysis. Results are important for the decision making process on sustainable water management, for instance, to quantify better the effects of flood management, or to improve the assessment of the impact of sustainable farming planning and sustainable drainage methods.

The Water Reuse project: Sustainable waste water re-use technologies for irrigated land in NIS and southern European states – project overview and first results

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In irrigated areas in the New Independent States (NIS) and southern European States, inefficient use of conventional water resources occurs through incomplete wetting of soils, which causes accelerated runoff and preferential flow, and also through excessive evaporation associated with unhindered capillary rise. Furthermore, a largely unexploited potential exists to save conventional irrigation water by supplementation with organic-rich waste water, which, if used appropriately, can also lead to improvements to soil physical properties and soil nutrient and organic matter content. This project aims to (a) reduce irrigation water losses by developing, evaluating and promoting techniques that improve the wetting properties of soils, and (b) investigate the use of organic-rich waste water as a non-conventional water resource in irrigation and, in addition, as a tool in improving soil physical properties and soil nutrient and organic matter content. Key activities include (i) identifying, for the NIS and southern European partner countries, the soil type/land use combinations, for which the above approaches are expected to be most effective and their implementation most feasible, using physical and socio-economic research methods, and (ii) examining the water saving potential, physical, biological and chemical effects on soils of the above approaches, and also their impact on performance. Expected outputs include techniques for sustainable improvements in soil wettability management as a novel approach in water saving, detailed evaluation of the prospects and effects of using supplemental organic-rich waste waters in irrigation, an advanced process-based numerical hydrological model, fully adapted to quantify and upscale resulting water savings and nutrient and potential contaminant fluxes for irrigated areas, and identification of suitable areas in the NIS and Mediterranean (in soil, land use, legislative and socio-economic terms) for implementation.

Understanding salt and water dynamics to enhance the quality of turfgrasses irrigated with saline ground water in a Mediterranean environment

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Secondary salinity threatens infrastructure and amenity areas in many regions worldwide. We have studied the water and salt dynamics under selected turfgrass species in plots irrigated with fresh or saline water over two years. Four turfgrass species (*Paspalum vaginatum*, *Sporobolus virginicus*, *Distichlis spicata* – three halophytes; and *Pennisetum clandestinum* – a nonhalophyte) were planted in a randomized complete block design with three replicates. Each plot also housed a weighing lysimeter. Blocks were irrigated with saline (13 dS m⁻¹) groundwater or with fresh water, both at approximately 80% replacement of net evaporation. Soil salinity over time was assessed with the EM38 and by soil sampling. Irrigation with saline water reduced turfgrass colour (*i.e.* ‘greenness’) in *Pennisetum*, whereas it did not affect colour in *Paspalum* or *Distichlis*, and even increased colour in *Sporobolus*. Under non-saline conditions, water use by *Pennisetum* and *Paspalum* was 83% of net evaporation, being higher than *Sporobolus* (at 74%) and *Distichlis* (at 63%). Under saline conditions, water use of *Pennisetum* and *Paspalum* were both reduced (to 58-63% of net evaporation), whereas it was not affected in *Distichlis* and even increased slightly in *Sporobolus*. Data on osmotic and ionic relations in the four species will also be presented. Elucidation of quantitative relationships between growth, water use and root-zone salinity and water content will improve basic knowledge on the functioning of halophytes managed for turfgrass and contribute to the future sustainable management of these species on saline sites.

Study on Relationship between Species Diversity and Groundwater depth in The Low Reaches of Tarim River, Xinjiang, China

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Based on the data of annual mean groundwater level, the paper divided the groundwater tables into six environmental gradients and data were sampled repeatedly three times (2004-2006) from vegetation plots for each gradient of groundwater table. The aim of this paper is to analyze the effects of groundwater to species diversity of desert riparian forest community in inland-river of arid zone. The results showed that as the increase of groundwater depth, Margalef's richness indices, Shannon-Weiner's indices, Atalato's evenness indices, correctional Simpson's indices all present unimodal distribution and reach to the peakvalue at the groundwater depth 2-4m. The Hill species diversity indices (diversity ordering) showed that the species diversity have distinct changing characteristics on the groundwater depth 6m, and while the groundwater table lower than 6m, the diversity indices becomes small. So the study concluded that to restore the degraded vegetation in the lower reaches of Tarim River, the groundwater table should ensured reach to 6 meter and the groundwater table should kept 4-6 meter in most areas even reach to 2-4 meter in some areas which near the water course.

Keywords: species diversity; groundwater depth; environmental gradient; the lower reaches of Tarim River

Soil moisture status and its responses on land uses and water conservation measures in the loess plateau region

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Soil moisture plays a very important role on vegetation growing and water cycling in arid and semi-arid area. It was affected and characterized by land cover and land uses as well as soil water conservation activities. Based on data from long-term survey of the soil moisture in depth of 0-4m at a 20cm interval during past 20 years at more than 100 sites in loess plateau region, the soil water status and its dynamics had been outlined. Soil moisture passively reflected rainfall pattern, therefore, soil turned to be drier along with rainfall decreasing from south to north. There were obvious differences in soil moisture profiles between land uses. It showed farm land > pasture land > shrub community land > arboreal forest. Soil moisture dynamic could be divided into three stages, including steady period (Oct.-March), drying period (April-June), wetting period (July-Oct.). In drying season, the soil water was decreased to a very low point, and the gap in land uses minimized, and even vanished. Most of forest land uses could result in a drier soil profile comparing with crop land. The soil moisture in rainfall > 550mm region was much better than that of rainfall in 400-550mm where the arboreal forest's growing could be restricted. Result figures illuminated the soil water conservation measures effects on soil moisture. The order of the variation coefficients of soil water storage under water conservation measures was fish-scale pit, narrow level belt, slope land, terrace. The soil water storage was increased since July, and was recovered again in October.

Keywords: Loess hilly and gully region, land use, water conservation measure, soil moisture dynamic

Effect of the conservation agriculture on some Vertisol physical properties in semi-arid Morocco

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In Morocco, Vertisols occur throughout the semi-arid and sub-humid zones. They are highly productive, displaying characteristic physicochemical properties and are of great agricultural economic importance. However, low soil water availability is the most serious constraint to crop production on this type of soils, since drought became a characteristic of the Moroccan climate during the last decade. There is an urgent need to improve Vertisol management to conserve water. Therefore, alternative conservation practices must be employed.

This paper discusses changes in hydrodynamic properties of a Vertisol, with wheat plantation, subjected to conservation (NT) and convention (CT) tillage. Hydraulic conductivity, sorptivity and porosity at four tensions were measured by disc permeameter, soil mechanical resistance was measured by penetrometer at different crop's stage and soil water content was collected by gravimetry. Hydraulic conductivity and sorptivity values (at pressure head ≤ -30 mm) were lower in CT than NT. This is due to the type of porosity under NT and CT. Soil compaction was evaluated at emergence and at harvest and it was higher under NT than CT. The lack of soil distribution with the presence of small and interconnected pores contributed to maintain greater soil water content under NT.

Keywords: Vertisols, No tillage, Hydraulic conductivity, Sorptivity, Soil mechanical resistance

Minimum tillage systems and its effect on soil structure, humus conservation and water management

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Our study presents the influence of a conventional plough tillage system on soil structure, humus and water conservation in comparison with alternative minimum tillage systems: paraplow, chisel plow and rotary harrow (which 30% of the crop residue remains on the soil surface). The hydrological function of the soil (especially the capacity to retain an optimum water quantity, and then gradually make this available for plant consumption) is one of the most important functions determining soil fertility, bioproductive capacity, and soil evolution.

Statistical analysis of the results showed that the differences in accumulated soil water depended on the variants of soil tillage and type of soil. Soil texture and structure have a strong effect on the available water capacity. The results clearly demonstrate that minimum tillage systems promote increased humus content (0.8-22.1%) and increased hydro-stabile aggregate content (1.3-13.6%), at the 0-30 cm depth compared to conventional tillage.

After ten years of applying the same soil tillage system, the data show that soil infiltration and soil water retention are higher when working with paraplow and chisel plow variant with values of 5.54 (c*) and 5.08 (b) l/m²/min, respectively. By contrast, the amount of water retained by traditional tillage was 4.25 (a) l/m²/min. The paraplow and chisel plow treatments were more favourable for infiltration and water retention. Positive effects on the saturated hydraulic conductivity of the paraplow (35.7 cm/h) and chisel plow (31.5 cm/h) treated soils were observed compared with the traditional tillage (29.4 cm/h) of the soil.

* a, ab, b, c - Duncan's classification.

Effects of conservation agriculture on trace element budget (Szentgyörgyvár, Hungary)¹

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Cultivation have been more and more intensive in the past 50-70 years. These agricultural activities have several positive and negative effects on soil both physical, chemical and biological. One of the most serious negative effect is erosion. Soil erosion results less productivity on one hand and causes off-site sedimentation damages on the other hand. Conservation agriculture (CA, e.g. non-till and minimum tillage techniques) can be a possible solution for sustainable farming.

GRI HAS has studied ecological, pedological, and economical correspondences of conservation agriculture within framework of SOWAP². The TRACE ELEMENT project was funded by Syngenta and SOWAP, which has studied the effects of various farming systems on trace element budget of soils. We monitored changes of trace element content of soils, the distribution and changes of trace element contents in various grain-size fraction, the distribution and changes of trace elements between various mineralogical phases and finally the trace element loss by soil erosion. The research has also focused on affecting factor on trace element mobilisation / immobilisation, such as mineralogical background, changes in Al and Fe oxides and hydroxides, organic carbon, etc.

Our results suggests that iron (minerals) is a more significant factor for trace element sorption in soil than soil organic matter, contrary to some scientific publications. Since the iron content of eroded sediments were higher than in year 2006 (and in the soils as well), the real role of this major element is not clear enough in field of trace element loss. The CA sediments have higher trace element concentrations than P sediments, because the conservation farming results higher organic matter in the soils and in the eroded sediments as well, while there are no differences in iron content. Because CA results much lower sediment loss, overall trace element loss is lower.

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Nitrate pollution in Niraj watershed

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The goal of our research was to conduct a systematic study of ground water nitrate pollution in the Niraj River Basin, to evaluate this contamination, and its causes. The evaluation of groundwater nitrate pollution in the Niraj catchments area was carried out in villages from the upper, middle and lower parts of the river basin. Also analyzed were samples from villages situated along the tributaries. Samples of water were obtained from individual water sources (wells) and from surface water sources. The sampled wells are situated in villages which have been inhabited for hundreds of years and the population largely obtains their water from individual water sources. In these individual water sources the concentration of nitrate has increased significantly over time, exceeding in many cases the maximum contaminant level, indicating a potential health risk to nearby residents.

The relationship between the potential pollution sources and groundwater nitrate pollution was analyzed in function of the agricultural practices, the nature of the pollution sources (punctual and diffuse pollution sources), the geographical conditions, hydrological conditions, and rainfall regime. During our research we linked the diffuse and punctual pollution sources with the spatial distribution of nitrate pollution of groundwater.

According to our research the main cause of pollution of the groundwater with nitrate is the type of agricultural practices employed, especially small scale farming with animals and bad management of the manure/waste. Another pollution source is the untreated household's wastewater. In the Niraj catchment area, in 43% of the sampled wells, the nitrate pollution exceeds 50 mg/l. The results differ in different parts of the catchment area, in the upper part (over 350 m) the average of the sampled wells where the concentration of the nitrate is higher than 50 mg/l is 26%, and in the lower part (under 350 m) the average of the sampled wells where the concentration of the nitrate is higher than 50 mg/l is 64%. These differences are caused by the soil properties and topography. According to our results, on the terraces and under the localities, there exists a concentration of nitrate pollution. The nitrate pollution of the groundwater depends also on the rainfall regime.

Keywords: nitrate pollution, nitrate leaching, Nitrat Directive, River Basin

The effect of urban stormwater runoff on surface water quality in Pécs, Hungary

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Urbanisation significantly impacts surface water quality with non-point sources of pollution and urban stormwater runoff is one of the major reasons that watercourses fail to reach the water quality objectives set by the EU Water Framework Directive. Main pollutants including gasoline and oil from motor vehicles, sediment from construction activities, chemicals from the different types of surfaces, solid waste from people, and fecal droppings from animals are difficult to identify, therefore stormwater runoff is a core issue of environmental sciences.

The aim of this study is to identify the relationship between stormwater runoff and the receiving water quality. To indicate the stormwater pollution in watercourses of Pécsi-víz is a very complex task, because the Hungarian surface water monitoring network collects data bi-weekly, so the sampling practice does not adapt to the hydrometeorological events.

Comparing statistically rainfall events (44 storms) and water quality parameters (during the period from January 1998 to July 2005 (BOD₅, SS, PO₄-P, Pb ect.)) of Pécsi-víz we are able to analyse the heaviest contributor of pollutants in urban stormwater runoff, and roughly estimate the mean annual load rates of stormwater pollution (using EPA Model for Annual Pollutant Loading Estimation) in case of city of Pécs.

Thermal properties as a function of water content in a silty porous media under laboratory conditions

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Soil thermal property data, especially as a function of water content, are currently not readily available. Demand for these data is, however, on the increase because of improvements in wider applications of soil heat and water transport models, as well as, of the vegetal growth studies. Most of these investigations were focused in sandy soils, clayed soils or peat horticultural substrates, due to the different properties and applications of each ones. Otherwise, in order to partly fill the thermal soil properties studies into other types of soils, we focused this work in the relation between thermal and hydraulic soil properties of a silty soil under laboratory conditions. Samples were obtained from Can Solé Road located in the Llobregat delta plain (Northern of Spain), where frequently *Cynara scolymus* is cultivated. Small dual-needle sensors, employing the heat pulse methodology and yield the soil thermal diffusivity, heat capacity and thermal conductivity were used. Three soil columns with an specific desing were used. The columns were monitorized to determine the volumetric water content and matric potential, as well as, the thermal properties. To obtain these kinds of data a frequency domain probe and micro-tensiometer were used.

Results obtained up to now allow a rather complete understanding of the relation between thermal and hydraulic properties at laboratory scale of the silty soils. Preliminary distributed water content and thermal data allowed investigating the variability of these properties and its relations between them for this type of soils.

Task-specific soil and landscape information from soil survey

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Soil and terrain information are vital for watershed management, which is increasingly dependent on an effective modelling approach. These models require data on the components of the catchment response at the scale that the catchment will be managed – task-specific information. Often, the only source of soil information which covers the watershed is from soil survey. But soil maps and even soil survey reports are unlikely to provide task-specific information. But there is hidden value. The power of soil survey information and its specificity can be substantially improved – using new approaches to convert soil survey data to task-specific information.

Task-specific information for watershed management includes: landscape attributes including the nature and dynamics of vegetated cover, terrain parameters, fluvial geomorphology, land use characteristics and the presence of anthropomorphic structures; and soil attributes such as soil erodibility, soil depth, soil permeability, pertinent soil chemistry and the vertical and horizontal variability in these features. Deriving task-specific information for watershed management from soil survey requires innovative use of existing information and a change in the way soil survey itself is undertaken. This paper describes a suite of approaches for the re-use of soil survey information in Queensland, Australia and the development of new approaches designed to broaden the impact of new survey.

The impact of historic data for watershed management was increased by integrated use of:

- Flexible data systems for soil site, polygon and classification data;
- Seamless integration with vector and raster GIS capability;
- Spatial modelling approaches such as knowledge discovery and data mining tools, rules based fuzzy modelling and geostatistics especially with new remote sensing data such as gamma radiometrics;
- Supplementary data gathering based on objective and contextual analysis of the existing data stock; and
- A set of well studied and comprehensively analysed reference sites.

This experience has led to the redesign of soil survey procedures and to an increasing recognition of the long term value of soil data sets – given a coherent program of data improvement.

Digital mapping of lowland excess water hazard

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Reasonable and preventive management of agricultural areas requires satisfactory information on the spatial and temporal distribution of excess water. The first attempts to display water excess hazard of lowlands on maps dates back to early '80s in Hungary. National and regional overview maps were compiled based on mainly even frequency records. These maps are however don't fit the requirements set up by agriculture and rural development, which require more accurate and reliable maps from both spatial and thematic point of view. Excess water is a complex process whose characteristics can only be determined through taking numerous factors into consideration. GIS together with large-scale spatial information on those factors, which significantly affect formulation of excess water, can provide suitable background for the compilation of maps with the expected accuracy.

For the territory of two counties situated in the lowland featured southern-eastern Hungary GIS based quantification and large scale mapping of excess water hazard was carried out. Limited numbers of affecting environmental factors were taken into consideration. However information on these factors was available in a harmonized manner i.e. the spatial resolution and information density as well as reliability was comparable in opposite to approaches where numerous but incompatible factors are treated together providing unreliable results. One well-defined and quantified parameter representing the affect of relief, soil, agrogeology, groundwater, land use and hydrometeorology on the formulation of excess water was defined and derived. Each factor was spatially represented. Generalized versions of the quantified spatial layers were jointly statistically analyzed with the map of relative frequency of excess water events. Multiple regression was used for the determination of the role various factors in the formulation of excess water thus providing weights for its linear estimation by the applied factors. The derived weights then were used with the more detailed original map layers to produce the result water excess hazard map. The resulted risk map can be utilized in numerous land related activities: land use and agricultural planning, water management interventions, water oriented cultivation systems, wetland restoration etc.

The effect of rainfall, slope gradient and soil texture on hydrological processes in a tropical watershed

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The Huehuetan watershed is located in the Tropical Pacific Coastal Region of the State of Chiapas, Mexico. At three investigation sites four micro-catchments were selected with mean slope gradients of 10 % (UNACH, pasture), 33% and 46% (Argovia farm, Coffee plantation) and 50 % (Cecilia farm, Maize-fruit trees). Each micro-catchment was equipped with rain recorders type Hellmann and standardized H-flumes with Stevens F-type water level recorders. Soil characterization included soil profile description, soil texture, porosity and pore size distribution analysis.

In the six year period from 2000 to 2005 a total of 2347 rainfall events were registered and analyzed. The runoff database includes hydrographs of 1120 events, providing peak discharge and total direct runoff. Physical soil parameters at the different sites were found to have considerable variation, with resulting important effects on the hydrology of catchments.

The results show that runoff is lowest on the coarse textured soils at Argovia farm under coffee production systems. The increase of runoff on the fine textured soils at Cecilia farm and the UNACH investigation site was significant. The direct comparison of the two catchments at Argovia farm made possible the measurement of the effect of slope gradient on runoff. The average runoff will increase by about 40% when mean slope gradient ascends from 33% to 46%. During highly erosive single storm events this difference can be more than double. An important factor for runoff behavior in the catchments is the annual occurrence of rainfall accumulations. The runoff coefficient can increase during three-day rain accumulations with more than 150mm up to 0.5. It can be assumed that on the coarse textured soils at Argovia farm lateral subsurface flow is an important flowpath during storm events, meanwhile on the fine textured and clayey soils saturation overland flow contributes considerably to runoff. The results raise important implications on the planning of land use and on management practices for different agricultural systems in the watershed.

Stormwater runoff under partially frozen conditions

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The transport infrastructure is a vital part of the society, with high capital investments, proper management and design of this system is therefore very important. Climate changes will increase the frequency of extreme precipitation events, floods and snow melt periods experienced by the infrastructure. According to initial analysis by the Norwegian transport sector these changes will affect road maintenance, emergency planning, design of new roads and infrastructure. Increased frequency of floods is expected to cause more closed roads because of insufficient and badly maintained drainage systems. More erosion on areas next to the roads is expected because of higher groundwater levels, which may cause instability of road fundaments, and also clog existing drainage systems. More ground frost is expected to affect the road quality and lifetime. Increased ground frost and ice formation on ground surface may also cause large increases in surface runoff during snowmelt. The project presented is coupling the state of the art climatic scenarios with historic data, local hydrology models and geology to create a model that can evaluate the run-off situations near roads and the applicability of current road design standards for different scenarios. Together with a risk analysis of the vulnerability of the transport infrastructure the model will be used to create guidelines for road construction with respect to run-off and drainage that can account for changes in climate.

Assessment of raindrops size distribution to natural precipitation in Kurdistan Province, Iran

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Using two methods, stain and flour-pellet, the effect of natural raindrops was assessed in seven Synoptic meteorology stations in Kurdistan province. Calibration equations of the above methods were determined by dropping raindrops from a certain height at terminal velocity and using them in turn and diameter of raindrops was calculated. Then the correlation between the diameter of the drops and the rainfall intensity was investigated. The mean and median (d_{50}) of raindrops diameter were maximum in Marivan station and minimum in Zarinneh station. The statistical analysis of the data using Gln distribution which is appropriate for unequal data was used. It was determined that the difference between the two methods was significant and also the Duncan test was used to compare the means. It showed that the stain method is more appropriate than flour pellet method.

Keywords: Flour pellet method, Raindrop size distribution, Rainfall, Soil Erosion, Stain method

Water and soil conservation management and designing for the development and construction projects of China

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This paper introduced that since the water and soil conservation designing was brought into practice in the development and construction projects of China, the country has legislated and perfected a series of laws and statutes about the water and soil conservation of the development and construction projects. The water and soil conservation design of large projects given an official by the Ministry of Water Resources summed to 1060, including 142 commission items. And that given an official by each province (municipality, municipality directly under the Central Government) of China summed to eighty thousands. The paper also introduced the supervising, checking and implementing situation in the process of water and soil conservation designing of the projects, and the benefit from the process of water and soil conservation designing.

Keywords: development and construction, projects design, water and soil conservation

Impact and constraints in the adoption of watershed development program – An analysis from South India

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Watershed management aims at improving the efficiency of resources like land as well as other inputs in the rain fed agriculture through conservation measures and improved soil and crop management practices. This investigation was carried out to analyze the effect of management factors on the impact of watershed development programmes (WDP) in 13 district watersheds of five agro climatic zones of Karnataka state in South India. The study revealed that, majority (89%) of the farmers belonged to medium economic performance category. The percentage increase of the total yield from the crops grown by the big farmers was 97.89, while it was 78.02 and 81.97 in case of small and marginal farmers respectively. The overall percentage of increase in income of marginal, small and big farmers was 50.1, 56.2, and 60.1 respectively. It was observed that, as decrease in the size of land holding there was increase in the total employment generation. It was 66.3 man-days with respect to marginal farmers, whereas it was 30.7 and 45.3 in case of big and small farmers respectively.

The beneficiaries of WDP expressed marginal productivity of dry lands (70%) undulating topography and poor soil fertility (66%) poor resource base (61%) and requirement of high level of management for adoption (60%) as main barriers. While 94.2 percent of officers in charge of WDP felt that land ownership rights, fragmentation of holdings, religious sentiments, reluctance of the people for change, and 89.9 percent of them expressed that non availability of suitable technologies for resource poor situations, low price for dry land commodities, fear of falling into debt and risk aversion act as major constraints for the development of watershed. Strategies to overcome these constraints and sustainable promotion of WDP are discussed in the main paper.

Stakeholders participation in watershed management – A study of India

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Participation is continuous educative process and has been long argued that peoples participation is essential for the success of any rural development programme. At the same time it has been seen that non- involvement of people in the development programme is great concern and challenge to rural development. In India, Watershed Development Programme (WDP) is being implemented by both Government and Non- Government Organizations. Realising the importance of people's participation in WDP, a comparative analysis of people's participation in WDP implemented by GO and NGO was attempted in Karnataka state, considering two Watersheds, one implemented by GO and other implemented by NGO. The sample size constitute 120 beneficiaries, 60 from each watershed spread over four micro-watersheds.

The study revealed that majority of the beneficiaries of WDP implemented by GO had medium level of participation (36.7 per cent) as against NGO, who had high level of participation (58.4 per cent). With respect to the participation of NGO beneficiaries in WDP planning steps, high level of participation was observed in collection of facts, analyzing the situation, identifying the problem, deciding on objectives, developing a plan of work and execution of plan. On the contrary, the GO Watershed beneficiaries were found in low level of participation in steps viz; collection of facts, identifying the problem, deciding on objectives, developing a plan, execution of plan and evaluation. Beneficiaries of the GO watershed were found to have information type, consultation and functional type of participation in different steps of WDP. While most of the NGO beneficiaries showed functional, information and consultation type of participation. Education, extension contact, mass media participation, social participation and awareness about the programme and personal benefits obtained were found to have significant relationship with the participation level. Lack of knowledge is the major constraint in participation.

λ -Frame dyke construction technique

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A λ -Frame dyke generally consists of foundation, λ -Frames, wing-walls and slabs. It is a reinforced concrete hydraulic, detachable structure across a small stream valley to impound water for water conservation. Totally more than 500 dykes have been constructed in Shanxi Province of China since 1990s. After more than ten years of operation and observation, the dyke is proven successful in terms of social, economic and ecological benefits, and has been regarded as an effective measure for soil and water conservation by administrative departments concerned at various levels in the province. The structure has the advantage of solving sedimentation problem. When the dyke is silted up, slabs of the structure can be removed so that water flow can wash away the silt. When flood comes, the slabs are removed, after flooding they are reinstalled so that the dyke can be used for a long time. The paper mainly discusses how to conduct site selection, structure design and construction of the dyke.

Keywords: λ -frame dyke, structure design, construction, sedimentation, water conservation

Study on the change trend of runoff volume in the Hutubi River Basin, Xinjiang, China in recent 50 years

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Xinjiang in northwest China is vast, there are totally more than 570 rivers, in which the proportion of the mid- and small-size rivers with annual runoff volume less than $3.0 \times 10^8 \text{ m}^3$ is as high as over 90%. These rivers play a very important role in supplying water resources in arid Xinjiang. Therefore, many researchers pay great attention to the change trend of water regime of these rivers all along.

Rising in the Karawuqin Mountain, the Hutubi River Basin ($43^{\circ}07' \sim 45^{\circ}20' \text{N}$, $86^{\circ}05' \sim 87^{\circ}08' \text{E}$) is located in the middle section of northern piedmont of the Tianshan Mountains and the southern marginal zone of the Junggar Basin, and it belongs to the stream system in the east section of northern slope of the Tianshan Mountains. The drainage net in the mountainous region at the upper reaches of the Hutubi River develops well, and the tributaries are distributed around the mainstream. There are more than 20 first-level tributaries along both riversides, in which 10 tributaries are mainly recharged by melt water of modern glaciers and firn, and others rise in the mid- and low-mountain regions and are mainly recharged by rainfall in summer and melt water of seasonal snow cover. The river channel upstream from Shimen Hydrological Station is 88 km in length, the catchment area, average elevation and longitudinal slope gradient of the riverbed are 1840 km^2 , 2984 m a.s.l. and 23.3% respectively, and the annual runoff volume is $4.71 \times 10^8 \text{ m}^3$ and occupies 93.6% of the total surface water volume in the drainage basin. Therefore, the cross section at Shimen Hydrological Station is selected as the typical hydrological section, and the data of runoff volume in recent 50 years from 1956 to 2005 are used to analyze the monthly, seasonal and annual distribution and multi-year change trend of runoff volume of the mainstream and the tributaries recharged by different water sources based on the various statistical data of runoff volume. The results reveal that the characteristics of the temporal series of runoff volume are closely related to the recharge sources, the difference of monthly and seasonal runoff volume is very high, the concentration rate is as high as 66.47%, but the variation coefficient of the multi-year change of annual runoff volume is low and for 0.15 only. Kendall rank test result reveals that the annual runoff volume of the Hutubi River has been in a significant increase since recent 50 years. Under different temporal (monthly, seasonal and annual) resolutions, the analyzed results reveal that the Hurst indexes of monthly runoff volume are all higher than 0.5 except that in April and June, and they are significantly durative; the Hurst indexes of seasonal runoff volume are also significantly durative all the year round, especially the Hurst index in summer is as high as 0.86; the Hurst index of annual runoff volume is as high as 0.8 and is significantly durative, too. Therefore, it is predicted that the runoff volume in the Hutubi River Basin will be continuously increased in the future.

Keywords: runoff volume, water resources, Hurst index, the Hutubi River Basin, Xinjiang.

Etude des variations de quelques paramètres physiques du sol et des rendements de cultures céréalières menées en sec et en irrigué dans une région semi aride d'Algérie

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Dans les régions semi arides d'Algérie ne sont pas à leur aise, ni les cultures délicates, ni les arbres, ni les céréales, la meilleure forme d'exploitation de ces régions est la steppe souvent, support du cheptel ovin.

L'espace du mouton algérien est caractérisé par des sols fragiles, légers et, superficiels sur lesquels l'action de l'Homme est néfaste notamment en matière de défrichement, de labours et de travaux de sol similaires.

La présente étude est réalisée dans une région semi aride dans la steppe centrale algérienne. Tout au long de deux saisons 2005/2006 et 2006/2007, et sous deux conditions, en irrigué et en sec, des mesures de quelques paramètres de sol mis en culture céréalières ont été faites, notamment porosité et densités in situ. Les résultats montrent que les variations des paramètres physiques tendent à mener l'horizon superficiel du sol vers une structure poreuse et légère tout au cours de sa mise en culture, aussi les rendements des cultures révèlent de très faibles résultats qui n'encouragent pas la mise en cultures des sols dans de telles régions. Le pompage d'eau pour l'irrigation ainsi que les labours fragilisants la structure du sol ne sont –ils pas des facteurs de dégradation irréversible? Devant une telle situation l'alerte est à signaler, ces zones sont le siège de mutations vers une désertification.

Mots clés: Sol, profil, climat, labour, irrigation, culture, rendement

Watershed management plan For Karun River in Iran (Case study)

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Watershed plays an important role as a source of water, biodiversity, tourist areas and place of living for local inhabitants. Since the ancient times, many important civilizations have risen in the regions, which could not come into existence in the first place without living in harmony with nature as well as practicing efficient use of limited resources in the area.

Watershed development is a fact of human development. It is essential to sustaining future. Development process leads to many changes in our natural environment including increasing in the flooding, erosion and sedimentation. Agricultural activities, land use and animal husbandry in Iran have a long history, which goes back to 5000 years ago, but documents indicating the damaging trend of the soil erosion and increase of flooding and sedimentation, overgrazing, water quality problems and salinity are problems mainly reported in the past 80 years. In recent years the country is also facing with a number of extreme events such as drying out some of the very old lakes, Qanats and springs.

In many regions in Iran, runoff and flooding are produced in some cases from rainfalls as little as 9 mm over a small catchments, causing considerable loss of life and properties. Drought and flood has become two familiar terms in the Iranian climatic conditions. In last half a decade, more than 3700 flood events have been reported, which 53% of them occurred during the last 10 years. The number and peaks (not volume) of flood events and their damages in the last 20 years have increased. Flooding and water shortages are two different sides of the same coin.

The Karun River is a tributary of Tigris-Euphrates and has the largest drainage area (about 70000 km²) in the Iran. The upstream basin occupies the highly elevated Zagros mountain range where natural disasters such as debris flow, landslides and floods are prevailing because of the land degradation and subsequent soil erosion.

In order to avoid and /or reduce the damage of the above mentioned natural disasters, the Government of Iran has made continues efforts afforestation in the mountain area and constructing small scale check dams to prevent soil erosion and keep upstream river channel stable. The objectives of study area are:

- To formulate a master plan on integrated watershed management of the selected area in Karun watershed (in KHUZESTAN province) to prevent further degradation of natural resources and promote sustainable development.
- To participate rural peoples and stakeholder for prevent land degradation and watershed management activities.

The overall goal of the master plan is to break through the above vicious cycle at two nodes of the "Degradation of natural environment" and "Decrease o farm income". In order to realize the overall goal, following five projects purpose are proposed:

1. Mitigation of flood, debris flow and landslide damages
2. Control of soil erosion and conservation of water
3. Restoration and improvement of range vegetation
4. Improvement of living standard
5. Improvement of agriculture product/input marketing agriculture extension and strengthening of community activities

Keywords: Land degradation, Natural disaster, Iran, Watershed management

Hydrogeology of the shallow aquifers at Wadi el-Ghussein, NE Jordan

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The research aimed to better understand the hydrogeology of the alluvial shallow perched aquifers in Wadi el-Ghussein in Tulul al Ashaqif area of the northeast Badia of Jordan.

Many generations of local Bedouins have dug wells by hand in the wadi and exploited the available water, which helped to support their water requirements. Recent studies have suggested that these aquifers are renewable, widespread and can be used as a water resource, provided that they are managed in a sustainable manner. This requires a full understanding of the hydrology of the aquifer.

Several techniques were used to collect data needed to better understanding of the hydrological situation in Wadi el-Ghussein. Total station surveys were used to draw a detailed topographic map for the study area, and hydrometers were used to check the elevation of the groundwater, and to draw ground water contours directly.

Very low frequency geophysical equipment (VLF) were used to determine the lateral extents and depths to the groundwater level along different profiles of the wadi and under the basalt pavements where direct measurements were not available. Samples of groundwater were collected for geochemical modeling and to check for the quality of the water.

Analysis of the results of data led to determine the flow directions of water, which were confirmed by geochemical modelling.

The general groundwater flow direction is from outside the wadi (basalt pavement) towards the center of the wadi and from the NW towards SE along the course of the wadi. Within the wadi, areas where recharge and discharge (towards deeper aquifers) were clearly detected. Geochemical modeling confirms these conclusions.

VLF data analysis also indicate that lateral extents of water is limited to the wadi bed, except in limited areas such as meanders where groundwater extends under some points of the basalt pavement.

Water quality is close to the permissible Jordanian and World Health Organization (WHO) standards, and the plot of the chemistry of the sampled water on the Piper diagram led to it's classification as carbonate water.

Water supply and rainfed maize production in a semi-arid zone Alfisol of Nigeria

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A randomised complete block design (CRBD) with six treatments, replicated four times was designed and developed in an Alfisol of the Guinea Savannah around Zaria (11° 10'N and 7°35'E) for a field where rain-fed and irrigation maize production were compared in a study of soil water balance and grain yield during the 2003-2005 years. The study revealed that treatment 3 (five days after irrigation) gave optimum grain yields when irrigation is compared with rain-fed, showing that for production of maize (95 TZEE-Y), this treatment gave average yield of 2.4-2.8 t/ha under irrigated conditions, compared to 3.5-3.8 t/ha for the rain-fed over the period, 2003-2005. After a water balance calculations, water use efficiency (WUE) and fertilizer use efficiency (NUE) for this treatment range respectively as 4.25-5.81 kg/ha-mm and 63.01-76.71 kg/ha indicating optimum values when compared with other treatments.

Keywords: Water conservation, Maize grain yield, Water-use Efficiency, Fertilizer-Use Efficiency

Farm pond option in the Integrated Watershed Management Programme

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NE Thailand is well known that unstable and low agricultural productivity region due to poor soil and erratic rainfall distribution. Degraded productivity of soil is noticeable resulted of heavy land use after falling forests without appropriated soil conservation measurements. Surface run off is the key factor of soil erosion, consequently, shallow and skeleton soil in upland, salinization and alkalization in lower land are further expanding. A holistic approach of watershed management programme on “Participatory Watershed Management for Reducing Poverty and Land Degradation in SAT Asia” were jointly implemented by a multi-sectoral consortium team with a trans-boundary approach by the International Crop Research Institute for the Semi Arid Tropics and Thai research organizations with financial support of the Asian Development Bank. The project was carried out in two benchmark watersheds, one in hilly and the other one in rolling land forms, of Khon Kaen Province in northeast Thailand, since 1999 and 2003, respectively.

Farm ponds, each has about 1,260 m³ of water storage capacity, a key option in the integrated watershed management for the impoundment of supplementary water. Within proper land use and water and crop management have resulted in significantly not only increased water availability and crop productivity but also reduced soil loss to 5-6 t/ha per year compared to 25-33t/ha per year in the traditional systems. Water utilisation indicated that hilly farm pond water was mainly used for rainy season vegetables and home garden crops whereas rolling landform farm pond water was also occasionally used for rainy season paddy rice securing as well as for various vegetables and field crops cultivation in dry season. These enable families earn additional income of which about 85%, 10% and 5% were derived from vegetables, fruit trees and local herbs respectively in the hilly watershed, as opposed to 78%, 10%, 8% and 4%, derived from paddy, fish, vegetables and fruit trees in the rolling watershed. Results indicated that the different soil type characteristics play a key role with regard to the water holding capacity in the hilly areas, whereas the pond water levels in the rolling areas show a close relationship to ground water levels.

Characteristics and hydrological effects of a cascade of benches on a semiarid hill slope in central Tunisia

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The benching of hill slopes, in Tunisian semi-arid regions, is intended to reduce water runoff, soil erosion and to support infiltration on the slopes. However, the hydrologic impacts of benches remain roughly unknown. In this study, author evaluated hydrologic impact of a cascade of benches built on June 1997 on a 14.48ha catchment area in Ousseltia region in central Tunisia. On June 2006, the total retention capacity of the cascade is roughly equal to 2535m³. After nine year, the channels upstream benches have lost about 31% of their initial capacities. Each year, approximately 171 tons of sediments are retained upstream these benches. Before introducing benches, the runoff coefficient for a rainfall event of 64mm is about 65% for uncultivated catchment area. After introducing benches, the first year, the runoff coefficient is equal to 20% for the same rainfall event. After nine years, the runoff coefficient is around 38%. Moreover, if all runoff area upstream benches have been ploughed, the runoff can be reduced to zero even after nine years. Consequently, benches considerably reduced water runoff, erosion and sediment transport on this catchment area.

Keywords: semi-arid region, contour ridges, runoff, erosion, central Tunisia

Groundwater flow modeling using visual modflow, a case study from southwest Iran

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The modeling as an efficient method with low cost will make it possible to be familiar with complex nature of groundwater systems. Hydrological investigations and groundwater modeling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological system is changing with time and in the sense that we are continually developing new scientific techniques to evaluate these systems. They are inexact in the sense that groundwater systems are complicated beyond our capability to evaluate them comprehensively in detail, and we invariably do not have sufficient to do so (even if we had the capability). For many problems of groundwater hydrology, such as aquifer development, contaminated aquifer remediation, or performance assessment of planned water supply projects, it is necessary to predict and evaluate the parameters of groundwater systems (e.g. water table and its fluctuation during the year). Using numerical models to simulate groundwater flow has been addressed in many works and researches in past decades. The main draw back with these models is the enormous and generally difficult or costly data requirements. In this paper, hydrological parameters of an aquifer in the NE Ahvaz (SW Iran) have been evaluated by visual modflow, in order to better management on water resources. The largest rivers basins in Iran (i.e the Karoon and Dez river basins) are situated in this region (Khuzestan province). A large proportion of Iran's irrigated lands are in this province, and more than one third of Iran's total surface water of 94 billion m³ is flowing into the Khuzestan province, but ironically most of its inhabitants (about 4 millions populations) are suffering from poor quality drinking water, especially during the summer months.

Keywords: Aquifer, Groundwater, Modeling, Southwest Iran, Visual modflow

Environmental effect of reservoirs accumulation highly mineralised oil-field waste waters

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A necessity may arise to accumulate oil-field waste waters in special reservoirs, the so called ponds, at the initial stages of exploiting oil-fields, particularly.

In 1961 a pond located in Shkapovski oil field (Bashkortostan) was filled with oil-field waste waters and was monitored for forty years. Its studies revealed it to be a source of contamination for soils, grounds, surface and underground waters. 5 – 6 years after discharge was discontinued salinization and solonetzization of grounds could be observed. The content of salts in under bed clay deposits made 2500 mg/100 g, reverse sodium 53.5 %. It was found that the water in a natural fountain 10 km away from the pond was highly mineralized. 19 years after there occurred significant desalinization and desolonetzization of grounds, 30 years after the numbers approached background ones.

In 1974 – 2004 water mineralization in the natural fountain was changing in the range of 1200 to 500 mg/l. If we know y (5 mg/l) and do the equation of its dependence on time ($y = 10.027e^{-0.0599x}$; $R^2 = 0.93$; $P > 0.95$), we can find x - years it takes waters to became fully free - salined (126 years after 1974, that is 2100).

The development of an accumulating pond of oil-field waste waters led to soil degradation in the pond bed as well as adjacent soils. 40 years after contamination chernozems shaved natural desalinization and desolonetzization due to flushing water regime and genetically caused high content of carbonates and gypsum in the profile and soil formation rocks. At the same time they kept increased content of water soluble salts, reverse sodium and electrical resistance typical for solonchaks and solonetz. In humus accumulative horizons there appeared hydrophobicity. As a result of leaching there decreased the content of carbonates, capacity of cation exchange, labile nitrogen and phosphorus supply.

1st, 2nd, 3d classes of toxicity elements Cd, As, Zn, Mo, Cu, Co, Ni, Cr, Sr, V accumulated in soils in rates higher than background and permissible concentration values.

The effects of wetting rate on aggregate stability in three soils

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Aggregate stability is a crucial factor of soil erosion and crust. Disintegration of aggregates is affected by wetting rate. At wetting rates of 2(slow), 10(middle) and 50 mm h⁻¹(fast), three soils (Loess, Red and Black soils, or Alfisols, Ultisols and Entisols respectively) of main arable lands in China were taken to investigate the effects of wetting rate on aggregate stability. The aggregate stability was found to be in the order of red soil > black soil > loess. Except slow and middle wetting rate for loess and red soil, there was significant difference among different wetting rate with different soils.

Exploiting spatio-temporal features of Kreybig Digital Soil Information System for the identification of regional scale soil degradation processes

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Requirements and demands of society for soil information increased significantly in the last decades. Traditional soil survey is time consuming and expensive, new conventional surveys in the near future are very unlike, consequently methods exploiting existing information are becoming increasingly important. In the recent digital era spatial soil information systems (SSISs) are playing a more and more important role in this context. There is much more utilizable information originating from soil surveys, than it was processed published on the map series and in reports, and what is provided by simply archiving them digitally. A true SSIS can and should reach higher levels of digital processing. Integration of an SSIS within appropriate spatial data infrastructure and its updating with efficient field correlation make an inherent refinement and upgrading of the system possible as well as the estimation of the reliability of the system. Field verification/correlation completed with appropriate data collection, and the inclusion of newly accessed data into SSIS can also significantly increase its reliability. This verification should be carried out by the reambulation of the originally mapped areas and the dug profiles accompanied with new samplings at the revisited sites assessing current soil status. On the other hand appropriate management of the SSIS also makes the elaboration of efficient survey and sampling design possible thus making fieldwork quicker and more economic.

In our paper we present GIS-based methods developed for the spatial and thematic refinement, improvement of the Hungarian, national, 1:25.000 scale SSIS. Implication of new sampling data collected at revisited sites makes the comparison of archived and newly surveyed data possible. Thus changes in soil properties can be identified. This, in one hand, should be recorded in the database updating it. On the other hand, trends can be identified in soil characteristics and functions, degradation processes can be realized and/or forecasted. Joint management and application of multi-temporal spatial soil information within an appropriate relational database management system and GIS environment makes KDSIS a spatio-temporal soil information system.

Compaction state in a Brazilian Ferralsol with no tillage management*

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No tillage management is widely used by the Brazilian farmers and technicians like a soil conservation system, which reduces the soil losses by water erosion, increasing the infiltrated and stored water in soil, warranting environmental sustainability. No-tillage system does not invert the soil; it causes the creation of a compacted layer. The samples were taken in the agricultural year 2005/2006 in a ferralsol Selviria at (MS/Brasil). The tillage management in the last 15 years was no-tillage system with crop rotation (maize -*Zea mays* L./bean - *Phaseolus vulgaris* L.). The analyzed soil physical properties were bulk density (BS), gravimetric water content (θ) and mechanical resistance to penetration (RP) at three depths: 0–0.10 m, 0.10–0.20 m and 0.20–0.30 m. The samples were taken in a mesh with 117 sampled points covering an area of 0.16 ha. It was investigated the existence of compacted soil layer, using the mechanical resistance to penetration to 0,60 m depth with soil water content at field capacity. The data shows low coefficient of variation, except the resistance penetration data. Bulk density and gravimetric water content has a normal distribution. Only resistance to penetration at 0.10-0.20 cm depth layer has a normal distribution. The correlation between different properties was low. The bulk density increases with depth; the increase of the values of soil bulk density are consistent with data in other papers, indicating there are not compaction problems for the crop development at the study area. The majority of values of resistance to penetration are lower than 2 MPa, being this value restrictive for root development. The analysis of resistance to penetration profile 0 to 0.60 m shows a compacted layer between 0.20-0.30 m. This compacted layer was caused by the conventional tillage system used at this area before the use of no-tillage system. The soil bulk density has higher values at the upper area, that it shows higher values of soil compaction. Although the values of bulk density and resistance to penetration are high, the area does not show great problems of soil compaction.

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The inventory, quantification and evaluation of soil sealing as a Desertification process

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Within the wide range of processes that intervene in Desertification, soil sealing has become the most important and dynamic in some areas such as the littoral and pre-littoral shores of the Mediterranean Region. Desertification, a global environmental problem that affects about 40 per cent of the Earth's land, "leads to a persistent decline in economic productivity of useful biota related to land use or a production system" in which sealing intervenes by destroying irreversibly the plant productivity of soils.

To assess the real soil sealing dimensions, a spatial and temporal methodological procedure, using Geographical Information Systems techniques has been developed. As a first step, precise mapping of the sealed surfaces for the year 1991 and 2004 using high definition orthofotos were undertaken, and classified according to major types or socioeconomic agents (communication networks, buildings, etc). Second, specific analytical procedures were developed based on (1) the application of landscape metrics such as sealed area by soil sealing type, number of patches or distance to major roads, and (2) the environmental impact by calculating the consumption of soil land capability with the soil sealing maps.

The above methodology has been applied to an intermediate region, "Camp de Turia", of 748 km², the Autonomous Region of Valencia (SE Spain). Results show in both dates moderate rate of sealed surfaces (5.6% in 1991 and 6.7% in 2004), were the most important trends are relative high degree of patchiness and soil isolation, less soil sealing density when distance to major roads and distance to the main nearest city (Valencia) increase. Also there has been an increase in losses of most fertile soils for agriculture production (consume of 6.7% and 7.7% of very high, high and moderate land capability soils in 1991 and in 2004 respectively).

The methodological approach using detailed and precise inventories of artificial sealing surfaces and specific indicators show the need to assess Desertification, even in very dynamic areas, as a way to evaluate the process both in time and space. Also, if applied regularly, would constitute an important tool for land evaluation, planning and management.

Salt efflorescences and leaching of heavy metals in acidified mined soils in SE Spain

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Past mining activities in southeast Spain (Mazarron, Murcia) left a legacy of derelict landscapes without vegetation and susceptible to wind and water erosions. Our field observations showed large amounts of salt efflorescences accumulated on soil surface due to high evaporation rates during the summer months. These landscapes contain materials of high Fe-oxyhydroxides, sulphates, and potentially leachable elevated contents of heavy metals due to extreme acidic conditions. Geochemical analysis of a representative area showed mean pH of 3.47, electrical conductivity of 2.57 dS m⁻¹, and total content of Cd: 39 mg kg⁻¹, Cu: 486 mg kg⁻¹, Pb: 27515 mg kg⁻¹, and Zn: 15207 mg kg⁻¹. The objective is to characterize the minerals in salts efflorescences and study the potential release of heavy metals from mined soil in response to soil acidification. Based mainly on color (e.g., pale yellow-10YR 8/2, pale brown-5Y 8/4, and red brown-5YR 5/3) of evaporite accumulations, we collected several salt samples from soil surface during the summer months in 2006 and 2007. We used X-ray diffraction and electron microscopy to determine the mineral composition. We also excavated an undisturbed soil column (15-cm diameter and 30-cm length) from a representative site to elucidate the release of heavy metals from soils. The column was leached weekly with distilled water for 10 times to simulate critical rainfall events. Leachates were collected and analyzed for various chemical properties. Results showed that salt evaporites were dominated by hydrated sulfate minerals of aluminum, iron, magnesium, manganese and zinc (or halotrichites). Apjohnite (MnAl₂(SO₄)₄·22H₂O) was observed in all samples although wupatkiite [(Co,Mg,Ni)Al₂(SO₄)₄·22H₂O] may also be present; apjohnite and wupatkiite had similar X-ray diffraction patterns. Our results supported earlier literature that halotrichites are common in areas where sulfur oxidation takes place. Leachates after week 1 had pH 2.2 and the highest soluble salt contents. The relative amounts of heavy metals followed the order Zn>>Cd>Cu>Pb and were interpreted to be strongly associated with the oxidation of sulphide minerals. These initial results were used to design a leaching experiment to evaluate the effectiveness of different amendments to minimize the risk of heavy metal release into the soil.

Degradation of boreal forest soil fertility caused by the invasion of *Kalmia angustifolia*: a forest management problem

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Forestry practices in Canada are principally established in the boreal forest and are said to be extensive, that is, forests are left to regenerate after logging with few silvicultural interventions. Soil quality is, therefore, largely determined by patterns of vegetation change over time. Successional changes in boreal forest species are often cyclical resulting in black-spruce dominated stands. In some areas, however, black spruce growth is kept in check by the invasion of ericaceous shrubs such as *Kalmia angustifolia*. Here, I report on a series of experiments that were devised to elucidate the mechanisms by which *Kalmia* gains a competitive advantage over black spruce, and discuss the management implications.

At the outset, it was recognized that the invasion of *Kalmia* coincided with the stunted growth and chlorosis of black spruce. Seedlings were diagnosed as being N deficient. Soil incubations and bioassays revealed that humus formed under *Kalmia* produced very little mineral N, in spite of there being large total N pools. When planted in this humus, *Kalmia* was able to uptake soil N whereas paper birch and black spruce seedlings could not. We tested the effects of labile C and mineral N additions on humus N dynamics and found that glucose had no effect on humus N dynamics, but mineral N additions increased both gross and net N mineralization rates. We hypothesized that leaf litter tannins produced by *Kalmia* could reduce mineral N cycling by forming stable complexes with soil protein and preventing these from mineralizing. It was found that *Kalmia* foliage produced up to five times more tannins than black spruce needles. The addition of purified *Kalmia* tannins to soil resulted in lower mineral N accumulation, with no sign that this was provoked by increased microbial immobilization. Bovine serum albumin was precipitated with black spruce and *Kalmia* tannins, and with commercially-available tannic tannins. While the mass of the precipitate was higher with tannic acid, the total N-content of the precipitate was higher with *Kalmia* tannins. These protein-tannin complexes were more easily metabolized by mycorrhizae associated with *Kalmia* than those associated with black spruce. In another series of experiments, we showed that *Kalmia* tannins inhibited important soil enzymes (acid phosphatase, amidase and β -glucosidase) and that these effects are concentration-dependent. A subsequent microcosm study showed similar enzyme inhibition when *Kalmia* leaves were added to forest humus, and a field study demonstrated a negative relationship between % *Kalmia* ground cover and soil enzyme activity. Silvicultural trials showed that fertilization had a positive effect on black spruce growth, but still better growth and improved soil properties were obtained by the complete eradication of *Kalmia*. Scarification appears to be the most promising management option to restore fertility on *Kalmia*-dominated cutovers.

Soil salinity and yield of drip-irrigated potato under different irrigation regimes with saline water in arid conditions of Southern Tunisia

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A field study was conducted in southern Tunisia to determine the effect of irrigation regimes with saline water (3.25 dS m^{-1}) on soil salinity, yield and water use efficiency of potato (*Solanum tuberosum* L., Cv. Spunta) grown during autumn, winter and spring seasons. Irrigation treatments consisted in water replacements of accumulated crop evapotranspiration (ETc) at levels of 100 % (100-L) 80% (80-L) 60% (60-L) and 40 % (40-L), when the readily available water in the control treatment (100-L) is depleted. A daily irrigation regime at 100 % of ETc (100-D) was also used. Results show that salinity was lowest under emitters and highest midway to the margin of wetted bands. Under emitters it increased gradually between 100-L and 40-L from 1.0 to 2.3 dS m^{-1} in autumn, from 0.65 to 1.97 dS m^{-1} in winter and from 0.75 to 2.55 dS m^{-1} in spring. Highest E_{ce} values were found to occur at about 20cm and 10 cm from emitters respectively for 100-L and 40-L. Yields were highest under 100-L although no significant differences were observed with 100-D. From values of 30.4, 22.7 and 39.6 t/ha respectively for autumn winter and spring, yields decreased almost linearly when applied water was reduced. However, reduction in quality was significantly important for 60-L and 40-L. The analysis outcome of the crop sensitivity to salt indicated respectively for autumn, winter and spring seasons that thresholds are close to the value calculated from published salt tolerance data (1.9 , 1.55 , 1.85 vs. 1.7 dS m^{-1}) but the slopes are considerably steeper (34, 54, 47 vs. 12%), apparently because of the combined effect of salinity and water stresses. Water use efficiency (WUE) reflected differences between seasons, it varied typically around 8-9, 6-8, and 11-14 kg/m³ respectively for autumn, winter and spring. Full irrigation with daily application resulted in the lowest WUE values, most likely because of higher evaporative losses.

Keywords: arid, salinity, water management, potato, yield, water use efficiency

Analyse de sensibilité du système oasien et mesures de sauvegarde de l'oasis de Metouia (Tunisie)

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L'oasis de Metouia située au Sud Est de la Tunisie est caractérisée par un climat aride où les précipitations sont rares et irrégulières. L'oasis doit donc son existence aux eaux souterraines qui, autrefois, provenaient de sources artésiennes actuellement tarées suite à une surexploitation de la nappe profonde. La pédogenèse actuelle est dominée par l'évolution des processus de salinisation et d'hydromorphie affectant en totalité ou en partie le profil pédologique. Cette salinisation est la résultante des effets cumulés de la salinité des eaux d'irrigation et celle de la nappe phréatique proche de la surface dont la remontée capillaire génère des efflorescences salines. Ce facteur est accentué par l'absence de lessivage des sols et le dysfonctionnement du réseau de drainage. Le suivi des paramètres abiotiques de l'oasis durant quatre années successives (2001 – 2004), a révélé une interdépendance étroite entre la qualité des eaux précédemment décrite et les processus géochimiques qui en résultent d'une part et la dégradation de la zone non saturée, siège des accumulations gypseuses d'autre part. Par ailleurs, aux facteurs précédemment signalés, viennent s'ajouter, la mauvaise exploitation des parcelles et l'absence de règles de gestion du système oasien dans sa globalité. Afin de contrecarrer ces phénomènes qui affectent profondément la sensibilité du système oasien, on a élaboré des recommandations visant l'optimisation des besoins dynamiques en eau, du mode de distribution, ainsi que du réseau de drainage freinant la remontée de la nappe et améliorant l'aération et le lessivage de la zone non saturée.

Secondary salinisation and Arsenic threat in the irrigated fields of Mekelle Plateau of the northern Highlands of Ethiopia

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Due to its semi arid climate, the Tigray Plateau suffers from considerable problems due to water shortage. In a country where agriculture represents the major form of income, ensuring adequate water becomes especially important. This concern was addressed historically by the construction of above 60 community dams throughout Tigray. However, the impact of these dams on the environment has not been researched well. Thus, the purpose of this study was to evaluate the impact of nine dams on the environment owing to soil salinisation and arsenic accumulation in Mekelle Plateau. Hence, a total of twentyseven soil samples and nine water samples were collected and sent to the Analytical Services Laboratory of the International Livestock Research Institute (ILRI-Ethiopia) for examining the magnitude and severity of soil salinity. Additionally, another twentyseven soil samples were collected from the randomly selected irrigated fields in the surroundings of the dams to inspect the arsenic distribution. Accordingly, all the water samples in these dams contain salts, which the TDS varied as little as 147 $\mu\text{g ml}^{-1}$ in *Adigudom dam* to 236.8 $\mu\text{g ml}^{-1}$ in *Gerebsegen dam*. Based on the ratio of soluble sodium percentage to salt concentrations, *May Gasa* and *Gum Selasa* dams were the most salted dams with the amounts of 34.6 and 30%, respectively. Fifty nine percent of the studied soils were saline with the salt level greater than 2 dSm^{-1} at which the growth of major cereal crops can be impaired and the remaining 49 % were greater than 1.25 dSm^{-1} , which are potentially hazardous. The arsenic concentrations in all the soil samples were extremely high, which were varied from 260-440, 260-300 and 260-460 ppm in soils of Koror, Gum Selasa and Kelamino irrigated fields, respectively.

Keywords: Arsenic, irrigated fields, Mekelle Plateau, north Ethiopia, salinity

The effect of immobilization treatments on the plant availability and partitioning of cadmium chromium and lead in salt-affected soils

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Two salt-affected soils differing in texture and irrigated with water containing 20 mg L⁻¹ of cadmium, chromium or lead were used to evaluate the effect of different chemical amendments on speciation, extractability and phytoavailability of metals to wheat. Triplicates of six chemical treatments were tested in pots grown with wheat. The treatments applied were calcium carbonate @ 6 and 12%, gypsum @ 50 and 100% soil gypsum requirement, farm manure @ 15 and 30 t ha⁻¹, and an un-amended control. Calcium carbonate, farm manure, or gypsum not only reduced the extractability of Cd, Cr and Pb in both soils but also significantly reduced the uptake of Cd, Cr and Pb by wheat. However, sequential extraction indicated that the Cd and Pb were dominated in carbonate fraction, while Cr was dominant in organic fraction of both the soils.

Keywords: Phytoavailability, cadmium, chromium, lead, salt-affected soils

Irrigation with saline water induces aggregate dispersion in an arent

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This work deals with the effects of a three-years irrigation with saline water on the loss of stability of aggregates. Irrigation saline waters were prepared as solutions containing 0.5% or 1.0% NaCl (w/v), contrasted with a reference quality water (QW) with no NaCl added. The investigation was carried out on the Ap horizon of a Xeralfic Arent from the Volturmo River Basin (Campania Region). The increasing water salinity led to an increase of pH, E.C. and ESP. To provide a measure of the susceptibility of aggregates to undergo dispersion, suitable aliquots of fine heart aggregates ($\varnothing < 2$ mm) were dispersed in deionized water (W) and in Na-exametaphosphate solution (Na-EMP). After dispersion, particles with size $2.0 > \varnothing > 1.0$, $1.0 > \varnothing > 0.5$, $0.5 > \varnothing > 0.25$, $0.25 > \varnothing > 0.1$, and $\varnothing < 1.0$ mm were collected. In any case, the amounts of particles with overall size $2.0 > \varnothing > 0.1$ mm obtained after dispersion by Na-EMP were smaller than the respective after dispersion by W, as a consequence of a more effective dispersion of pseudo-sand and pseudo-silt stable in water, with an enrichment of the respective fraction with $\varnothing < 1.0$ mm. However, in samples from plots irrigated with quality water, 562 g of particles with $\varnothing < 0.10$ mm per kg soil were obtained after dispersion by W; such amount increased up to 879 g/kg after dispersion in Na-EMP, with a net increase of 317 g/kg. Differently, in samples from plots irrigated with 1% NaCl, a part of $2.0 > \varnothing > 0.1$ mm aggregates were already dispersed by water, so that up to 885 g of particles with $\varnothing < 0.10$ mm per kg soil were collected; such amount increased up to 906 g/kg after dispersion in Na-EMP, with a net increase of only 21 g/kg. A Relative Stability Index (RSI) of aggregates $2.0 > \varnothing > 0.1$ mm was calculated on the base of the respective amount of $\varnothing < 0.10$ mm particles obtained by the contrasted procedures, according to the formula $[(P_{Na-EMP} - P_W)/P_{Na-EMP}] * 100$, where P_{Na-EMP} and P_W represent the amounts of particles obtained by treatment with Na-EMP and W, respectively. The aggregates from plots irrigated with QW showed a relative stability of 36% with respect to the Na-EMP dispersion. Contrastingly, samples from plots irrigated with 1.0% NaCl showed a relative stability as low as 2%, thus indicating that 98% of aggregates were already dispersed by water.

Influence of saline-sodic waters on pore characteristics and water availability of two Iranian soils

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There is little quantitative information about the influence of water quality on soil pore characteristics. This study was done to examine the influence of water salinity and sodicity on pore size distribution (PSD) of two non-saline and non-sodic agricultural soils: a clay and a sandy clay loam from Hamadan province, Iran. All combinations of water ECs of 0.5, 2, 4 and 8 dS m⁻¹ and SARs of 1, 5, 13 and 18 were applied (in total 16 solutions). Pure NaCl and CaCl₂ salts were used to prepare the solutions. Distilled water was also used as control. The soils were poured into cylinders to have an initial similar void ratio of 1.2. In total, 17 solutions × 2 soils in 3 replicates for EC of 0.5 dS m⁻¹ and 2 replicates for other ECs (total 76 soil cores) were used. The soil cores were wetted and dried 5 times with the solutions. After that, soil cores were again saturated with the corresponding solutions and weighed. The water retention (gravimetric) of the soil cores was measured at matric suctions of 10 and 100 cm on a sandbox and at matric suctions of 300 (field capacity, FC) and 15000 cm (permanent wilting point, PWP) in a pressure plate apparatus. The difference between saturated water content and water content at matric suction of 10 was considered as macro-porosity (Macro-P). The difference between water contents at matric suctions of 10 and 100 cm was considered as meso-porosity (Meso-P). The water content at matric suction of 100 cm was taken as micro-porosity (Micro-P). The difference between FC and PWP was considered available water content (AWC). Water quality treatments could affect soil PSD. As water EC increased and SAR decreased, macro-pores and especially meso-pores were destructed and altered to micro-pores due to swelling and particles dispersion. Thus, Macro-P and Meso-P reduced and Micro-P increased when using low-quality waters. Because PSD was affected by water quality, FC, PWP and AWC were changed, too. With increment of EC, FC and AWC were decreased and PWP was increased. With increment of SAR, PWP and FC both increased due to increase of adsorptive surfaces of the soil. The increasing effect of SAR on PWP was greater so that AWC was reduced. The influences of water quality were pronounced for the clay soil. As a result, high values of SAR of irrigation waters decreased available water to plants besides its toxicity and hazardous effects on soil structure and aeration.

Effects of irrigation and fertilization practices on cotton in coastal salinity-affected areas near the Bohai Sea in China

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Food production in the coastal areas surrounding the Bohai Sea in China is mainly constrained by increasing freshwater resource scarcity and land salinity threats. The objective of the research is to determine the effects of various irrigation and fertilization practices on cotton (*Gossypium hirsutum* L.) seedling emergence, and to provide an assessment of irrigation with desalinized sea-ice water and fertilization management practices for cotton crop in the salinity-affected and freshwater-limited coastal areas near the Bohai Sea.

The experiment for cotton crop was conducted at the Zhongjie Farm, located in Huanghua city of Hebei province, on a clay soil with a medium salinity in the coastal areas near the Bohai Sea in China. The experiment was set-up using split-plot design with 2 water sources (well water and desalinized sea-ice water); 2 irrigation methods (with PAM (Polyacrylamide) and without PAM); combined with 4 fertilization treatments: 1) CK, 2) fertilizer (F), 3) fertilizer+manure (FM), and 4) fertilizer+gypsum (FG).

The variation in salinity contents in the soil was large, varying from 0.3 to 14.3‰ measured during cotton seed germination. Seedling emergence rate varied from 11% to 85%. Irrigation with PAM caused a significant increase in seedling emergence (about 154%), as compared with no PAM irrigation. Seedling emergence increased by 220%, 163%, 174% and 404% with F, FM, FG and PAM respectively, compared with CK treatment. There was no significant difference in seedling emergence between 2 water sources.

In conclusion, sea-ice water desalinized is possible to be used as a water resource for cotton irrigation, especially with PAM mineral fertilizer plus gypsum (or plus organic manure) in the salinity-affected and freshwater-limited coastal areas.

Mixed sodium and calcium ions affects the permeability and ion exchange behaviour in saline-sodic soil

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Sodium (Na) and calcium (Ca) ions are the most common ions on the exchange complex, particularly in the arid and semi-arid saline-sodic soils. We examined the effects of the composition of mixed Ca and Na ions on the soil permeability and Na-Ca exchange behaviour for an agricultural sodic soil by carrying out ion exchange transport experiments in saturated columns. Generally the permeability was found to decrease with increasing sodium adsorption ratio (SAR) and decreasing electrolyte concentration. This reduction was attributed to partial blocking of pores by dispersed clay particles, as evidenced by the appearance of suspended clay particles in the effluent during leaching. However, this mechanistic behaviour or “critical threshold and turbidity concentration” occurred at SAR 15. The Na-Ca breakthrough curves at SAR 15 showed an initial increase in the effluent Na following commencement input of the 10mmol/L and subsequently decreased rapidly with decreased input solution to 2.5mmol/L. The effluent Ca concentration decreased progressively with the decreasing input solution. In most cases measured pHs of the solution were found to remain essentially constant during leaching while the electrical conductivity (EC) decreased with decreasing electrolyte concentration.

Keywords: sodium adsorption ratio, exchange reactions, permeability, calcium and sodium ions

Hydrologic, Erosion, Vegetation, and Weather interactions in landscape change: A case study from the Walnut Gulch Experimental Watershed

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In arid and semi-arid regions changing conditions associated with desertification often relate to a system "threshold" that may be crossed when a land area moves from one ecological state to another. In state and transition models, for example, the hypothesis has been proposed that discontinuous and nonreversible vegetation dynamics may occur when thresholds are surpassed and one stable ecological state transitions to a different state. Rarely is such a transition observed under research conditions. The Walnut Gulch Experimental Watershed is a semi-arid research watershed located in southeastern Arizona. During the period of approximately 2004 through 2006 a significant drought was experienced on the watershed. On one of the intensively monitored sites, the Kendall sub-watershed, a shift in ecological state occurred as a result of the drought. In early 2006 it was noted that all of the perennial, largely native, grasses were dead, including the root systems for those grasses, because of extensive drought. Vegetation had been replaced largely by annual forbs. During the summer of 2006 a relatively large rainstorm event occurred on this site. The monitored small watershed at the location experienced a level of erosion for that storm that was far in excess of any that had been measured since the early 1980s, even though many comparable storms had occurred during the monitoring period. It was apparent that the site had become erosionally unstable. Vegetation transects were taken on the site prior to the drought, after the native grasses were dead, and again in the fall of 2006. In the fall of 2006 the annual vegetation had been replaced by perennial grass, but in this case the predominant species was a non-native and less desirable Lehman's Lovegrass. The circumstances of a relatively abrupt change in ecosystem state on a system that was intensively monitored for both vegetation and sediment provide a unique opportunity to document and quantify the circumstances of this transition.

Environmental transition in badlands: an analogue model for the impact of climate change on desertification?

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On a continental scale, the effects of climate change, along climatic gradients, on surface processes and landforms are well understood. In this study, the geomorphic reaction of two badlands, the Zin Valley in Israel and the Dinosaur in Alberta, to changes of rainfall characteristics are analysed. In Alberta, weathering limits erosion rates and the reaction of slope erosion to climate change is therefore largely controlled by its effects on weathering. In the Zin Valley, hillslope erosional response is more complex because the pattern of runoff generating areas, runoff frequency and continuity as well as surface properties are strongly influenced by rainfall characteristics. The analysis of the Zin and Dinosaur badlands shows that relatively small changes in the amount of rainfall have the potential to produce a highly variable range of geomorphic responses. Our understanding of the impact of such climate change on surface processes and landscape development is limited in two ways. First, climate will be in a quasi-permanent state of change, which affects the nature, spatial and temporal patterns of surface processes. Second, over time, surface properties will be altered in response to changing processes, generating themselves a feedback on surface processes. A key element to assessing the impact of climate change on desertification is therefore the recognition of the dynamic interdependence between surface processes and properties. Continuing climate change, accompanied by further land use change on agricultural land, will create environments characterised by a permanent state of transition during the 21st century. The impact of future climate change on surface processes and desertification cannot be addressed, as is commonly done, by simply linking *future climate* to runoff ratios and erosion rates observed under *current surface conditions*. Such an approach ignores the dynamic nature of surface-climate interaction. Geomorphologic research on desertification has to gain a better understanding of such *transitional environments*, in particular the identification of synergies and discontinuities that would alter present surface process regimes beyond the validity of current model projections.

Ecogeomorphological spatial patterns as indicators of desertification in Mediterranean drylands

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The spatial variability of a number of “quick response” ecogeomorphological variables was monitored, for 10 years, along a climatic transect from the Mediterranean climate to the arid zone in Israel. Based on the assumption that along with the expected increase of temperature, rainfall characteristics will change similarly to the present differences in rainfall that occur when shifting from the Mediterranean climate zone to the arid zone, the relationships of climatic conditions – available water – vegetation characteristics – soil properties – overland flow – erosion, were investigated at regional and plot scales.

Concerning the regional scale spatial variability the results show that: (1) soil organic matter content and aggregate size and stability decrease with aridity, while sodium adsorption ratio and runoff coefficient increase; and (2) the rate of change of these variables along the climatic transect is non-linear. A steplike threshold exists at the semi-arid area, which sharply separates the arid ecogeomorphic system, controlled by abiotic factors such as soluble salts content and mechanical crust formation, from the Mediterranean sub-humid system controlled by biotic processes such as plant growth, microbial activity and organic matter production and decomposition. This means that even a relatively small climatic change is enough to shift the border between these two systems. As many regions of Mediterranean climate lie adjacent to semi-arid areas, they are threatened by desertification in the event of climate change.

Concerning spatial variability at the plot scale, different patterns of vegetation cover and of overland flow generation and continuity characterize hillslopes under different climatic conditions. While in the Mediterranean climate area vegetation cover can reach 100 percent and infiltration is the dominant process all over the hillslope, in the arid area vegetation cover is very low, some shrubs concentrates in the lower part of the hillslope and overland flow predominates. In contrast to the relatively uniform distribution of processes in these two zones, a mosaic-like pattern, consisting of locally “wet” water accepting (shrubs) patches and “arid” water contributing (bare soil) patches, is typical of the transitional semi-arid area. Such pattern is strengthened by fires or grazing which are typical to this area. The development of such mosaic pattern enables most rainfall to be retained in the hillslope.

The absolute size of each contributing unite, as well as the ratio contributing/accepting area, increase with aridity. Changes in these factors together with a change in the location along the hillslope of contributing versus accepting water areas can be used as indicators of desertification. Moreover these results are of great relevance for rehabilitation strategies as they illustrate how valuable the vegetation – soil mosaic is in trapping soil moisture on hillslopes.

The *Program* to combat desertification and mitigate the effects of droughts in South America

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The *Program* to Combat Desertification and Mitigate the Effects of Droughts in South America is being implemented at a regional scale. The general objective is to provide a sound basis for addressing dry land degradation and drought in, Argentina, Brazil, Bolivia, Chile, Ecuador and Peru, in accordance with the UNCCD principles.

This initiative is being carried out by a joint effort, represented by the Inter-American Development Bank-IDB, responsible for the administration of the financial resources of a non-reimbursable fund from the Government of Japan and the Inter-American Institute for Cooperation on Agriculture-IICA, as the executing Agency, of the *Program*.

The specific objectives are: (i) to improve the institutional capacity in the participating countries to combat the socio-economic and environmental problems caused by dry land degradation and drought; (ii) to develop and apply the use of standard indicators for desertification; and (iii) to contribute to the reduction or address the causes for dry land degradation and drought. These objectives will be pursued with due consideration of gender and indigenous community participation

Among the specific objectives the harmonization and application of the agreed upon set of indicators, constituted by a 'base-line' of indicators can be highlighted. A computer based 'Desertification Indicator Management System', (Sistema de Gestion de Indicadores de Desertificacion-SIGINDES which will represent the interfacing Geographic Information System-GIS, between the databases of indicators and models to be utilized in the simulation of scenarios), is currently being developed by the *Program* in cooperation with the University of Chile.

In order to establish a common 'base-line', seminars were held in all countries, where specialized agencies and specialists convened to devise an approach and a methodology for the selection of Desertification Indicators (physical, biological/agricultural, and socio-economic and institutional) from a pool of sources already available, based on clear criteria for their selection, usefulness for specific purposes, cost effectiveness of collection or analysis.

Once the methodology and the indicators are defined, they will be tested in various affected dry land areas (Pilot Sites). These tests will be used to improve the usefulness of the Indicators and the generation of comparable data. This testing will be performed by applying a sound monitoring and evaluation system, using the SIGINDES at selected Pilot Sites.

Application of remote sensing with Alsat-1 data followed the desertification in the steppe of Algeria

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The degradation of the natural resources in the arid and semi arid land has drastically been emphasized during this century because of the demographic growth and the transformation of the land use systems. The extension of the cultivated areas in the marginal land and the cattle growth led to different processes of degradation, green cover destruction, over pasture land erosion and their fertility deterioration. The steppe in Algeria is presented in the form of pathways or Alfa and for the majority; these pathways are degraded with low recovery. This, under the aridity affect of the medium and the over pasture which is being forced on this pathways makes the degradation process worse for the physical medium and then lead to desertification. All the time, the politicians have been searching with more or less success to master the natural resources and to diminish the aggressive effects exerted by man in a conscience or no conscience manner on the medium. With all these problems, to which the Algerian steppe, allowing the determination of the lands being damaged by desertification and also to better use the pastoral resources. The work is mainly based on the classification criteria of the arid lands and the steppe, these criteria are numerous, climatic, phytogeographic, pedology and agronomic. The approach is based on the Alsat-1 data images and geographic information system GIS, completed with terrain observation. With regard to the ecosystem fragility a synthesis chart was designed classifying land in to five classes. A deserted class, a very sensible to desertification class, a sensible to desertification class, a more or less sensible to desertification class, a little or most sensible to desertification class.

The DESIRE project: Desertification mitigation and remediation of land – a global approach for local solutions – the first year

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Fragile arid and semi-arid ecosystems are in urgent need of conservation approaches that can prevent and reduce the widespread on-going land degradation and desertification processes, such as erosion, flooding, overgrazing, drought, and salinization. The DESIRE project will establish promising alternative land use and management conservation strategies based on a close collaboration of scientists with stakeholder groups in desertification hotspots around the world. This integrative participatory approach ensures both the acceptability and feasibility of conservation techniques, and a sound scientific basis for the effectiveness at various scales. DESIRE employs a bottom up approach such as is favoured by the UNCCD: i) degradation and desertification hotspots and stakeholder groups will be identified in countries surrounding the Mediterranean, and in 8 external nations facing similar environmental problems, ii) desertification indicator sets will be defined in a participatory way; iii) new and existing conservation strategies will be defined with the stakeholder communities; iv) these strategies will be implemented in the field, and monitored and modeled to quantify their effectiveness at various scales; v) the results will be extrapolated using indicator sets, geoinformation data, and integrated modeling systems combining socio-economic and environmental aspects; vi) finally the results will be translated to a series of practical guidelines for good agricultural practices and environmental management, which will be disseminated to all stakeholders. The DESIRE project started on February 1st, 2007, has 28 project partners and will last 5 years. The results of the first project year will be presented.

Benchmark & Indicators for Desertification Monitoring & Assessment in Asia

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Benchmark & Indicators is the technical foundation of desertification monitoring & assessment. Desertification is a global environmental problem and combating desertification requires not only universal serious-minded attentions but also acceptable, available and effective tools and methods. Benchmark & Indicators is developed and set up in order to reveal the intrinsic characteristics of desertification and the regular patterns of desertification occurrence and development. Based on such Benchmark & Indicators a series of methodologies and standards for desertification monitoring & assessment can be developed and the results can enable informed decision-making for combating desertification with guidance of UNCCD to alleviate the negative effects of desertification and raise of public awareness on desertification and its effects. The existing Benchmark & Indicators system may not be sufficient or suitable for desertification monitoring & assessment at regional level. Improving and standardizing the Benchmark & Indicators system can firstly contribute preparation of desertification mapping. It is essential to work out a common set of benchmarks and indicators that is widely accepted by the region, and eventually by the world.

The proposed indicator system includes four aspects: pressure, state, desertification impact and implementation. Pressure indicators characterize driving forces both natural and man-made, affecting the status of natural resources and leading to desertification. They will be used to assess desertification trends and for early warning. State indicators characterize the status of natural resources including land. Desertification impact indicators will be used to evaluate the effects of desertification on human beings and environment. Implementation indicators will be used to assess the actions taken for combating desertification and to assess its impacts on natural resources and human beings.

The framework of state indicator system is based on three aspects, namely agro climatic region, land use and degradation process. For the pressure, impact and implementation indicators, the framework of the proposed indicator system is in reference to agro climatic regions.

The Benchmark & Indicators proposal has been received from most of the TPN1 member countries so the proposal has been firstly revised to reflect part of the comments and suggestion.

Quantitative assessment of desertification by the desertification model in Tabas Area, Iran

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Arid and semi-arid environments cover more than 75% of Iran which is coincided with desert belt of Earth. Because of climatic-geomorphologic conditions of Iran desertification has been widely recognized as one of the most serious environmental problems in Iran. This issue is also evident in Tabas basin that has selected as case study in this research. In order to quantitatively assess desertification in Tabas basin, a study was carried out in an area of 136000 ha. In this study after information collection and determining the study units (based on geomorphologic faces) a model by the name of IRIFR.E.A was suggested and evaluated. In current study the map of land erodibility to wind erosion was designed by IRIFR.E.A model and intensity and sedimentation potentials of wind erosion have been estimated in each of the study units. The results show desertification was active in the area was on a rise. In the study area, the main factors of desertification were degradation of vegetation and water resources under natural and human effects such as lithology, geomorphology, climatology, overgrazing and unwise exploitation of underground water resources. At the end of this research, the study area has mapped into 4 wind erosion classes. Among the whole area understudy (136000 ha), about 41846ha (30.7 percent) was found to be in very high class, about 20923 ha (15.3 percent) in high class, 31384 ha (23.3 percent) in middle class and 41846ha (30.7 percent) in low class intensity of wind erosion.

Keywords: Desertification, Wind erosion, Assessment, Desertification Model, Tabas basin

Soil degradation indicators for rangelands (Southwest Spain)

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Many rangelands of the world, especially in semiarid and arid areas, suffer problems of land degradation, mainly related with a reduction of the vegetation cover caused by grazing animals, as well as human induced wood extraction and deforestation. Management and planning of rangelands, which occupy large proportions of the world's drylands, require indicators which should be relatively easy to measure, not be too numerous and represent the most important degradation processes of the area. The present paper deals with soil degradation of rangelands in the semiarid and subhumid parts of the south-western Iberian Peninsula. They are composed of grasslands with a varying degree of tree cover, ranging from treeless to 80 individuals per hectare. In some areas, shrubs form a third component of the vegetation. The dominant soil degradation phenomena include different forms of water erosion (mainly sheetwash and gullying) and physical and biological degradation.

In 54 farms, which represent the most important types of rangelands in the region of Extremadura, a methodology for a rapid appraisal of soil degradation is tested. Previous research has shown that land degradation in the area varies strongly with regard to the natural factors, but also with respect to land use and management, justifying the need for working at the farm-scale and also in numerous places distributed throughout the rangelands which cover more than 2 million hectares in the region. A large number of variables are applied, which represent either the present state of degradation or degradation risk. Depending on the erosion process, different features, easily recognizable in the field, are considered. Sheetwash features include, for example, root exposure and tree mounts. In the case of rills, which are not common in the area, their abundance is noted. Gullies and headcuts are mapped and ranked by signs of activity. Soil degradation parameters include bulk density, porosity, water content at field capacity, soil depth, outcropping rocks, stone cover, crusting, organic matter content, aggregate stability and standard chemical properties (Na, Ca, Mg, K, P, N, cation exchange capacity). Parameters used for indicating degradation risk include the abundance of livestock paths and excrements, vegetation cover, slope gradient, texture, rainfall and livestock species and density.

Two indicators composed of various parameters, one for sheetwash and the other for soil degradation, show relationships with several of the risk factors, such as the degree of bare soil, soil depth, rainfall and livestock density. However, the relationships with soil physical and chemical properties are poor. Although the first results are promising, a larger dataset is necessary due to the high variation of the parameters. Furthermore the land use and management indicators need to be quantified with more precision.

Desertification in Europe

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A common misunderstanding is that desertification is linked to the presence of deserts. The truth is that desertification can and does occur far from any climatic desert, as the presence or absence of a nearby desert has no direct relation to desertification. Desertification is the result of human induced land degradation which can be accelerated under severe drought conditions, and can occur under very diverse climatic conditions. This is particularly the case for Europe, with extensive desertification processes occurring both in the Mediterranean and in the Central and Eastern European countries, all severely affected by various human induced land degradation processes. Both areas have been recognized within the UNCCD as affected and are grouped within the convention under annex IV (Mediterranean) and annex V (Central and Eastern Europe) of UNCCD. Main desertification processes occurring in these areas are related to soil erosion, loss of soil organic carbon, contamination, salinisation, soil compaction, soil sealing, loss of soil biodiversity and landslides. These threats have been included in the recently adopted Soil Thematic Strategy of the European Commission and will require urgent action in the near future in order to reverse the negative trends. In addition, increasing effects of climate change due to greenhouse gas emissions start to be detectable also in Europe, and will lead, according to recent scenarios, to a dramatic increase in the next years of extreme climatic events, like droughts, forest fires, flooding and storms. A full assessment of the major degradation processes and their driving forces, pressures, impacts and possible responses still is lacking. Preliminary results already allow for an extensive mapping of major risk areas for the various threats and would form a good basis for National and local action plans, as required by the UNCCD and the Soil Thematic Strategy.

Effect of desertification on livelihood of people in the Upper Mustang Region of Nepal

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Effect of desertification on livelihood of the people in the upper *Mustang* Region of Nepal is clearly visible. Although long-term research information on desertification is not available, an increasing trend of the extent and magnitude of the symptoms has been observed. The characteristics of rain shadow, 0.02 rate of annual rainfall to potential evapotranspiration, and high elevation (more than 2012 meter) indicate semi-arid type of climate in the Region (Yogarcharya, 1997). The Region is facing problem of land degradation due to both climatic (e.g. low rainfall, high wind velocity, freezing of the ground for long periods, substantial flows of snow melt) and human activities (e.g. deforestation, overgrazing, poor vegetation). These factors may have played a prominent role in increasing desertification in the area. Impact of prolonged drought and desertification is indicated by a declining trend in farm productivity.

Farming system is an integral part of the livelihood of the people in the area. The major components covered by the agriculture practice include cereal crops, livestock raising, and cultivation of fruit and farm trees. The system is predominantly traditional and subsistence. At present, considerable areas of land cultivated in the past by the native people are lying fallow. The underlying rationale of not cultivating these lands is not clear. The long-term effect of desertification has led to out migration.

The upper Mustang Region of Nepal is situated north of two Himalayan ranges Dhaulagiri and Annapurna. As the area adjoins Tibet, this area shares the spectacular high desert landscape of the Tibetan Plateau. The people of upper Mustang mostly belong to *Bhotia-Gurung* and *Bista* ethnic groups and speak a Tibetan dialect.

The purpose of the study is to review the effect and impact of desertification on livelihood of the people in the upper Mustang Region of Nepal and share the challenges faced by the mountain people with the groups of intellectual community.

The study paper will include a critical review of current documents, together with analysis of field data and anecdotal evidence to study the effect of desertification on livelihood of the people in the upper Mustang Region of Nepal. The conference topic of the abstract is desertification.

A methodology to appraise and select strategies to mitigate desertification based on stakeholder participation and global best practices

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The main aim of the methodology presented in this paper is to provide a framework for a participatory process for the appraisal and selection of options for desertification mitigation. This methodology is developed within the EU-project DESIRE where it allows to select promising conservation strategies for test implementation in 18 degradation and desertification hotspot sites around the world. The methodology consists of three main parts:

The first part aims at identifying and listing existing prevention and mitigation strategies already applied in the hotspot sites through process-oriented learning during workshops with representatives of different stakeholder groups (land users, policy makers, researchers). The methodology allows initiating a mutual learning process by sharing experience and jointly reflecting on current problems and solutions regarding land degradation and desertification.

In the second step these identified locally applied solutions (technologies and approaches) are assessed with the help of the WOCAT methodology. Comprehensive questionnaires and a database system have been developed to document and evaluate all relevant aspects of technical measures as well as implementation approaches by teams of researchers and specialists together with land users. This research process ensures systematic assessing and piecing together of local information, together with specific details about the environmental and socio-economic setting.

The third part comprises another stakeholder workshop where promising strategies for sustainable land management are selected based on the best practices database of WOCAT, including the evaluated locally applied strategies of the DESIRE sites. A comparative selection and decision support tool allows to assess and negotiate these applied strategies for future implementation at the own site.

Desertification intensified by the impact of human mismanagement on water resources in drylands; examples from Central Iran

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Desertification as the result of recent climatic changes and human impacts is a major environmental issue threatening the livelihoods of millions of people worldwide. Generally, the intensification of land use has been regarded as the main factor in human-induced desertification. This paper addresses the impacts of human mismanagement on water resources in arid lands and with examples from central Iran highlights the importance of desert groundwater resources in alluvial megafans. They are the vast fan-shaped topographic structures well developed along fault-bounded depressions. Desertification is a major problem at the distal parts of these megafans, where they grade into deserts at playa fringes and playa salt lakes toward the centre of these depressions. The ancient people well recognized the water resources in desert environments and this is why they built the cities on alluvial megafans in the desert borders in central Iran. They tried to supply the water by Qanats, an underground irrigation system invented in Iran for >2500 years ago. Recent technology advances in groundwater exploitation replaced the Qanats by deep water wells and the competition and mismanagement in water pumping and consumptions resulted in draw down of the groundwater tables, not only in megafan aquifers but also in playa lakes. This brought along serious problems, among which is the change in the trend of natural processes associated with intensified desertification in such an otherwise very sensitive environment. This study is an example stressing the needs drawing up a plan of action, something considering natural and socio-economic aspects on a local scale, for effective management of the water resources to combat desertification in arid lands. It presents examples for the change of people attitudes toward environmental problems and/or policy interventions toward changes in management approaches at a local scale.

Keywords: Desertification, water resources, drylands, alluvial megafans, central Iran

Rehabilitation of rocky desertification in Southwest China

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Rocky desertification in the karst area of Southwest China is mainly due to intensive land reclamation during the past half century and unsustainable farming practices. The degradation has been undermining the local farm economy and farmer's livelihoods. Resettlement of local residents due to soil erosion of their cropland is of great national concern. The challenge for the central government is to find ways to use public funds to effectively rehabilitate eroded land, restore the ecological balance and maintain chances for sustainable future development of the area. This paper reviews both structural and non-structural interventions taken by the government to tackle the problem and assesses the economic and ecological impacts of the interventions.

Impact of tillage and fertilization practices on enzymatic activities in soil particle-size fractions

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Soil biological and biochemical parameters may have a role as early and sensitive indicators of soil ecological stress and restoration; in particular soil enzymes have been suggested as potential indicators of soil quality because of their rapid response to changes in soil management and environmental factors. In a long-term field experiment near Ancona (Marche, Italy), started in 1994, a rotation between *Triticum durum* and *Zea mais* crops was chosen as a representative site in the national project SOILSINK, to compare no tillage vs. conventional tillage at two N fertilization levels. In June 2007, 12 samples were collected (2 tillage practices x 2 fertilization levels x 3 replicates) on maize soil. Bulk soil samples were fractionated into four particle-size fractions (coarse and fine sand, silt and clay) by a combination of wet-sieving and centrifugation, after low-energy ultrasonication. All fractions were assayed for β -cellobiohydrolase, N-acetyl- β -glucosaminidase, β -glucosidase, α -glucosidase and β -xylosidase, acid phosphatase, arylsulphatase and leucine-aminopeptidase using a microplate fluorimetric assay based on MUB-substrates. Microbial biomass C, total organic carbon and total nitrogen and were also determined on the soil fractions. Enzymes were mainly located in the sand fractions, whereas microbial biomass was highest in the silt fraction, which accounted for 55% of the bulk soil. Microbial biomass and soil enzyme activities in particle-size fractions were affected mostly by the type of tillage and to a lesser extent by fertilization. Enzymatic activities discriminated between the two tillage levels in the coarse and fine sand and in the clay fractions. No tillage on average doubled soil enzymatic activities with respect to conventional tillage. This effect was larger in the coarse sand fraction where an increase of 293% on average was observed. The enzymes more responsive to tillage practices were those related to the C cycle.

Use of GIS and Geostatistical Analysis for Soil Mapping

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Soil maps are particularly used for information on the spatial distribution of soils and their characteristics because they are the fundamental support for crop cover development. Indeed, soil is a primary natural resource; it plays an essential role in the biophysical and biogeochemical functioning of vegetation ecosystems. Understanding the spatial distribution and management of soils is critical to understand the complex balance of chemical and physical processes that make agricultural ecosystems more productive. Today there is great demand for accurate soil information over large areas from environmental and hydrological modelers, civil engineer and land use planners (both urban and rural) as well as more traditional agricultural users of soil resource inventories. Unfortunately, this inventory of soil resources is not always available and its realization still remains a very slow and expensive operation using conventional methods.

Soil resource inventory or pedological mapping is a type of thematic mapping. It consist in determining the patterns of the soil cover, characterizing it, and presenting it in understandable and interpretable form to different users. Despite the increasing demand for soil information, soil mapping has not fully participated in the information technology revolution, especially in developing countries. For example, in Morocco, the inventory of soil resources today does not cover more than 12 % of the country's surface. This situation represents a major restriction for agricultural implementation projects as well as soil conservation planning. This is mostly due to the complexity of soil geography, the hidden nature soils, and the expensive and laborious traditional soil mapping methods. Thus, it is necessary to develop an approach to map the soil surface parameters based on modern and rigorous methods such as GIS, GPS and geostatistics coupled with laboratory analysis. Geostatistics together with GPS and GIS offer a powerful tool for the spatial analysis of soil quality indicators for land management purposes. GPS provides the accurate spatial location of sampling points. Geostatistics is definitely established in soil science as a key tool, which offers opportunities for spatially modelling soil quality indicators at their specified level of interest. It also provides a sound basis for designing optimal sampling plans based on the structure of spatial dependence. On the other hand, GIS provides tools for spatial manipulations, spatial analysis, and overlay of the resulting maps, especially in combining the effects of multiple soil quality indicators. This research explores the potential use of the synergy between GPS, GIS, soil laboratory analysis and geostatistical analysis for soil spatial distribution mapping in semi-arid environments in Morocco. We demonstrate that information technology can be advantageously used to replace expensive traditional soil mapping methods.

Plant canopy classification methodology based on hyperspectral data cube on a polluted mining site

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Remote sensing is the science of acquiring, processing, and interpreting images and related data, acquired from aircraft and satellites that record the interaction between matter and electromagnetic energy. Small bandwidths distinguish hyperspectral sensors from multispectral sensors, acquiring spectral information of materials usually over several hundreds of narrow contiguous spectral bands, with high spectral resolution on the order of 20 nm or narrower. As such, they allow identification of specific materials, whereas broadband multispectral data only allow discrimination between classes of materials.

In this study canopy analysis was presented for the Szárazvölgy flotation sludge reservoir using ENVI 4.3 geo informatics software based on hyperspectral data. This area is a part of Gyöngyösoroszi abandoned Pb-Zn mining site located in northern Hungary, where Záray (1991) reported serious heavy metal contamination.

Canopy analysis was carried out in order to classify the differences between vegetation types at the Szárazvölgy flotation sludge reservoir. Supervised classification methods were used to distinguish 8 vegetation types based on the spectral properties of the area: forest (*Quercus sp.*), young deciduous forest, reed (*Phragmites sp.*) and aquatic plants, false indigo (*Amorpha fruticosa*), Australian pine (*Pinus nigra*), shrub – mainly sloe (*Prunus spinosa*) and dog rose (*Rosa silvestre*), blackberry (*Rubus caesius*), low biomass. The results of the classifications were compared to a ground truth image in order to know the best process for classification. The ground truth image is based on ortophoto, topographic map, and GPS based field data collection. According to results of the comparison, the paralellpiped classification method is proved to be appropriate method based on the overall accuracy of canopy classification, which was 54 % due to heterogeneity of the vegetation. The results showed that hyperspectral remote sensing is an effective tool for the characterization of canopy and monitoring of canopy changes at the examined polluted sites so that the obtained information can be a valid base for modelling soil degradation and erosion.

Evaluation and improving of urban soils fertility state

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Soils from built-up urban areas have been generated as effects of physical impacts of civil or industrial engineering, streets and green areas fitting out, on natural soils. As way of consequence, major physics, chemical and biological transformation were taken placed. Moreover, the pollutant emissions and imissions emanated from industrial and household environment have been contributed to contamination and pollution of anthropic soils generated in urban areas.

Having in mind that the urban soils from farther of center and peripheral areas are often horticulture used in purpose to produce some vegetal origin food for the own consumer or even for commercialization, a good knowledge of the fertility state of these kind of soil is necessary. With this purpose in view, we proposing an urban soil fertility index, that including a series of physics, chemical and biological soil properties. According to the fertility level obtained by this fertility index calculation, we could make concrete proposal on the one hand for agro-technique, agro-chemical measures and on the other hand for combating the pollution potential or removing the effects of pollution phenomenon. The aim of all these measures is obtaining the superior quantities and qualities vegetal origin foods, free of any contaminants and/or pollutants.

Microbial community structure and functionality under peanut based cropping systems in a sandy soil

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Little information is available on soil microbial and biochemical properties, important for understanding nutrient cycling and organic matter (OM) dynamics, as affected by different peanut (*Arachis hypogaea* L.) cropping systems and how they relate to soil functioning. Peanut is typically produced in sandy soils, which have lower numbers and diversity of microbial populations and nutrient availability compared to soils with higher clay and OM contents. Thus, we investigated the properties of a loamy sand (fine-loamy, kaolinitic, thermic Plinthic Kandiudults) in Georgia, which is first in peanut production in U.S., after 5 and 8 years under continuous cotton (*Gossypium hirsutum*, L) (CtCtCt), cotton-cotton-peanut (CtCtPt), corn (*Zea mays* L.)-peanut-cotton (CrPtCt), peanut-peanut-cotton (PtPtCt), and continuous peanut (PtPtPt). Soil organic carbon, phosphatases activities, and fungal and bacterial populations were higher under peanut-based cropping systems (PtPtPt, PtPtCt and CrPtCt) than under cotton-based cropping systems (CtCtCt and CtCtPt). The activities of glycosidases involved in C cycling were more sensitive to the cropping systems than phosphatases, and showed a distinctive cropping system separation: PtPtPt>CrPtCt>PtPtCt>CtCtPt>CtCtCt. This study demonstrated distinctive positive effects of peanut based crop rotations (i.e., CrPtCt and PtPtCt) on organic matter and the microbial component of this sandy soil that should be considered in management decisions targeting the selection of cropping systems for peanut production to maintain and/or improve soil quality, functionality, and sustainability of agricultural production.

Crop rotation and tillage effects on a rhermic ustalf on the Southern High Plains of Texas

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Considerable research has indicated that changing from plow tillage to no-, minimum- or conservation-tillage will, for many soils, result in improved soil physical, chemical, and biochemical quality. Recently however, some researchers have reported that for sandy soils in warm temperature regimes, the benefits may not be as apparent or even be absent when compared to finer soils or soils in cooler temperature regimes. We have completed three rotations of cotton following sorghum and two rotations of cotton following cotton following sorghum on a Thermic Ustalf at the Big Spring Field Station near Big Spring, Texas, USA. Superimposed on these rotations are four tillage and residue management treatments consisting of 1.) conventional tillage of two passes with a disk plow followed by raising beds on 1 m spacing, 2.) ridge tillage where 1 m spaced beds are raised around the standing residues from the previous crop, 3.) no-tillage where the crop residues are shredded to within 15 cm of the surface, and 4.) no-tillage where the crop residues are left standing at full post-harvest height. The tillage and residue management treatments have resulted in dry matter and economic crop yield differences and differences in observed wind erosion. We will report differences in soil physical, chemical, and biochemical properties noted from intensive soil sampling of the study site to be conducted post-harvest 2007.

Regional impact of re-vegetation on water resources – A case study in the Loess Plateau

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Re-vegetation is considered one of the most efficient measures for controlling severe erosion on the Loess Plateau. Many research results show that re-vegetation can make impacts on water resources, such as hydrological circle attributes, runoff and soil water. This research was performed in the Coarse Sandy Hilly Region of the Loess Plateau. The objective was to develop a software tool to evaluate and predict the impact of re-vegetation on water resources. The outputs include regional spatial databases for climate, river flow, land use, vegetation and DEMs, and vegetation suitability assessment models. Based on these models a series of maps of the suitability and longevity of the proposed re-vegetation schemes can be produced by the developed tool, taking into account rainfall, potential ET, water requirements of different vegetation types, landscape position and changes to the soil moisture. A decision support tool called ReVegIH (Re-Vegetation Impacts on Hydrology) was developed from this research. ReVegIH provides a means for users to: (1) determine where priority (and target) re-vegetation activities should be undertaken; (2) ascertain what species are suitable for a specific location; and (3) simulate the related hydrological impact, and should therefore greatly assist in environmental planning and management within the Yellow River Basin.

Keywords: Re-vegetation, water resources, impact, Loess Plateau

Study on soil management strategies enhancing crop production and soil conservation

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Nowadays, due to the overall attention developed on environmental topics, the challenge for soil scientists is to identify eco-compatible farming techniques that at the same time do not leave out crop productivity. In step with this general trend, the “Dipartimento di Scienze delle Produzioni Vegetali” of Bari University has been carrying out a long-term field research (set up in 1972) aiming to evaluate how different soil management strategies perform crop production improvement and soil quality maintenance jointly.

The soil management strategies tested are three cropping systems (a three year crop rotation [SW₁bW₂]: sugar beet S, wheat + bean double-crop W₁b, wheat W₂; a wheat + bean double-crop [Wb]; a continuous wheat monoculture [CW]), three fertilizer levels and two crop residues management modalities (burning [B], incorporation [I]).

For the productivity aspect, different quantity and quality parameters of wheat production were analyzed: number of spikes m⁻², grain yield, hectolitre weight, 1000 kernel weight.

In order to estimate the potentiality of the soil management strategies compared in preserving soil quality, soil texture, water extractable organic C (WEOC) and N (WEON), estimated crop C input were considered. The selection of these parameters was based on previous results concerning some basic physical and chemical soil quality indicators that showed absence of statistically significant differences and then prompted to investigate the main factors linked with SOM turnover. In particular, soil texture was chosen because it is well known that clay plays an important part in SOM turnover; WEOC-N were taken into account as indices of SOM qualitative variation; estimated crop C input to evaluate the role of crop species in influencing SOM level.

Soil evolution on gypsum quarry rehabilitation influenced by the organic amendment rate

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Open cast gypsum mining rehabilitation is made difficult because the original soil resource is not retained and local substitute materials, that is, soil-forming materials (*SFMs*), have to be used as growing media. One severe limitation of *SFMs* is their poor inherent structure and nutrient content, mainly derived from their low organic matter (OM) content. Soil development may be accelerated through the use of soil organic amendments. In this sense, composted residue addition to soil has been considered an effective method for carrying out successful rehabilitation programs under semiarid conditions. Moreover, plant community composition greatly depends on the organic amendment rate applied to the soil so that rehabilitation success is determined by the treatment. The restoration strategy was mainly based on subsuperficial organic amendment (MSW compost) and topsoil replacement. A 6-year field experiment was conducted in 2 landfill materials (gypsum fines and sterile material) to evaluate the effect of the addition of a composted urban residue (at the rates of 0, 10, 30 and 50 Mg ha⁻¹) on the evolution of soil chemical properties of the superficial and subsuperficial layers. The changes produced in the content of total organic carbon (TOC), N (Kjeldahl) and available P, K, Ca and Mg were evaluated using a multivariate statistic tool (discriminant analysis). This evolution was compared with autochthonous gypsum soil profiles. The results showed that moderate MSW compost rates are a useful management practice for the rehabilitation of landfills in gypsum quarries. As it has been established, primarily P, TOC and N limited soil development in the initial stages of surface mine landfill rehabilitation. Although the reconstruction of the superficial layer was highly fast, the subsuperficial layer seems to need further time than the period considered.

Keywords: organic amendment, gypsum quarries, soil rehabilitation, compost

Water infiltration in a deeply disturbed Oxisol as influenced by different revegetation systems

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Reclamation of soils and deep regoliths disturbed by public works is a very important issue for environmental preservation. The aim of this study was to assess the vegetal cover used as green manure and soil infiltration during the rehabilitation of a deeply excavated lateritic saprolite. The experiment is located in Mato Grosso do Sul (Brazil). The undisturbed soil was an Oxisol under “Cerrado” natural vegetation. Soil horizons were removed to a depth between 5 and 8 m during the construction of a hydroelectric power plant. On the remaining saprolitic material a field trial was set up. Treatments included different crop covers and also sludge application, leading to contrasted levels of soil organic matter content as follow: 1) *Astronium fraxinifolium* a wooden species, 2) *Astronium fraxinifolium* + *Canavalia ensiformis*, 3) *Astronium fraxinifolium* + *Crotalaria juncea*, 4) *Astronium fraxinifolium* + *Brachiaria decumbens* + sewage sludge. These treatments were compared to a control treatment on the residual soil and to a treatment on the natural soil under “Cerrado”. Structural stability and porosity were indirectly assessed by soil water infiltration. The sensitivity of this soil physical property as indicator of the efficiency of the rehabilitation treatments also was statistically assessed. Results confirm the well-known role of organic matter content and soil tillage in increasing soil porosity, thus the infiltration rate of treatments with vegetation cover in comparison to the unvegetated control. However, recovery of soil porosity in the saprolite was far from the status which characterized the natural soil before disturbance.

An integrated (furrow-biogeotextile in alley cropping) cultivation system to improve the sustainability of rainfed highland agriculture in Thailand

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Traditional Thai hill farming systems are leading to severely degraded soil productivity and agro-environmental problems. Response strategies involve identifying appropriate cultural practices to sustain soil productivity, increase crop production and improve environmental quality. Three-year field experiments under two parallel projects have evaluated the agro-environmental effects of integrated techniques during 2004-2007. Experimental plots were established on farmer's cultivated land in two catchments. Site A (18°31'05"N, 98°17'30"E, altitude 1,245 m, slope gradient 120%) is in Chiang Mai Province. Site B (19°33'47"N, 98°12'9"E, altitude ~980 m, slope 80%) is in Mae Honson Province. Experiments at Sites A and B consisted of 15 and 12 subplots (5x30 m each) with a completely randomized design, with three replicates of 5 and 4 treatments (combinations of geotextiles, furrow cultivation and alley cropping with contour cultural practices), respectively.

Treatments at Site A were: (i) conventional contour planting (CP), (ii) contour planting mulched with bamboo geotextile mat (CP-BM), (iii) contour furrow planting mulched with bamboo mat in the furrow (CF-M), (iv) contour furrow planting in alley cropping (CF-AL) and (v) contour furrow planting mulched with bamboo mat in alley cropping (CF-M-AL). Site B had the same treatments as Site A (CP, CF-AL and CF-M-AL), except Imperata grass (*Imperata cylindrica*) panels were used as biogeotextiles, and the hedgerow in CP-AL had the addition of vetiver grass rows (CP-AL-VG). Annual multiple crops were sown in a relay cropping system, with rotations of sweet corn (*Zea mays*), upland rice (*Oryza sativa*) and lablab bean (*Lablab purpureous*) during early-mid, mid-late and late summer rainy season, respectively.

Similar results were obtained from both sites. CF-M-AL was the best, and CF-M or CF-AL, were the second best, for improving soil properties, decreasing soil erosion and runoff, increasing rainfall harvest and total stored soil water during the wet period, leading to increased rainfed multiple crop yield production, compared to either CP, CP-BM or CF treatments. Generally, the most effective practices to improve sustainable rainfed hill farming were such composite systems (contour furrow cultivation, mulch with biogeotextiles and alley cropping with hedgerows of mixed fruit trees and leguminous ground cover crops).

Keywords: Anti-erosive technique, Furrow cultivation, Biogeotextiles, Alley cropping, Water harvest technique, Soil erosion

The impacts of direct seeding on soil and environment protection in the Mediterranean climate

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A principle key of direct seeding into mulch (DSM) system is the retention of crop residues on the soil surface to preserve soil water for crop growth. In response to the negative impact of soil degradation processes under conventional cropping systems that are based on soil tillage, DSM system without tillage practices and with protective cover of crop residue are being developed in many parts of the world. Apart from the positive effect on soil conservation and sustained land productivity, another major impact of DSM is decreasing labour costs, generally leading to higher income and a better standard of living for the farmers. Water is often a major limiting factor for crop production. Soil water availability is directly related to environmental factors i.e. precipitation, evapotranspiration, soil type and topography, but may be influenced by agronomic practices, including irrigation, fallowing and sowing time, or via specific water conservation practices, such as terracing and mulching. However DSM is a successful system especially in the south of America, but the impacts of system in the Mediterranean climate especially in the south of France is less well known; so that this study has been carried out within the scope of an European project. Durum wheat was sown for two years on Lavalette experimental site in Montpellier (43° 40'N, 3° 50'E, altitude 30m) in the south of France. There were two main treatments: DSM and conventional tillage (CT). There were different irrigation and nitrogen rates. Crop production, water and nitrogen balance, soil bulk density, plant density, infiltration rate, soil temperature and soil water content in different layers, soil preparation time and diesel oil consumption, root development, soil carbon, soil nitrogen and soil organic matter were assessed and compared in these two systems.

The results show that the crop production is higher in CT system, where nitrogen losses and water use efficiency are higher too. In environmental protection view, DSM system has more advantages such as increasing soil water content, soil carbon, soil nitrogen and organic matters which may have a direct and positive impact on the soil quality. DSM decreases soil preparation time, diesel oil consumption and nitrogen losses, which mean that DSM could mitigate CO₂ emission by decreasing fossil fuels consumption. The results show that the presence of mulch can limit soil evaporation and stores extra soil water content, which is suitable for crop and mineralization during dry periods. DSM decreases soil temperature and moderates its fluctuation in the top soil layer which the first effect can increase the necessary time for plant emergence for winter crops. All in all, DSM can be considered as a reliable alternative crop system in the Mediterranean context.

Soil rehabilitation and improvement in carrying capacity of alpine and sub-alpine pasture lands through agrostological interventions and weed management

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Alpine and Sub-alpine pastures are the life-line for nomadic population comprising of Gujjars and Bakarwals of Jammu hills who follow age-old practices of moving throughout north-west Himalayan tracts of India with a change of climatic conditions mainly to meet the grazing requirements of their cattle especially sheep and goats. Of late there has been a steady decline in the productivity of these pastures due to resource base degradation mainly attributed to excessive soil erosion and encroachment by certain aggressive weed species leading to extinction of traditional grass species. After extensive survey of these alpine and sub-alpine areas one location each in Rajouri (Doba), Bhadarwah (Sartingle) and Poonch (Nadian) were taken up for agrostological interventions to encourage healthy sod culture in these pastures. It was observed that the soil fertility was relatively good with nutrient availability in medium ranges but there was a steep decline in soluble nutrient contents with increase in altitude. Prominent grasses of these areas were identified as *Phelum alpnium*, *Poa supine*, *Poa annua*, *Fragaria* spp., *Trifolin* spp., *Festuca giganta*, *Danthonia cachemyriana* and *Puruella vulgaris* contributing to a major chunk of forage supply. There was a massive encroachment by various weed species on degraded areas which were identified as *Aconitium heterophyllum*, *Euphorbia* spp., *Ranunculus* spp., *Rumex nepalensis*, *Sonchus* spp., *Datura* spp., *Cirsium arvensis* and *Stipa* spp. The frequency of almost all the weed species was more pronounced during the summer months of June to August. The herbaceous weed density varied from 0.01 to 2.5 per sq. m with highest biomass productivity and density recorded in case of *Rumex* spp. Brush weeds population varied from 1700 to 3600 per hectare giving a hay yield of 12 and 5.5 q/ha, respectively as compared to a hay yield of 43 q/ha obtained in weed free areas. Application of picloram @1.5kg/ha before spring regrowth and dicamba @ 1kg/ha at one leaf stage of forage grasses obtained 87 and 83.5 per cent weed control efficiencies. It was observed that the weed problem in grasslands was aggravated mainly in areas with under or over grazing, poor soil and water conservation and lack of fertilization. Introduction of genetically superior grasses with good grassland management techniques helped to increase the productivity in hill pastures.

The effect of different soil tillage systems on soil physical characteristics and crop yield of main crops from the Moldavian plain, Romania

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The effect of different soil tillage systems on soil physical characteristics and crop yield of main crops from the Moldavian Plain were studied during 2002-2006. Experiments were established in split-split plots on a typical cambic chernozem of clay-loam texture, with a 3,4 % humus and 7 pH value and a moderate level of mineral nutrients. We have investigated two variants of classical soil tillage system – ploughed at depths of 20 cm and 30 cm– and two variants of minimum tillage – one Chisel-tilled variant and one disk harrow-tilled variant – in beans/wheat/maize crop rotation. Hydrophysical characteristics variation have recorded reduced values with the increase of soil depth and growing stages, no matter what kind of tillage system has been used. The values of these indices have been bigger with the increase of soil mobilization. The soil compaction indicators had lower values at emergence time and in tilled layer; for each variant, it has increased with depth and once with vegetation development. During the vegetation period, the highest compaction was found in ploughed variants with furrow inverting; the differences between the values of compaction degree at the emergence, in vegetation and until harvesting were the highest, especially at a depth of 10-20 cm. The values of total porosity decrease from sowing to harvesting in all tillage systems variants and the mean values of this indicator have been bigger with the increase of soil mobilization. The aeration porosity was not significantly influenced by depth, growing stages or tillage systems. The structure hydrostability, regardless of the vegetation stage or tillage variant, has increased once with depth, reaching maximum values in the 20-30 cm layer, at ploughed variants. The tilled variants without furrow inverting had high values of structure hydrostability in the upper layers (0-20 cm). The Chisel-tilled variant had, on the average, the best structure hydrostability, at a depth of 10-30 cm. The tillage system and level of fertilizer determined the difference between wheat, maize or beans crop production, usually the yields being higher in conventional variants but not always statistically significant.

An ecosystem approach for the rehabilitation and management of degraded lands of Southern Guam

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Soil erosion and land degradation is a major concern among soil and agricultural scientists in the islands of Micronesia. Accelerated erosion threatens both the soil resource base and downstream environment in southern Guam. The challenge facing soil and agricultural scientists is to develop conservation and restoration strategies that address crop production needs within a framework of increasing environmental and financial constraints. Toward this end, we will emphasize crop residue management and green manure as means of restoration and conservation of badly eroded soils of southern Guam and the other islands in Micronesia.

In this investigation, an integrated approach is designed to evaluate a variety of options, including the effect of conservation tillage, crop rotation with leguminous plants as green manure for organic matter build up, and residue management for soil conservation. An annual legume cover crop (sunhemp) is being planted in rotation to corn as green manure to provide a baseline nitrogen source and increase the organic content of the eroded soils.

The objectives of this project are: 1) To evaluate cropping rotation and tillage management for increasing the organic matter content and improve the overall quality of these severely eroded soils (2) To evaluate the restoration of the productivity of eroded soils and (4) To assess the effects of conservation practices and restoration techniques on water runoff and infiltration.

Twelve field plots (33ft X 28ft²) are set up at the Ija experiment station in southern Guam for this project. No-tillage, Reduced Tillage, Conventional Tillage with rotation with sunhemp, and Conventional tillage with no crop rotation (control) were set up to study the effect of tillage treatments and plant residue management on runoff and water infiltration into these severely eroded soils of southern Guam.

In this presentation, the methodology as well as up-to-date data will be presented to illustrate the effect of different farming practices and conservation strategies for the restoration of severely eroded soils of southern Guam.

Keywords: Soil and Water Conservation, Land Degradation, Soil Rehabilitation, Tillage Treatment, Crop Residue Management, Runoff and Water Infiltration

The influence of conventional and unconventional tillage systems on the physical properties of a chamic chernozem from the North-East of Romania

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For plant growth it is desirable to have a physical condition in which the soil is in optimal conditions, friable, where porous assemblages of aggregates permit the free movement of water and air, easy cultivation and planting, and unobstructed germination and root growth. The experiment carried out during 2005 - 2007, was located in the East part of Romania, at the Experimental Farm of the Agricultural University of Iași (47°07' N, 27°30' E), on a chamic chernozem with a clay-loamy texture, 6.8 pH units, 2.7 % humus content and a medium level of fertilization. The experiment was in a "divided plots design" with three replications. Plots covered surface of 60 m², seeded with maize, in soy-bean, winter wheat, maize rotation system.

Each set of plots received annually the following treatments: Tillage systems: – **conventional**, ploughed at 20 and 30 cm – **unconventional**: disk harrow, chisel + rotary harrow, paraplow; fertilizers – two variants: N₈₀P₈₀ and unfertilized. Soil bulk density (BD) is a useful parameter in the studies of soil and crop responses to machinery traffic in agriculture. BD at maize (*Zea mais*.) had the lowest value at the seeding time at 0-10 cm depth. The values grow on 10-20 cm layer recording the greatest intensity in the Disk harrow variant. Soil penetration resistance (PR) was measured after sowing, during the growing period, and at harvesting, using a digital penetrometer (Eijkelkamp equipment, The Netherlands). Ten penetration resistance measures were taken from each plot from the soil surface to a soil depth of 50 cm. Soil strength in the upper layer of soil profile has usually been observed to be greater under minimum tillage systems compared to conventional tillage

Several methods have been proposed to determine soil aggregate size distribution and stability (Kemper and Rosenau, 1986). The suitability of these methods depends on the purpose of the study. The most widely used approaches are based on the wet-sieving method (Kemper, 1966; Kemper and Rosenau, 1986). The macrostructural hydrostability degree for all five tillage treatments showed an increasing trend from sowing to harvesting period. Thus, at the sowing time, we had the biggest average value at the Chiesel + rotary harrow variant and the smallest one at Disk harrow treatment.

Polyacrylamide Molecular Weight and phosphogypsum effects on infiltration and erosion in semi-arid soils

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Seal formation at the surface of semi-arid soils during rainstorms reduces soil infiltration rate (IR) and causes runoff and erosion. Surface application of dry anionic polyacrylamide (PAM) with high molecular weight (MW) has been found to be effective in stabilizing soil aggregates, and decreasing seal formation, runoff and erosion. The objective of this study was to investigate the effects of surface application of granular PAM (20 kg ha⁻¹) of two MW (2x10⁵ and 1.2x10⁷ Dalton) together with phosphogypsum (PG) (4 Mg ha⁻¹) on the IR, runoff and erosion from semi-arid soils ranging in clay content between 8 and 65 percent, during simulated deionized water rainstorms. Spreading dry PAM (both MWs) mixed with PG was effective in increasing soil IR (3-5 times) and reducing erosion (2 - 4 times) relative to the control. PAM with moderate MW was as effective as PAM with high MW in its effect on IR and runoff. Conversely, PAM with moderate MW was more effective in reducing soil loss than PAM with high MW. For instance, in the sandy clay, application of amendments resulted in comparable final IR values (15.2 and 15.9 mm h⁻¹), while soil loss decreased from 838 g m⁻² (in the control) to 371 and 569 g m⁻² for the PAM with moderate and high MW, respectively. Our results were not consistent with former studies on the effects of PAM MW, probably due to differences in the methods of PAM application and soil types.

Tillage, cropping system and crop residue removal effect on aggregate stability of a Vertic Calcixeroll in semiarid Morocco

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Soil aggregate stability is the major factor controlling hydrodynamic properties (permeability and erodibility) at the soil surface and governing transfer of energy and movement of fluids through the profile. However, this soil physical quality is affected by land use and management. In addition, aggregate stability is also a function of chemical and biochemical properties of the soil, mainly its organic matter. In order to seek effects of various tillage and cropping systems on aggregation, long-term experiments were initiated respectively in 1987 and 1994 in a semi-arid research station of Morocco. Among pertinent findings were: build-up of well aggregated surface horizon under no-tillage, improvement of aggregation with addition of surface residue, and a yearlong favorable aggregation under this system as compared to conventional tillage. We have also shown that wet aggregate stability is a better soil quality index than dry aggregate distribution (mean weight diameter) in expressing differences among soil management systems. It was also reported that fallowing reduced aggregation. It was suggested to test other aggregation measurement methods and study the organic matter mediated aggregation process over time.

Keywords: Soil moisture, dry aggregate, wet aggregate, soil quality, no-tillage, rotation

Management of soil contaminated with urban industrial toxic wastes of Wazirpur, Delhi

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Land disposal of Industrial toxic wastes has posed a serious threat to Soil degradation. The present study was undertaken to ascertain the seriousness of soil degradation and to find out some suitable management practices. The industrial wastes of Wazirpur, Delhi, are heterogeneous and highly acidic (Av. pH – 3.05) in nature containing a large amount of macro and micro-elements including toxic heavy metals (viz. Fe, Mn, Zn, Cu, Cr, Cd, Ni & Pb). Representative waste samples were observed to contain higher amounts of Fe, Mn, Cr and Ni and other metals viz. Pb, Cu, Zn and Cd were low in concentration. Soils used in this pot culture experiment were collected from JNU (Jawaharlal Nehru University) Nursery (uncontaminated) and Chhattarpur Farm-House (contaminated) They were sandy loam, alkaline, low in available Nitrogen, Phosphorus and C.E.C., but differing in other properties. Both Total as well as DTPA available metal concentrations in Chhattarpur control soils. Both Total and DTPA available metal concentrations in representative waste samples were many times higher than those in both the control soils.

The waste samples were lime treated @ 0%, 0.5% and 1.0% and then mixed with homogenized JNU and Chhattarpur soil samples separately with different percentages (10%, 20% and 30%). Pea (*Pisum sativum*) and Wheat (*Triticum aestivum*) plants were grown in pots containing these two soils amended with the treated and untreated wastes maintaining 50% moisture of their Water Holding Capacities in a Glass-House Chamber at a constant temperature of around 25°C. The samples of Soils and Plants (Roots + Shoots) were collected at the different stages of plant growth. The Seeds/ Grains of the pea and wheat crops were harvested at the end of the experiments. The samples of Soils, Plants and Seeds / Grains were properly processed and chemically analyzed.

The chemical analysis of the experimental Plants revealed that the concentrations of heavy metals showed significant increase with waste application and the growth period. The Lime Treatment @0.5% and 1.0% lowered the concentration of all the heavy metals studied. It was found that the pea plants were more susceptible than the wheat plants towards metal toxicity and soil acidity. This fact was supported by the estimation of Translocation Factor (TF) from root to shoot which was higher in pea plants as compared to wheat plants. Larger amounts of heavy metals were retained in roots except in a few cases. The Bio-Concentration Factor (BCF) has been utilized for uptake of heavy metals by plants. The BCF in Pea shoot varied in the order: Mn>Fe>Ni > Zn >Cd > Pb > Cu in all the treatments of both the soils. The BCF in Pea Seeds followed the order: Ni >Cr > Fe= Mn >Pb > Cd = Zn > Cu. Whereas, the BCF in Wheat Shoot varied in the order: Fe > Mn > Cr > Ni > Pb > Cd = Zn > Cu. And the BCF in Wheat Grains followed the order: Fe > Mn > Ni > Cr > Pb > Zn > Cd > Cu. The BCF in Seeds / Grains of Pea & Wheat were quite low as compared to the corresponding values in Shoots of these Plants.

Out of the eight (8) heavy metals studied, three (3) heavy metals viz. Cr, Ni & Pb were found to exceed the permissible limits (USEPA) not only in shoots & leaves but also in the seeds / grains of Pea & Wheat crops harvested with reference to pots of 20% & 30% waste amended soils. The Food procured from all the samples with reference to the treatment of 10% waste with 1% lime amended soils were found to contain the heavy metals within the permissible limits.

Agricultural recultivation of sterile dumps resulted from surface mining within Rovinari Lignite Bearing Basin

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The surface mining within the CNLO framework affected 18,443 ha of which 13,680 ha agricultural land and 4,763 ha forest land. The Rovinari Lignite –Bearing Basin has the largest land area affected by surface mining (9,429 ha of which 7,342 ha agricultural land and 2,081 ha forest land).

From this total land area, within this company, 5,287 ha were available for recultivation, of which 3,807 ha for agricultural use and 1,480 ha for forest use. Such kind of land within the Rovinari Lignite-Bearing Basin covers 3,611 ha of which 2,442 ha for agricultural use and 1,168 ha for forest use.

The recultivation procedure includes two stages: the technical mining stage to develop the sterile dump for its recultivation; and the biological stage to cultivate the plants and to apply the fertilizers in view to increase the fertility of the dump materials.

The field experiments carried out in this view revealed:

- Best results are obtained by cultivating the mixture of oats and *narrow-leaved vetch*, of *Lolium perenne*, alfalfa, *Lotus corniculatus*, sorghum and maize;
- Fertilization system should include high rates of organic (40-50 t/ha) and mineral (N₁₅₀₋₂₀₀P₈₀₋₁₂₀K₈₀₋₁₂₀) fertilizers;
- Green manure (*Lotus corniculatus*, mixture of oats and *narrow-leaved vetch*, *Vicia sativa*, peas, *Sorghum sacharatum*) are recommended supplementary to the organic fertilizers;
- Presence of coal residues in the dump materials allows to increase the rates of mineral fertilizers and to obtain significant yield increases;
- Chopped vegetal residues incorporated in soil plus 50-100 kg/ha nitrogen are recommended for soil organic matter reserve increase, soil water conservation and biological activity in dump materials;
- Bacterization of all the legumes before sowing is recommended;
- Regardless the chancel form of fertilizers, the nitrogen assures similar yield increases;
- Yield increases per one kg of NPK in the first years are low, but they are improved as the dump rehabilitation process develops.
- Plants grown on sterile dump are without chemical elements at the harmful levels of their quality;
- As a result of a long term application of high amounts of organic and mineral fertilizers, an incipient process of an Anthropic Protosol amelioration is observed.

Sustainability of Irrigated and Tank-fed Rice Farming Ecosystems in South India

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The study was conducted by collecting the data from hundred rice growing farmers in Mandya and Tumkur districts of Karnataka, India, at irrigated and tank-fed ecosystems respectively. Results of the study revealed that tank-fed ecosystem is more safe when compare to irrigated ecosystem with a mean ecological safety index of 54.62 and 40.60 respectively. With respect to economic security of rice farming, it was evident that the irrigated system was more economically better secured with an index of 64.92 than tank-fed (52.59). In case of social stability of rice farming, irrigated rice ecosystem was having high mean social stability index of 49.46 when compare to tank fed rice cultivation having social stability index of 41.96. Nutrient and water management was better in tank fed rice ecosystem with mean index of 55.9 and 63.33 than in irrigated rice ecosystem (54.74 and 45.82). Integrated Pest Management was more superior with an index value of 48.95 in tank- fed ecosystem when compared to irrigated rice farming (38.22) ecosystem. Crop yield security was highest in irrigated situation (82.16) and it was least (65.64) in case of tank-fed situation. Supremacy of irrigated rice farming was observed in case of land and Input productivity with an index values of 5.72 tones per hectare and 3.019 when compared to tank fed rice farming situation (3.81 tones / hectares and 2.199). Information self-reliance and family food sufficiency was exhibited highest in irrigated rice farming ecosystem, however tank fed system was superior with respect to input self sufficiency.

Dependency on purchased inputs, hired labors and chemical pesticides, no crop rotation, imbalanced use of inorganic fertilizers, non adoption of precautionary measures, improper water management after fertilizer application, inadequate use of organic manure, non use of micronutrients and no control over standing water in the fields were the major reasons for low sustainability of irrigated rice farming. In case of tank-fed rice farming system, dependency on purchased inputs, lack of information reliance, dependency on purchased inputs, poor input productivity, imbalanced and inadequate use of organic manures and inorganic fertilizers, non use of soil amendments, susceptibility to external threats and dependency of hired labors are the major reasons for low sustainability in tank fed-rice farming situation. Finally the paper suggests measures to improve sustainability of irrigated and tank fed rice farming ecosystems with suitable extension strategies.

The potential for vegetation restoration from soil seed bank in abandoned croplands on the hilly-gullied Loess Plateau, China

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The aim of this study was to identify the characteristics of soil seed bank, the relationship with standing vegetation, and the potential significance of soil seed bank for vegetation restoration in abandoned croplands on the hilly-gullied Loess Plateau, China. The results of field survey, direct germination and correspondence analysis showed that the soil seed banks density ranged from 900 to 6 467 seeds m⁻² at 0-5 cm depth, 117 to 2 467 seeds m⁻² at 5-10 cm depth, with species richness of 7-14. The early successional species *Artemisia scoparia* dominated in the soil seed bank, but the dominant species of the later successional vegetation stages occurred at very low density in the soil seed bank. The compositional similarity between soil seed bank and standing vegetation was low, with the Sorensen similarity coefficient between the seed bank and the standing vegetation ranging from 0.143 to 0.414. The most important variables discriminating community variation were: soil water content, extractable P, soil seed bank density, and aspect. Soil seed bank alone explained 32.1% of the standing vegetation community variation. These results show that the potential of vegetation restoration from the soil seed bank is limited and that restoration is a slow process. It is recommended to transplant some later successional species such as *Bothriochloa ischaemun*, *Artemisia gmelinii*, *Lespedeza davurica*, *Stipa bungeana* into abandoned croplands to accelerate vegetation succession and reduce or even prevent soil loss on the hilly-gullied Loess Plateau.

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Keywords: Correspondence analysis, Direct germination method, Eroded lands, Loess Plateau, Seed-bank density, Similarity

Determination of soil physical and chemical properties in pure stands of oak (*Quercus Castaneifolia*) in Galandroud forest (North of Iran)

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This research was carried out at four stages: 1-information and background collection, 2-field sampling. 3-soil test 4 – statistics analysis. At first stage, all information related to silviculture, climatology, geology, pedology, hydrology and etc were collected. At second stage, three distincts of galandroud forest, which were located in north of Iran and contain pure stands of oak, were selected. In each distinct, six samples with 2000 square meter area were allocated. Then in the center of each sample, soil profile was dug with 1.5 m depth. Moreover, 30 dominant trees of oak were chosen and statistical parameters of them were measured, then, the accompanied plants were identified. At third stage, many parameters of soil samples were tested. The results showed that oak trees grow on six different soil types: Typic Haplumbrepts, Typic udorthents, Mollic Hapludalfs, Typic Rendolls, Lithic Udorthents, Typic udisammments. The mean of diameter and height in three elevation classes (lower than 500m, 500-1000m, higher than 1000m) was evaluated and it was confirmed that there is a significant difference between measured parameters in three localities with different subgroups of soil and the highest value of parameters were occurred in Typic udorthents soils.

Keywords: Galandroud forest, Oak tree, soil physics, soil chemical

Evaluation of the cropland modelling component of the U.S. national scale CEAP project

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The USDA-Natural Resources Conservation Service is partnering with the USDA Agricultural Research Service (ARS), the National Agricultural Statistics Service (NASS), Farm Service Agency (FSA) and other agencies to conduct a national assessment of environmental benefits and effects of 2002 Farm Bill programs. The resulting Conservation Effects Assessment Project (CEAP) has two components; one of which is a national-scale assessment effort using the National Resources Inventory (NRI) as a sampling base for estimating the environmental benefits of the implementation of conservation practices both on-site and off-site. The Agricultural Policy Environmental Extender (APEX) model has been proposed for use to evaluate on-site benefits of conservation practices in place in cultivated croplands. Farmer surveys have been conducted at a subset of NRI sample points about ongoing farming activities and conservation practices; and an array of databases has been generated and utilized to provide base data to the simulation model. Existing data provides baseline estimates with current practices employed at farms that use NRCS conservation programs. “No practices” alternative scenario will be run in order to estimate the benefits of those programs. An independent evaluation of the cropland component of the national-scale assessment is being performed at the USDA-ARS Crop Systems and Global Change Laboratory and the University of Maryland. Objectives, evaluation approach, tools used as well as preliminary results will be shown in this presentation.

Integrating the normative principles of sustainability and the precautionary approach into water and soil conservation

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Over the last three decades sustainability and the precautionary principle have become internationally accepted “grundnorms” or guiding principles in human interaction with the natural environment. While the principle finds expression in international treaties and agreements, it is far more difficult to incorporate it into domestic regulation in a meaningful, and enforceable, way. In 1991 New Zealand incorporated the principle of “sustainable management” as the statutory purpose of the Resource Management Act 1991 (“RMA”). The precautionary approach is arguably implicit in this regime.

The RMA repealed all pre-existing planning, water and soil, clean air and noise control legislation and was intended to provide an integrated approach to the use and management of land, air and water. The Act provides for an “ecological bottom line” within the “sustainable management” purpose, addressing the issues of inter-generational equity, environmental protection, and ecological integrity. It also provides a comprehensive policy-making and planning regime, and an integrated consenting and enforcement regime incorporating a specialist “Environment Court”. All policy-making, planning and decision-making functions are required to be undertaken in a manner that *promotes* the central purpose of sustainability. In terms of water and soil conservation, these principles are taken into account in the preparation of formal policy documents and planning instruments governing land and water use, and to decision-making on specific water and soil use applications.

After 15 years of practice under this regulatory regime, a number of system failures have become apparent. On the other hand the regime has made consideration of sustainability issues a fundamental part of any soil and water use activities.

Implications of the proposed European Soil Directive- from an Irish Perspective

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The European Union is in the process of establishing a framework Directive for the protection of soils to include provisions on the prevention and remediation of contaminated land. The impetus for this development can be sourced to the 6th European Action Program and reflects initiatives at international level.

As a member state of the European Union, Ireland will be under an obligation at EC law to transpose and comply with the Directive once adopted. As such, these obligations will be imposed against the backdrop of a rather fragmented approach to the regulation of contaminated land in Ireland. Unlike many other EU countries, Ireland lacks a dedicated statutory contaminated land regime. This coupled with the constitutional prohibition on retrospective liability, makes Ireland a compelling lens through which the contaminated soil provisions of the proposed Soil Directive may be examined.

The aim of this paper is to analyse the implications of these provisions for Ireland. It shall provide an assessment of the adequacy or otherwise of the current Irish regulatory patchwork and make an evaluation of the added value of the provisions in an Irish context.

Promoting sustainable agricultural systems in Northern Iraq through revitalized higher education and technology transfer

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Events of recent years have had profoundly negative impacts on the once vibrant, conservation-effective agricultural systems and overall food security of Iraq. Beginning in late 2003, the University of Hawaii secured grant funds to build partnerships with several institutions in four provinces of northern Iraq toward establishing *centers of excellence* in agricultural education, research, outreach, and training to support revitalizing sustainable agriculture in the region. This broad goal was addressed by a balanced set of specific objectives aimed at: (a) Strengthening academic and extension programs in agriculture through professional development of agricultural professionals, (b) Rehabilitating the infrastructure that supports these programs, (c) Building a knowledge base for use in supporting clients and technology transfer, (d) Developing computer-based, rapid response mechanisms for addressing problems faced by field-based stakeholders, and (e) Establishing strategic centers for direct information dissemination and assistance to land users.

Substantive and substantial progress was, and continues to be made in meeting the above objectives. Our Iraqi partners have acknowledged the considerable gains from these partnerships to their institutions. Gradually, they are assuming increasing responsibility for implementing the required enhancements of their agricultural institutions, using their own funds. This has facilitated our efforts to engage in new country-wide initiatives for partnerships and to successfully attract the necessary financial resources to support them.

Our presentation will provide additional details, updates and specific examples on emerging sustainable land use issues as well as soil and water conservation challenges in the region.

Contribution of the “World Overview of Conservation Approaches and Technologies – WOCAT” Programme to the Serbian practice and education

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The aim of WOCAT is to provide tools that allow SWC specialists to share their valuable knowledge in soil and water management, that assist them in their search for appropriate SWC technologies and approaches, and that support them in making decisions in the field and at the planning level. WOCAT has developed tools to document, monitor and evaluate SWC know-how and to disseminate it around the globe in order to facilitate exchange of experience. A set of three comprehensive questionnaires and a database system have been developed to document all relevant aspects of SWC technologies and approaches, including area coverage. WOCAT results and outputs are accessible via the Internet, in the form of books and maps and on CD-ROM. WOCAT uses global knowledge for local improvements. It offers contacts as well as opportunities to share experience around the globe. It provides SWC specialists with technical information about SWC technologies and approaches from their own and other regions. Wocat in Serbia is led by Faculty of Forestry of Belgrade University. It is involved in the study programme of IV year of studying (Department for Ecological Engineering in Soil and Water Resources Protection). Faculty of Forestry is organising trainings and workshops, then mentioned education/research, revision of collected data and publishing results. Data collecting is organized through Water Management Enterprises (“Erozija” Niš, “Erozija” Kragujevac, “Loznica” – Loznica), Student’s Forum of World Association for Soil and Water Conservation (formed at the Faculty of Forestry in 2005) and partly by the Faculty of Forestry. WOCAT is financed by the Directorate for Waters of the Ministry for Agriculture, Forestry and Water Management. Special attention in the paper is given to WOCAT in education as well as to the institutional/organizational setup/framework, which is mostly different than in other countries. The best examples of technologies, approaches and maps (for 17 communities of Belgrade District) give the good pool of knowledge and information which can be used in the field as well as at the planning level.

Legislative and institutional aspects of soil & water conservation: The Philippines Experience

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The Philippines has a total land area of thirty (30) million hectares. Of this, 15.9 million hectares is reserved for forest lands, mineral land and national parks, while 14.14 million hectares is considered alienable and disposable (A&D) for economic development; Six million hectares are titled and that less than 1/3 of land supports crops. Land degradation of agricultural areas is becoming one of the most serious problems confronting the sector.

Study reveals that it will take some 13 years or the country's top soil to be depleted. The country has an average of 45.6 % of total lands suffering from moderate (28.3%) and severe (17.3%) erosion. These areas have been identified in the south & north of Luzon and central portion of the Philippines.

Policy advocacy, notably legislative advocacy in the Philippines has undergone an overwhelming progress since the historical EDSA revolution, when the rule of martial law has ended and a new Congress begun in 1988.

This policy paper, explores the trends and development in human development policy advocacy which encompass major concerns in the country to include issues on environment and natural resources relating to aspects of soil & water conservation. It will cover the 8th Congress (1989-1992) thereon up to the 13th Congress (2004– 2007), touching on policy development i.e. legislating policies, filing of policy measures, unfunded laws and budget allocation & reprioritization. The stakeholders and their mechanisms will be dealt with, touching from the Executive department, the Congress, political parties, individual legislators, multilateral and bilateral institutions, the media, academic & research institutions, business groups, local government units and the leagues, civil society. Hopefully moving the policy advocacy issues forward and better, as there is a lot more to be done to professionalize and make better stronger policy advocacy on soil and water conservation in the Philippines.

The ‘Accordion’ approach to soil and water conservation: The case of the Water, Agroforestry, Nutrition and Development (WAND) Project in Mindanao, the Philippines

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The traditional approach to soil and water conservation in Mindanao is either too simplistic or too complicated with the farmer ending-up unsuccessful in implementing it either way. With a lot of resources poured into soil and water conservation programmes in Mindanao the past decade, we should have seen positive results, but results is dismal, leading one expert to comment that “if these projects were successful, then we could have reforested Mindanao many times over.” There is also a pause in literature about successful cases of soil and water conservation initiatives in Mindanao. This paper, by utilizing process documentation, participant-observation and personal interviews, attempts to showcase an award winning (Development Marketplace, 2004) initiative called water, agroforestry, nutrition and development (WAND) started in 2001 in one barrio and now replicated in 12 barrios in 2 provinces. The approach responds to the multiple felt needs of the farmer for water, the need to grow trees at the same time to expand his economic base by growing cash crops and farm animals for meat and draft, the need to grow vegetables and using organic matter as fertilizer and the need to be organized and giving women a chance for leadership roles. The approach is successful because it is not overly linear and simplistic (eg. purely tree planting or purely contour farming) or overly complicated (eg. using GPS in watershed mapping). The overly simplistic initiatives eventually fail because it does not recognize the multiplicity of farmers’ needs while the complex project is too much for the farmers to comprehend and eternally need an outsider for support. We call our approach ‘accordion’ because we try to present a meeting ground between the simple and the complex. The WAND provides a menu of support that is localized and responds to the felt need of the individual farmer. It recognizes that although there is homogeneity in the condition of the farmers in a given locality, their situation per individual varies therefore support is graduated according to their peculiar condition. Even the type of trees to plant is based on the condition of their farms and not pre-planned ipil-ipil or gmelina planting schemes as done by others. Community mobilization is done through a variety of educational and participatory farm planning and budgeting process. Local “barefoot technicians” are trained and mobilized and contests on vegetable gardening, contour farming, animal-raising are promoted. Starting from the Development Marketplace support of 20,000 USD and covering 120 households in 2004, the project has now grown to an annual budget of more than 100,000 USD and covers 2,200 households in 12 barrios with funding support coming from Germany, Japan, UK and Belgium. To date a total of 300,000 seedlings of ASEAN’s most important trees have been planted (survival, 85%), 63 farmers’ organizations built and 2 federation functioning. The German Government has expressed willingness to expand the initiative to a nearby province in 2008-10. We are expanding the WAND concept to include ecological sanitation (using feces and urine as fertilizer) thereby closing the loop between consumption and agriculture and land redemption (redeeming land mortgaged by farmers, even upland farms!).

**Quality of enforcement in the implementation of Water and Soil
Conservation Law
A case study of the mining industry of China**

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Water and Soil Conservation Law (WSCL) of China was issued in 1991 with an important objective of controlling human induced water and soil degradation resulting from intensive construction activities. This paper reviews the whole legislation framework and enforcement programs in order to identify how the enforcement system of WSCL could be improved more effectively. Applying the “Table of Eleven”, a behaviour-analysis model with high practicability on compliance and enforcement assessment, we reveal the decisive factors affecting compliance behaviour of target groups and investigate the performance of the enforcement system in improving compliance. The behaviour of mining industries is studied in this research. The analyses involve the perceptions of both regulators and the mining companies with respect to the law and its enforcement. The result shows that during the past decade the enforcement programs have provided a solid legal foundation and mechanism to reduce water and soil degradation, supplied perception of high risk of being inspected to target groups, created the familiarity of the law, and well built the permitting process. However, the full compliance of law requirements is yet there. The research finds that the main factors encouraging the violating behaviours are as following: 1) substantial benefit from non-compliance, 2) low cost of violations, 3) low risk of being reported by social communities, 4) low risk of sanctions, and 5) minor severity of sanctions. These factors also reflect main weaknesses of the enforcement system. Based on the analysis, we suggest that improvements in seven aspects will constructively contribute in influencing target group’s behaviour and enhancing the compliance.

Keywords: Compliance, Enforcement, Quality, Water and Soil Conservation Law

High rates of land degradation trouble India

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Agriculture is the mainstay of the Indian economy, contributing nearly 22% of Gross Domestic Product. Nearly 65 – 70% of the population is dependent on agriculture for their livelihood. The agriculture output, however, depends on monsoon and soil quality of arable land. But India is facing an acute problem in meeting its annual agricultural output targets as its expected output of food grain is falling short every year due to erratic behavior of monsoon and high rate of soil erosion. On the other hand, the demand for food and other agricultural products continue to rise. On an average, the country is losing soil at the rate of 16 tons per hectare annually, which is more than three times the acceptable limit of 4 -5 tons. It is 30-40 times faster than the natural replenishment rate making arable land unproductive. In India, it is estimated that nearly 6.6 billion tons of soil is lost every year which further affects the ecology as about 60% of the washed away soil ends up in rivers, streams and lakes, making waterways more prone to flooding and causing loss of keynote species which disturbs the ecosystem balance. Thus, soil and water conservation measures are one of the essential inputs for increasing agricultural output in the country.

Erratic behavior of monsoon is linked with the climate change. Some of the key factors responsible for land degradation in India are: soil erosion (distribution, intensity and amount of rainfall, slope of the ground, nature of the soil, vegetation cover and soil management), soil pollution (reduction in the productivity of soil due to the presence of soil pollutants such as pesticides, fertilizers, organic insecticides like DDT, chemicals and radioactive wastes, discarded non-biodegradable house waste), desertification (increasing human population in India has put a great pressure on the land; vast areas of land have been cleared for cultivation of agricultural crops resulting in accelerated soil erosion and consequently leading to desertification), urbanization (productive areas are fast depleting due to developmental activities such as road construction; construction of one kilometer of road in the mountainous region of Himalaya creates nearly 40,000 to 80,000 m³ of debris), salinization and water logging (increase in the concentration of soluble salts due to excessive irrigation, water-logging and defective drainage system) and shifting cultivation (a very peculiar practice of slash and burn agriculture is still prevalent in the north-eastern hilly regions of India – when the fields become sterile, these are abandoned and a fresh patch of forests are burnt and fresh fields are formed for crops). Land degradation due to these said activities has reduced the agricultural productivity through the loss of nutrients and topsoil.

The deforestation, shifting cultivation and the commercial water logging have aggravated the problem and are far serious offenders in making the land wasteful, unproductive, unsustainable and are causing maximum soil / land degradation in India in comparison to others. Almost half of the country's total landmass needs conservation measures to check soil erosion. Satellite imagery now enables both the monitoring and measuring of soil erosion.

Keywords: land degradation, soil erosion, water logging, shifting cultivation, conservation

Future of lands degraded by erosion in Romania

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Making the ratio of the agricultural area of Romania and the number of inhabitants the result is 0.68 ha/inhabitant. Apparently, this is an extremely favorable situation. But, in many areas the soil productivity is affected by 2-3 limiting factors (i.e. drought, erosion, floods, land slides). Consequently, the yields and their stability depend, mostly, on the interventions for disasters prevention.

Erosion process is active on 42.6% of the agricultural area, which represents a big value. Therefore, the anti-erosion works are of public interest, their contribution to the nourishment safety being indisputably.

In 1989, Romania changed its communist regime. After 1991, Romania became the country with the biggest number of farms in Europe (4.48 million). The future of the lands degraded by erosion depends on numerous factors, like: engineers working in the management of the soil and water resources, specialists in environment protection, economists and factors which decide in political and financial issues. Population can benefit of the effects of interventions for the mitigation of the major negative implications generated by the erosion. The main conditions are that farmers to accept the projects and to adopt and maintain the works. The conclusion is that it's very important to investigate the land -owner's attitude and list of priorities. One of the most important social and economic methods of investigation consists in the utilization of questionnaires. These are very useful tools for the sociologists, which furnish information about the farmer's requirements and customs.

Following interdisciplinary co-operation, the authors of the paper carried out research activity on social and economic aspects in 5 watersheds. The outcome was that the anti-erosion works occupy hardly the 4-th or 5-th place in a hierarchy of priorities avowed by the farmers who own lands with vulnerability to erosion.

Our conclusion was that an intense lobby activity is necessary. We've submitted several ways of developing the conscience about the dangers and damages caused by erosion. Also, we've acted in order to replace theory by practice to facilitate communication between groups involved in the field of soil erosion.

On national level, it was acted through legislative, institutional, educational and financial means.

Local authorities are supported by the EU. It started off and continued the farming exploitation reform and promoting systems of the best agricultural practices.

Key sustainability issues and the spatial classification of sensitive regions in Europe

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Cross-cutting environmental, social and economic changes may have harsh impacts on sensitive regions. To address sustainability issues by governmental policy measures properly, the geographical delineation of sensitive regions is essential. With reference to the European impact assessment guidelines from 2005, sensitive regions were identified by using environmental, social and economic data and by applying cluster analysis, United Nation Environmental Policy priorities and expert knowledge. On a regionalised ‘Nomenclature of Territorial Units for Statistics’ (NUTS) level and for pre-defined sensitive region types (post-industrial zones, mountains, coasts and islands) 31 % of the European area was identified as sensitive. However, the delineation mainly referred to social and economic issues since the regional data bases on environmental indicators are limited and do not allow the separation of medium-term vital classes of sensitive regions. Overall, the sensitive regions showed indicator values differing from the EU-25 average.

Mitigation of road construction induced land degradation effects on livelihood: A case of rural access programme Nepal*

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Road building along the geologically vulnerable slopes with disturbance in natural drainage system and heavy cuts and fills across and along the slopes trigger erosion, mass wasting and sedimentation resulting excessive land degradation in nearby areas. These effects have direct bearings on livelihoods of people living on subsistence agricultural farming. The engineering solution of mass balance, which in principle sounds good, has not been possible to attain in actual practice in rural hills of Nepal. Side casting in road construction is unavoidable and has become major cause of land degradation in rural hills of Nepal.

Based on past experiences and realising the facts, Rural Access Programme (RAP) since its inception in 2001, has adopted labour-based, environmental friendly and participatory approach of road construction coupled with bioengineering measures to control erosion and mass wasting and sedimentation in order to minimize land degradation effects. Unlike to the conventional road construction techniques, RAP has adopted "Green Road Concept"- phased construction with no use of blasting materials and heavy machines and equipment. Simultaneously, RAP through the implementation of social and economic development programmes has focussed to improve and sustained livelihood of the directly project affected families and poorest of the poor of the communities residing within the zone of influence. The RAP thus, has intervened through the physical and social and economic development programmes to abate land degradation effects on livelihoods due to road construction in programme areas of rural hill districts of Nepal.

RAP working through local road building groups with 15 to 20 members in a group has over 10,000 members involved in about 300km length of road construction, including bioengineering and environmental management activities. Part of the income of wage earnings of road building groups, which is directly paid based on work performance to these groups by the project, is encouraged to save, which they lend among the group members and use for other income generating activities. The initial results of the programme show very encouraging situation and has greatly helped to reduce the interest rates of local moneylenders where financing institutions outreach is beyond their capacities. The degraded land area falling outside the road corridor but within the right-of-way can be used as a means of livelihoods of the roadside neighbours and the road building groups during the operation phase of the road. The paper deals with the impacts on socio-economic aspects of land degradation, the mitigation measures adopted to minimise the effects and share experiences and challenges faced by rural people of the programme areas with groups of intellectual community.

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Millennium Challenge Corporation – a new actor on the African land policy scene

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Founded to reward states, which excel in good governance and adopt policies for growth and poverty reduction, intending a more efficient use of development funds, MCC became soon an important player in the arena of international organisations. Field operations do only difficultly meet the expectations raised: administrative barriers are extremely high, procedures are heavy and do sharply contrast with the light technical concepts of the Corporation. This will be shown in the domain of land policies. MCC literally ignores all the discussion in this complex area of development policy that took place in the last decades and subscribes without distinction to a surpassed conception of land registration. At the same time this shows that the discussion on land policies needs further empirical and conceptual foundation.

Farmers' participation in water conservation program in the Northeast of Thailand

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Thailand has a severe problem in water scarcity, though the country is located in the tropical monsoon region of the world. Rapid population growth since the past and the expansion of cultivation area, especially lowland rice, are among the main reasons why water received from the rain is not enough for growing crops and for general consumption of population. The problem has been most serious in the Northeastern part of the country since long ago.

Since 30-40 years ago, the Thai government has set up a program to develop water resources in small, medium and large size. Large dams were built for several purposes, especially for water supply and electricity generation. At present it has not been possible to build any more dams like in the past. Controversy about the dams, both for those already in operation and in the blueprint, makes it almost impossible for the large-scale water development program to be executed from now on.

However, the Land Development Department has been involved in the small-scale water resource development, which concerns the construction of water storage structures of medium and small size. The small sized ponds of 1,260 cu m capacity are being favored by farmers/ villagers and several thousands have been built in recent years. Earlier, such kind of ponds was offered to farmers without cost but later on a small part of the construction expense, around 10-15%, has been levied as a standard amount that the recipients are required to pay.

From a recent field survey it was found that such kind of cost sharing is practical and most farmers are able to join the program. This is a good sign that the agrarian population of the country have learned to have a sense of responsibility, which is favorable and will enhance a better aid program to poor people. It is suggested that the program be expanded wider to help keep excess water during rainy season in the upper area to alleviate flooding in the lowland, apart from being used for agricultural production and human consumption. However, there should be some practical regulations in spreading the help, so that there will be fairness in society.

A behavioural model for the adoption of soil conservation practices

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This paper reports on a study to explain the adoption of soil conservation measures in Belgium. As agricultural policy becomes increasingly concerned about sustainability, policy makers seek measures to encourage a more environmentally friendly way of farming. Soil erosion is one of the serious problems agriculture is still facing, in spite of the whole range of measures to inhibit soil erosion. This is due to the low adoption rate of most of these measures. Therefore, governments want to fully understand the adoption decision process of the individual farmer, in order to develop policy measures to encourage voluntary adoption. A behavioural approach, the Theory of Planned Behaviour, is used to study this decision process in Belgium. A behavioural approach is one that focuses on the motives and attitudes and is largely quantitative. This kind of approach uncovers the underlying cognitions of the decision process, rather than developing profiles of adopters and non-adopters, which was often the final result of studies using the adoption-diffusion or the economic approach. Furthermore, a purely economic approach is due to provide unsatisfactory results, given the uncertain nature of the decision's outcome and because there are other than managerial considerations involved, namely environmental and social issues. A questionnaire was carried out on a sample of 138 farmers in four erosion-prone areas in Belgium. Structural equation modeling is used to predict adoption and intention to adopt for three common soil conservation practices: reduced tillage, cover crops and buffer strips. Results show some remarkable conclusions. First, farmers have full volitional control over the adoption decision suggesting the unimportance of intervening exogeneous factors. Second, socio-demographic, diffusion-type, farm structural and economic factors are largely background factors, their effect being mediated by one of the components of the model. Third, low adoption rates are mainly due to a negative attitude caused by irrational beliefs about the practices, not supported by science. Farmers act rational based on wrong beliefs, giving their decisions a sense of irrationality. The paper concludes with some policy recommendations, following from these results.

Collective forest property right reform take great effects on watershed sustainable development management: a case of Nanping China

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River Min watershed ecosystem is fragile relatively for its west-north high and east-south low mountain landform and profusion rain fall disproportion in seasons. The watershed is abundant with forest, which is very important to its sustainable development. Before the reform of forest property right, collective possession, customary tenure, mingled with state law and occasional private titling, continue to govern rural and forest lands in the South of China. Making farmers to get more decision-making powers in forestry management, forest property right reform takes positive effects on heightening farmer's enthusiasm in forestry management, advancing forestry market management, adding forestry farmer's income and promoting forestry development. But most forestry farmer would rather get a few personal economy incomes than product great many of ecological utilities, such as water and soil conservation, air cleanness, carbon fixation and biodiversity protection, which can not get compensation from society for its positive exteriority. To some degree, forest property right reform takes some negative effect on watershed sustainable development. With a case of Nanping, a city in upper reaches of River Min, the article compares farmer's forestry management behaviors, such as forestry plant maintain and harvest model, forest breed option, cutting period management, which influence forest resource in watershed, and then influence watershed sustainable development directly, before the reform with that after the reform. And then, we conclude that small management scale, feebleness of forest and forest land running right and lack of farmer cooperation organization are main restrictive factors of watershed development management in the environment of private forest property right according to the factor analysis and regression analysis of data of sampled farmer household in Nanping.

Rainfall -Sheet Flow Hydrodynamic Model on Sloping Land

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Aiming at revealing the effect of rainfall splash on hydrodynamic features of sheet flow, with a simulated rainfall experiment in condition of changeable rainfall densities and changeable gradients. This text studied the raindrop kinetic energy, flow patteern and resistance coefficient of overland flow, established the rainfall-sheet flow hydrodynamic model.

Keywords: rainfall, sheet flow, hydrodynamic model

Impact of forest variation on the runoff of watershed in the loess hilly-gully region of China

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Research of this paper was conducted in the Luergou Watershed, Qiaozi Eastern watershed and Qiaozi Western watershed in Tianshui City of Gansu Province of China. By using GIS technology. The author established space database and attribute database for the different land use / forest cover in 1985, 1993, and 2001, in order to analyze the variations of runoff of the watershed under different forest cover, and further probed the impact of the forest on the runoff of the watershed. Analysis result of Luergou watershed shows that the flood runoff module has an exponential relationship with annual precipitation and forest cover rate, i.e. $W = ae^{bP-cl}$. Monthly runoff varies with precipitation distribution in a year. Runoff decreases along with increase of forest cover. The compare of Qiaozi Eastern watershed and Qiaozi Western watershed shows that with the increase of forest area, the flood runoff and peak discharge in watershed decrease at same time in same precipitation condition. The function that forest weakens flood runoff is obvious with reduce of connectivity and complexity and increase of adjacency.

Effects of vegetation restoration on water stability and organic carbon distribution in aggregates of degraded red soil in subtropics of China

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Soil organic carbon plays a major role in the formation and stabilization of soil aggregates. However, our knowledge on the relationship between organic carbon and stable aggregate is not clear in the restoring process of degraded red soil. The water stability of soil aggregates in five soils (include bare land; *Pinus massoniana* forest, *Castanea mollissima* plantation and *Paspalum notatum* Flugge grassland which were restored from severely eroded land; protected second forest- next to the village) was measured with dry sieve and wet sieve, then different size aggregates (wet sieve) and whole soil were analyzed for organic carbon content. The stability of macroaggregate was lower in bare land than that in *Pinus massoniana* plantation forest, *Castanea mollissima* plantation and *Paspalum notatum* Flugge grassland, and the best one was in protective second forest. Organic carbon contents of different size aggregates were not changed in bare land. However, after vegetation restored, organic carbon content and distribution proportion in different size aggregates were changed since organic material inputs increased. The macroaggregate had greater organic carbon content than the whole soil, microaggregate and silt and clay particles. The restoration speed of organic carbon in macroaggregate was faster than that in microaggregate and silt and clay particles. The proportion of organic carbon in macroaggregate comprised of about 15% of total organic carbon in 0~10cm soil layer of bare land, and the data were between 32% and 42% in other soils. After vegetation restored, the increase of carbon accumulated in soil macroaggregate, microaggregate and silt and clay particles accounted for 41%~51%, 24%~38% and 20%~31% of total increased carbon, respectively. The water stability of soil aggregates was related to soil organic carbon content. The higher concentrations of total organic carbon were recorded in the soils with higher aggregate stability.

Keywords: soil aggregate, organic carbon, vegetation restoration, degraded red soil

The preliminary study on the characteristics of the layer of salt crust in forests irrigated with saline water in mobile desert

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The experiments about forestation irrigated with saline water in the Taklimakan Desert indicated that a significant salt crust layer formed in the topsoil of forest irrigated with saline water. Through survey the thickness and electrical conductivity of salt crust layers in all experimental plots, some conclusions were drew as the following: (i) the degree of minalization of irrigating water, irrigation method, irrigation program (irrigation water quota, irrigation interval) and texture of soil had great effect on the features of salt crust; (ii) the features of salt crust had a clear spatial distribution, the salt crust in the forest by ridge irrigation was distributed in micro-relief great differently from drip irrigation, slope aspects and soil texture and structure also has great effect on the distribution of salt crust; (iii) the temporal changes of salt crust was very significant. In an irrigation period, the EC of surface soil increased firstly, then decreased and leveled off, salt crust generally formed 5 days after irrigation. The EC of salt crust changed among months with air temperature variation. Because annual dust deposition and litter accumulation on ground surface led to great changes of the structure of topsoil, as the forest grows, the thickness of salt crust in the ground surface of forest should tend to stabilization, the EC of salt crust increased firstly and then decreased.

Keywords: Salt crust, influencing factors, spatial and temporal variations, irrigated forests, Taklimakan Desert

Research of sediment yield statistical model for single rainstorm in Chabagou drainage basin

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Research on drainage basin erosion and sediment yield amount is not only an important task in physiognomy, but also an important one in river harnessing and water conservancy. The structure of drainage basin sediment yield statistical models is simple, convenient to calculation and serves as a power tool available for sediment yield prediction. This paper tries to conducted an integrated analysis of the effect of rainfall, runoff and physiognomic forms on drainage basin sediment yield, on the basis of considering sediment yield mechanism and to establish sediment yield formula for single rainstorm in Chabagou drainage basin which will have a certain sediment yield mechanism. Through integrated analysis of the effect of rainfall, runoff and physiognomic factors on sediment yield, we can find that as for the effect of rainfall amount and its temporal and spatial changes on drainage basin sediment, the correlation coefficient of rainfall amount and rainfall intensity product PI with drainage basin sediment yield modulus M_s is the highest. But when we consider rainfall runoff effect on drainage basin sediment yield, rainfall action has become negligible, the main factors affecting sediment yield are runoff depth H and flood peak discharge Q_w . The effect of runoff depth H on sediment yield is essential, but its effect on sediment yield of different scales of drainage basins is the same. Flood peak discharge Q_w is mainly accountable for the remarkable difference in sediment yield of drainage basins of different scales. With the increase of area, the effect of flood peak discharge Q_w on drainage basin sediment yield also weakens. Of the physiognomic factors, drainage basin area and ravine density play the leading role, and drainage basin channel gradient ratio is on the comparatively secondary position.

Keywords: Drainage basin sediment yield; Rainfall factors; Runoff factors; Physiognomic factors; Statistical models

Study of surface runoff yield and simulation of model on slope of red soil

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Runoff law was studied on the typical slope in Jiangxi province by runoff plot method. Mathematical model was established and simulate surface runoff on slope of red soil at plots in Jiangxi province. The result shows that: 1. runoff is unequal every months and shows double peak value in a year. Runoff have two peak value in Apr~May and Aug. every year; 2. runoff at a time is increased by intensity of rainfall; 3. runoff is changed on bare slope, litter covered and vegetation covered, not only time of coming into being runoff but also runoff value. Therefore, change of land surface is one of the important measure to control runoff. 4. model of runoff on slope was studied and it accords with fact. Simulation of model is less than 15%.

Research on features of sandstorms in the hinterland of Taklimakan Desert – A case of Tazhong area

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Taklimakan Desert is a hot area of Chinese petroleum exploration nowadays. Sandstorm is a major disaster in this area. For clearly understanding the law of sandstorm occurrence in the hinterland of Taklimakan Desert, this article analyses the intensity, process, types and temporal variation of sandstorm based on the meteorology data from 1997 to 2002 of Tazhong meteorological station. The results are as follow: 1) The annual average days with sandstorms in Tazhong is 16.83d, is higher than Luntai, Minfeng and Hotan in the north and south fringe of Taklimakan desert respectively; this phenomenon indicates that dust source is the limiting factor of sandstorm occurrence in the fringe of Taklimakan desert; 2) There is a special stage before sandstorm occurrence with wind abrupt speed decline and wind direction turning; 3) like in the fringe of Taklimkan Desert, the sandstorms in Tazhong can also be classified into five types, the type of eastern cold air mass invasion is a predominating one; 4) Sandstorm in Tazhong have a clear temporal variation: Sandstorms occur more frequently in daytime, in particular, in afternoon and twilight. 3) There is clear seasonal variation about occurrence of sandstorm. It can take place from March to September and more frequently from April to July; It occurs more frequently in summer than in spring unlike other regions around Taklimkan desert; the sandstorm occurrence varies greatly among years with high coefficient variation; there is a clear trend to decline from 1990's to beginning of 21 century corresponding with all stations in Xinjiang.

Keywords: Sandstorm, The hinterland of Taklimakan Desert, Intensity, Types, Temporal variation

Analysis on the response of soil erosion and sediment yield to the temporal variation of the precipitation on the Loess Plateau, China

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Precipitation is the key driving force of the ground surface hydrological and erosion processes. The different amount and intensity of rainfall lead to different surface runoff and sediment yield. Thus, it is somewhat significant to study the relationship between rainfall pattern and soil erosion. In China, the course sediment source region of the Yellow River, on the Loess Plateau, is an important area for soil erosion research. The Loess Plateau has a typical monsoonal climate with the annual precipitation of 150~700 mm. The geomorphy in the course sediment source region is so complicated that rill erosion and gravity erosion broadly happen and contribute to the main portion of sediment yield up to 5000 t/ km² a. Especially in the flood season, several storm rainfalls can lead to the most amount of the annual sediment yield, thus the influence of rainfall pattern is more important in this region.

However, daily rainfall data, commonly employed in large scale simulation, should be scaled down to the computational time step to take the influence of the rainfall intensity into account. In this paper, statistics analysis was carried out to obtain the precipitation-duration curves in the Wuding River on the Loess Plateau to achieve a downscaling method for the daily rainfall data. This method was validated in the Xiaoli River, a tributary of the Wuding River.

Following the precipitation variation of the latest decades of the Loess Plateau, that is the decreased annual precipitation with slightly increased intensity of storm rainfalls, the parameters of the proposed downscaling method and the annual precipitation were modified to set different scenarios reflecting the trend of change. Simulations were implemented in the Digital Yellow River Model for the different scenarios in the course sediment source region. The results were used to analyze the river basin scale influence of climate change, represented by the variation of precipitation, on soil erosion and sediment yield. It is disclosed that in the studied region, the decrease of annual precipitation is insufficient to induce the reduction of erosion, rainfall intensity is a key factor for the process of soil erosion, and the heavy storm rainfall is still the chief risk for soil losses.

Slope disintegration and its control in South China

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This paper introduce slope disintegration and their disaster characteristics in South China based on the information of regional survey and orientation study. The processes of slope disintegration formation, development and evolution are described, and then the factors influencing slope disintegration and its disaster are analysed. The authors put forward that in addition to raditional methods, hydro-geology and engineering geology as well as technologies of geographical information system (GIS) should be applied in monitoring and management of slope disintegration in order to provide scientific bases for hillside use, environment protection and disaster control.

Keywords: South China, slope disintegration, disaster control

Symbiosis of landslides, debris flows and rainfalls in Jiangjia Ravine

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JiangJia Ravine is a world-famous debris flows valley in Dongchuan, YunNan, China. Every year a large number of landslides and collapses happened and caused enormous damages to people's properties and lives. With longtime observation and researches in JiangJia Ravine we have found out that one kind of special landslides that both have the features of landslides and collapses distribute great contribution to debris flows. When debris flows outbreak, there always exist some kind of symbiosis among rainfalls, landslides and debris flows. In order to learn this symbiosis we have carried out artificial rainfall landslide local and model experiments and slope surface erosion experiments, observed the experiment phenomena and surface flows during artificial rainfall experiments. With slope soil moisture content monitoring and deposits erosion analysis, the full course of turning landslides deposits into debris flows under rainfalls condition and its mechanism have been analyzed. This essay described the Symbiosis among rainfalls, landslides and debris flows in JiangJia Ravine and showed that the moisture content dispersed in a certain range in the symbiosis, critical state exists in the process of turning landslides deposits into debris flows on rainfall conditions.

Keywords: Landslides and debris flows, Rainfall, Symbiosis, Critical state

– Poster presentations –

Approach to assessment of transport risk of inorganic pollutants on the basis of immobilisation capability of soil

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At the present time comprehensive EU strategy for the soil protection is required. This strategy should take into account all the different functions that soil can perform, their variability and complexity. One of environmental functions which was established by Directive EU is also filtering of substances. In our Institute we try to evaluate this function to main soil processes (filtering or immobilisation of water, nutrients and contaminants). Because of very different physical-chemical properties of contaminants, we divided this group of substances on organic and inorganic pollutants. In present time we attempt to assess of inorganic contaminants immobilisation. The objective of this paper is an ambition to elaborate the system of judgement of potential transport risk of inorganic risk elements and create a map of soil potential to immobilisation/transportation of potential risk elements. The categorization of potential transport risk of inorganic risk elements was realized on two layers, contamination layer and layer of potential soil sorption. The level of contamination has been evaluated according to Slovak Soil Law. Potential sorption of soil (PSS) is formed by qualitative (soil reaction – pH value, optical value of soil humus quantitative factors (C_{org}, H -depth of humus horizon) and was evaluated according to equation: $[PSS] = F(pH) + F(Q_6^4) + F(C_{org}) * F(H)$. Map of soil immobilisation potential was created by fusion of contamination layer and layer of potential sorption of soil and shows the distribution of five categories of potential risk elements immobilisation. Soils with very low immobilisation potential are distributed in Košice and Banská Bystrica region predominantly, where soils are contaminated by geochemical anomalies and anthropogenic sources. Transport is reversible process to immobilisation. For that reason the highest category of potential to immobilisation is identical with the lowest category of transport.

Keywords: inorganic contaminants, contamination, immobilisation, transport, soil properties

Identification of nitrate vulnerable zones applying functional soil mapping

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Nitrate is the most widespread contaminant of groundwater and its loading is still a unsolved environmental problem. Diffuse input by the rural economy is the main cause of this loading. Council Directive of EU on nitrate pollution of waters requires identification of nitrate polluted waters and vulnerable zones together with the establishment and implementation of action programmes in order to reduce water pollution from nitrogen compounds in vulnerable zones. One of the used specific criteria refers to groundwaters, which contain or could contain nitrate concentrations greater than 50mg/l. All known areas of land contributing to nitrate pollution of these waters are to be identified for designation as Nitrate Vulnerable Zones (NVZs). Specific vulnerable zones in national territories are expected to be displayed on maps. Designation of NVZ's, that is identification of areas with higher risk of N-leaching, can be carried out by interpreting functional soil maps representing soil's nitrate filtering function. In order to produce a map of potential nitrate leaching, data on soil are to be combined with spatial information on specific environmental factors (climate, terrain, groundwater, land use etc.) in appropriate deterministic or stochastic inference models. This is just the issue what functional soil mapping is supposed to produce.

In our paper we present functional soil mapping approaches, which are able to provide nitrate vulnerability maps in national level (~ 1:1,000,000) as well as at regional scale (~ 1:50,000 - 1:25,000) for pilot areas with different geographical conditions. In both cases rather simple environmental models were used taking into account few but really dominant environmental factors. The features of the applied methods differ in the case of the two levels, however there are common considerations, too.

Approach to the analysis of extreme events as evidence of climatic change

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An evidence of the alteration of natural climate variability as a consequence of the human action is the increment in the occurrence frequency of extreme events related with hurricanes and tropical storms. In this sense, the present investigation seeks developed like an approach to the frequencies analysis of such events happened during the period 1971-2006 in the Atlantic Ocean. Once obtained the data via Internet of the National Center of Hurricanes of Miami attributed to the NOAA (National Oceanic and Atmospheric Administration) the corresponding tables and charts of hurricanes, tropical storms and total extreme events were built for every year of the selected period, which were analyzed starting from the probability density function (PDF) with adjustment to a normal or Gaussian distribution for two sub periods: 1971-1989 and 1990-2006, besides statistical tests of mean and variances accumulated contrast. The selection of 1990 as separation among the sub periods, it is related as the reference moment selected by the UNFCCC in connection with the reduction of the Greenhouse Effect Gases emissions (GEI). In conclusion, a PDF was obtained for each sub period, where a numeric increment of the hurricanes mean is evidenced (4,8 at 6,6), tropical storms (3,2 at 5,1) and total extreme events (8,3 at 12,0), as well as of hurricanes variances (1,6 at 2,8), tropical storms (2,0 at 1,9) and total extreme events (2,7 at 3,8). Nevertheless, although such increments are not still statistically significant (hurricanes - 11%, storms - 44%, total - 22,4%) the displacement is evidenced to critical probabilities (5 - 10%), reason for the one which the Intergovernmental Panel for the Climatic Change (IPCC) in its report of the year 2007 are not conclusive in connection with this aspect.

Keywords: extreme events, evidences, climatic change

Evaluation of landscape changes using GIS methods with special regard to aridification

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As a consequence of the increasing aridity experienced in Hungary in the past decades, any future decision in spatial planning should consider the threat of an arid environment. For identifying sensitive and endangered areas, suitable methods should be found and developed. These could help then responsible and preventive decision making in providing quick and suitable actions in planning.

On regional scale the vegetation cover, on local scale the strictly protected wetlands are good indicators to assess the degree of changes in the complex system.

Through the investigation of vegetation, regional scale variations in the landscape along with the responses of forests to climatic changes can be easily detected. Our primary aim was the evaluation of the natural water supply on the Danube Tisza Interfluvium by studying the forests, meadows and pastures in the summer half of years between 1992 and 2005. We investigated with the help of remote sensing the short term response of vegetation to the altered geographical conditions. According to the spatial and temporal analyses of vegetation indices based on AVHRR and MODIS images, a considerable decrease in the activity of vegetation can be observed throughout the entire vegetation period. Due to the suspected climatic changes, 33 % of the studied vegetation might be endangered.

Our wetland study area is very changeable seasonal, therefore is why, answer the question above we have done a long-term study (more than 150 years) with maps, aerial photos and satellite images (CORONA, LANDSAT TM and ETM+). The tendencies of disadvantageous years it is to be feared than in the next 40–80 years the wetland surfaces will completely disappear, and they will recover only seasonally in early summer. Almost 40 % of study area is endangered by aridification and 80 % the wetlands has already dried out or getting drier.

Impact des fluctuations hydroclimatiques sur le transport solide en zone semi aride. Cas du bassin versant de l'Oued Haddad, Algérie (1970-2000)

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En Algérie, à l'instar des pays méditerranéens, les précipitations sont caractérisées par une très forte variabilité spatio-temporelle. A la variabilité naturelle s'ajoute une forte variabilité interannuelle consécutive au changement climatique et aux activités anthropiques, qui peut aller jusqu'à modifier le régime d'écoulement des cours d'eau et, en conséquence, le transport solide (Achite & Ouillon, 2007). Des données de pluie, température, débit liquide et concentration récoltées durant trois décennies (1970-2000) dans le bassin versant de l'Oued Haddad (470 km²), dans la partie nord ouest de l'Algérie, sont ici analysées. Elles illustrent l'impact majeur du changement climatique sur les ressources en eau (apports liquides), sur le transfert de matières en suspension (apports solides) et sur leurs conséquences dramatiques en termes socio-économique et environnemental.

Mots clés: Ressources en eau, changement climatique, variabilité, apports solides, oued Haddad, Algérie.

Isolation, screening and characteristics of hydrogen-oxidizing bacteria in legume

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The group of aerobic hydrogen-oxidizing soil bacteria have the ability to utilize gaseous hydrogen as electron donor with oxygen as electron acceptor and to fix carbon dioxide. Hydrogen enhanced the quantity of hydrogen-oxidizing bacteria, thus developed bacteria colony increased plant growth. A gas-cycle incubation system (H₂ treatment system) was developed that provided stable H₂ exposure rate (4.16×10⁻⁵-1.25×10⁻⁴mol/L-1) by electrolysis. Mineral salt agar medium (MSA) was used to separate hydrogen-oxidizing bacteria in soybean rhizosphere, which were able to utilize hydrogen as sole energy. A total of 40 bacterium strains were isolated by incubation system, and the capability of uptaking hydrogen of these strains were measured, among which 20 bacterium strains had the ability to uptake hydrogen and grew chemolithoautotrophically. They were preliminarily identified as hydrogen-oxidizing bacteria, with the bacteria colony form and physiological- biochemical characteristics studied.

Keywords: hydrogen-oxidizing bacteria, soil, gas-cycle incubation system, screening

Flux de gaz carbonique et stockage du carbone par les sols: Inventaire au niveau de la Tunisie

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Les changements climatiques attendus actuellement, seront le résultat de l'augmentation de la concentration atmosphérique en gaz à effet de serre. Le sol joue un rôle important dans la séquestration du gaz carbonique atmosphérique, mais aussi il peut le dégager après sa minéralisation. A partir de cette caractéristique double que possède le sol, d'absorber et d'émettre le CO₂, l'estimation du bilan du gaz carbonique de la pédosphère tunisienne donne une idée sur le gisement du carbone organique, qui en plus de son importance dans la pédogenèse et la fertilité du sol il a un intérêt environnemental. L'estimation du bilan de gaz carbonique est basée sur sept profils représentatifs des grandes unités de sol du pays et sur la restitution annuelle en matière organique, qui prend en considération pour chaque unité la végétation la plus dominante sur son sol. Le stock total de carbone des sols du pays, et pour une profondeur d'un mètre est égale à 1.335GtC (1GtC=10⁹ tonnes de carbones), ce qui correspond à 4.887 Gt de CO₂. Annuellement la pédosphère tunisienne qui représente un puits de carbone, emmagasine 51304.344×10⁻⁶ Gt de CO₂ et libère 1269.805×10⁻⁶Gt de CO₂ comme étant une source de carbone.

Mots clés: Les changements climatiques, sol, séquestration de carbone, stock, effet de serre, CO₂, Tunisie.

Remote sensing analysis of land cover with sugar cane applied to the environmental studies in northeast of São Paulo state, Brazil

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Sugar cane is the basis of an important Brazilian Alcohol and Sugar Industry. The technique of harvesting is increasing in Brazil and mapping and monitoring the areas in agricultural lands constitutes an enormous challenge for planning the soil management in the complex agricultural sugar cane production system. Using remote sensing technology and geographical information systems, the research work was conducted for evaluating the land cover with the leafy tops of the cane stalks that stay on the ground after harvesting for provisioning an environmental study in northeast of the São Paulo State, Brazil. The land use and the predominant area of row sugar cane harvesting were evaluated in an area of 671089 hectares. Satellite images were gotten from the CBERS-2 Program. Four satellite images from CBERS-2 CCD camera, of the point 156/127, date 08/13/2004; 08/14/2005; 08/15/2006 and 08/16/2007 was used for processing and for image classification potential. The spectral bands used were RGB. Geographic Information System (GIS) was used to analyze the data. The raw harvesting land cover data was identified and differentiated from the spectral response patterns and a map of the area was developed using the supervised image classification. For analyzing the pixels was done a field observation and annotation in the training sites obtained with global positioning system and it was create a spectral signatures for the cutting stalks that stays at ground level after sugar cane harvesting. The image was classified considering each pixel comparing the similar signature made through statistical analyses. Testing the significance of spectral bands it is observed that has been an increasing in the size of raw harvesting area. As can be seen from the total area of the image of 671089 hectares occurred an increasing area between 2004 and 2006, with a minimum reducing in 2007. The area estimated in the last four years of land under harvest raw sugar cane cultivated is: 2004-39665 hectares (6%); 2005 – 44756 hectares (7%); 2006 – 51154 hectares (8%) and 2007 – 47460 hectares (7%), of the total area. Additional sources of clime showed that the small decreasing after 2006 was due to the precipitation that occurred before the time of the data of the satellite image, which delayed the raw harvesting. This work has shown that the spectral characteristics of sugar cane at raw harvesting are significantly similar.

Effects of long-term monoculture on aggregate stability of soils in the São Paulo State, Brazil*

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The deforestation and the agricultural practices can modify the tropical soils properties. The intensive cultivation, usually used in the sugar cane culture, can carry to the structure degradation, favoring the increase in the soil density and the reduction in the porosity, water infiltration and aeration of the soil. With the aim to evaluate the effects of long-term sugar-cane monoculture on soil aggregation two soils were chosen: an Ultisol (U) and an Entisol (E), located in the São Paulo State, Brazil. Three situations were studied for each soil: plots under natural vegetation, plots under continuous sugar-cane monoculture for a period of five years (E) and twelve years (U) and plots under continuous sugar-cane monoculture for a period of twenty-five years (E) and fifty years (U). The soil samples were collected, in each area, in six points chosen at random between-lines of planting, during the months which preceded the culture harvest, in the following depths: 0,00-0,05; 0,05-0,10; 0,10-0,20 and 0,20-0,40m, and submitted to **sieving**. The values of soil aggregates, obtained for size class, were used to calculate the mean weigh diameter (MWD) and the mean geometric diameter (MGD). The soil aggregate stability were higher under natural vegetation areas where compared with those under sugar-cane monoculture. The decrease in the soil aggregate stability was similar for the areas used for smaller (five and twelve years) and for long-term (twenty-five and fifty years) with sugar-cane monoculture.

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Forest fires impact in semi arid lands in Algeria, analysis and followed of desertification by using remote sensing and GIS

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The Forest in steppe present ecological diversity, and seen climatic unfavourable conditions in zone and impact of forest fires; we notes deterioration of physical environment particularly, deterioration of natural forest. This deterioration of forests provokes an unbalance of environment witch provokes a process of deterioration advanced in the ultimate stadium is desertification. By elsewhere, where climatic conditions are favourable, the fire is an ecological and acted agent like integral part of evolution of the ecosystems, the specific regeneration of plants are influenced greatly by the regime of fire (season of fire, intensity, interval), who leads to the recuperation of the vegetation of meadow- fire. In this survey we used the pictures ALSAT-1 for detection of zones with risk of forest fire and their impact on the naturals forests in region of Tlemcen. A thematic detailed analysis of forests well attended ecosystems some processing on the picture ALSAT-1, we allowed to identify and classifying the forests in there opinion components flowers. We identified ampleness of fire on this zone also. Some parameters as the slope, the proximity to the road and the forests formations were studied in the goal of determining the zones to risk of forest fire. A crossing of diaper of information in a SIG according to a very determined logic allowed to classify the zones in degree of risk of fire in a middle arid in a forest zone not encouraging the regeneration on the other hand permitting the installation of cash of steppe which encourages the desertification.

The effect of the change of the useage of forest lands on the physical and chemical specification of the forests soils in the North of Iran

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In this study, three hight classes less than 500m., 500m. to 1000m .and more than 1000m. above the sea level have been selected, and in each height class ,six plots (40m.*50) were selected,which all on the south skirt with slope and master stone were identical .Three plots out of six plots from natural forests and the other three plots which had undergone the change of usage in other forests,were selected .In the center of each of these plots ,which were totally 18 plots, A profile was digged which while identifying.The different horizon soils and the analysis of the profile of soil ,we also analyzed the physical and chemical characteristics of the samples of the different horizon soils such as texture of the soil, color, structure, consistency, the percent of the organic matter, and the percent of nitrogen, phosphor, potassium, calcium and EC. The obtained results of this study showed that the rate of the texture of the soil, the percentage of the organic matter and the Ph of the forests soils, which had undergone the change of the usage, had been changed. According to the obtained results, the rate of the acidity of soil has changed from poor acidity to the alkaline, the texture of the soil from loam and clay loam to clay and percentage of the organic matter from the forest soils, which had undergone the change of the usage also had reduced.

Keywords: lands, North Iran, forests, change land use

The influence of different land use on soil biochemical properties in Mediterranean environment: preliminary results

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The use of biochemical properties is particularly useful in detecting changes occurring in microbial pool and activity when comparing different land uses.

Soil characterized by different managements with growing human impact were chosen in Sardegna (Italy) as representative sites in the Italian national project SOILSINK: vineyard (tilled and no tilled), grassland, pasture and forest (*Quercus suber*). The aim of the study was to determine if land use and management practices modified microbial biomass pool and activity in term of C mineralization rates and enzymes. Enzymes were chosen on their relevance in the C (β -cellobiohydrolase, N-acetyl- β -glucosaminidase, β -glucosidase, α -glucosidase), N (leucine-aminopeptidase), S (arylsulphatase) and P (acid phosphatase) cycles. Moreover, the metabolic quotient (qCO_2 , ratio of respired C to biomass C) was used as a valid indicator of the microbial efficiency in the use of energy and the degree of substrate limitation for soil microbes.

Microbial biomass and enzymatic activities on average increased noticeably in soils with a lower human impact and showed the ranking forest > pasture > grassland and vineyard. This trend was consistent with the presumable larger input of organic matter from vegetation to soil, greater in pasture and forest sites. The C mineralization rates showed an opposite tendency, reaching the minimum values in the forest site. This resulted in a significant decrease of the metabolic quotient in the sites with lower human impact, indicating the presence of a microbial community more efficient in the use of available resources.

The effects of land use change on the erosion in the Pannonhalma World Heritage Site (Comparison of soil properties on slopes under different land use forms)

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The landscape of the Pannonhalma World Heritage Site has changed radically in the past decades. As a result of an intensive need for land use the natural environment has been diminishing. On the other hand, the needs of society for intact areas have been increased more and more. The area has a big environmental stress, because of tourism, agriculture and suburbanisation.

Due to a change in land use, such as the new roads, tourism, agriculture and sylviculture, the spatial structure becomes more and more fragmented. The fragmented spatial structure and hillside relief enhance the erosion processes.

In the study we chose slopes with pairs of land use (e.g. arable land with forest or arable land with meadow or meadow with forest etc.) where the slope length and angle are similar under the different land use types, so we can compare the soil properties under the two land use types. The observed hillside area is one of the mostly eroded part of the region.

We took soil samples from the upper and from the lower third of the slopes in order to compare the soil properties on these slope tiers. We had laboratory measurements of basic soil parameters. The measurements provide help for farmers to reduce the nutrient loss (save fertilizer), hold the nutrient at the right place.

We show erosion maps using USLE model. In this way, the mostly endangered slopes can be determined. We are going to make suggestions based on the calculations, for altering the use of erosion areas which are mostly influenced by landscape change as a result of the created map database. The application of the USLE took place with the use of Mapinfo and Arcview GIS Tools.

Studies on connections between soils, vegetation, management and erosion in human influenced grasslands of the northern Hungarian mountain range

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Hungarian natural grasslands are usually managed by mowing or grazing. Cover of grasslands in Hungary exceeds 11% of the total area, about 20% of this being under nature protection.

Grasslands generated by traditional landscape management were observed in two areas of the Northern Hungarian Mountain Range, concerning their soil base, botanical values, vegetation and its role in avoiding erosion. Laboratory analyses of nutrients gave opportunity for comparing soil relations and erosion of natural, ploughed, mowed or grazed areas.

Various vegetation cover on arable lands (ploughed or mowed regularly) of small-scale farms and abandoned vineyards situated on steep slopes play important role in defending soils against erosion in the Putnok Hills. Fertile layer of soils in old vineyards was destroyed by erosion during the past hundred years, resulting in loessy material appearing on the surface, giving home for protected plant species. Many of the researched abandoned areas are in different stages of revegetation, resulting in the development of a secondary grassland (slope steppe) in a close-to-natural state. Regular mowing resulted in high number of plant species. Lack of regular mowing on a parcel with similar management history, however, resulted in the dominance of aggressive weeds.

Intensively grazed patches of grasslands in the Bükk Mts. (Nagymező area) developed after deforestation are characterised by high phosphorous and potassium content (P_2O_5 : 275.5 mg/kg, K_2O : 427.5 mg/kg), especially around the stable of the Lipizza stud. Besides accumulation of nutrients, soils have become shallow and compacted caused by intensive trampling, giving a good indicator of overgrazing. Grazing on mesofil meadows causes a massive change, in parallel with very high nutrient content, this is why their maintenance is only possible with regular mowing instead of grazing.

The role of land use change on water erosion in the Godollo Hillside

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The landscape of Hungary has changed radically in the past decades. As a result of increasing need for land (spreading of residential areas, greenfield investments etc.) the natural environment has been diminishing. On the other hand, the need of society for intact areas has increased, too. The Godollo Hillside bears big environmental stress, because it is situated close to the Budapest agglomeration. In the recent years, the effects of suburbanisation manifest more significantly since the population has already started moving out of the capital city. The need for establishing new residential areas grew, while cultivated lands are shrinking. Due to land use changes (new roads, houses, less agriculture and silviculture) the spatial structure becomes more and more fragmented. The fragmented spatial structure enhances the erosion processes; more soil sealing causes more runoff. The observed hillside area is one of the most eroded lands in Hungary. The erosion processes can be stopped just in time applying the tendencies written in the survey. We show erosion maps using USLE model. This way, the most severely endangered slopes can be outlined. Selected slopes, threatened by intensive erosion are examined for surface runoff and potential rate of sedimentation based on the WEPP model (the USLE model is not capable to calculate sediment). The effect of land use changed is shown in different scenarios based on different land cover values.

We are going to make suggestions based on the calculations, for altering the use of erosion areas which are mostly influenced by landscape change as a result of the created map database. This way the settlements' authorities can take this information into account to avoid catastrophic situations; to plan the surface channel system, gather runoff and sediment; to protect buildings, roads and other man made works; to protect natural environment and human health.

Land Evaluation for Agricultural Purposes - Bulgarian System General principles

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The Bulgarian system of agricultural land evaluation began to develop in the 1960's. In 1970 Petrov and his team published "Methods for introduction of cadastre of agricultural land in Bulgaria", which was updated several times afterwards. The last officially adopted variant of this practical system for land evaluation was from 1988.

The system is in itself a parametrical method, which evaluates the characteristics of agricultural land (climatic, relief, soil, etc.) through original methods developed in Bulgaria. This is done in compliance with the requirements of 22 basic crops for condition of irrigation and non-irrigation agriculture. The social and economical changes in the country during the last 10 years led to re-evaluation of all land from the agricultural fund on a large scale and that was in fact good practical test through which the advantages of Bulgarian land evaluation system became clear.

The aim of the present project is to show the main principles of land evaluation applied in Bulgaria. This is an information paper, which does not involve scientific novelties of Bulgarian science but aims at popularization of Bulgarian system abroad.

After numerous meetings of the authors of this paper with colleagues abroad they were convinced that Bulgarian land evaluation is not very popular abroad. We consider it as having values that must be shared and may be useful in countries that wish to develop similar science and applied science activities.

Introducing irrigation in the dry farming systems of Lanzarote (Canary Island, Spain): Impact on Tephra-mulched soils

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The extreme aridity and scarcity of hydric resources of the island of Lanzarote led to a traditional dry-farming system developed since the 18th century, based on soil mulching with basaltic tephra and locally known as *arenados*. This dry farming system is highly sustainable, conserving water and soil, improving salinity and the thermal soil characteristics. In the last decades, the increase in the availability of desalinated (DW) and reclaimed wastewaters (DRW), which constitute 99% of the hydric resources in the island ($20.7 \text{ hm}^3\text{year}^{-1}$), has caused a change in the management of this system by introducing irrigation. The objective of this work was to evaluate the impact of irrigation on soil and crop quality in the *arenados*. The main characteristics of DW were: EC ($880\text{-}1078 \mu\text{Sm}^{-1}$), SAR ($7\text{-}10 \text{ meqL}^{-0.5}$) and B ($\approx 1 \text{ mgL}^{-1}$). Consequently, the municipal residual waters with tertiary treatment, DRW, also displayed high values of SAR ($6\text{-}14 \text{ meqL}^{-0.5}$) and boron ($0.7\text{-}1.3 \text{ mgL}^{-1}$), as well as levels of salinity between $660\text{-}1874 \mu\text{Sm}^{-1}$. In order to evaluate the influence of irrigation on the soil quality, eight field plots were selected, comparing in each one drip-irrigated and non-irrigated subplots, both covered with basaltic tephra. Soil samples were taken at 0-10 and 10-30 cm. The results showed a significant increase of salinity in the case of DRW-irrigated soils, especially in the surface layers, with values exceeding 5 dSm^{-1} . The same trend was observed in the case of irrigation with DW, albeit EC values were under 2 dSm^{-1} . The SAR values generally increased with irrigation, especially under DRW. Both hot water soluble and soil solution boron increased significantly with irrigation, and levels considered toxic were reached in some cases. However, no phytotoxicity symptoms were observed in the crops.

The results reveal an increasing degradation of the soil quality at mid/long-term as a result of irrigation, boron being specially concerned. This study should be extended to other irrigated areas in order to verify the observed trends, in which case the sustainability of the *arenados* would not be warranted under the current management practices.

Study on the Ecological Agriculture Mode with High Effectiveness A Case Study of Shengshui Town in Liuhe County of Jilin Province, China

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For the demand of national economical development in given region and on the basis of natural and social economical status in small valley of Shengshui Town, the development of integrative restoration and management mode of water and soil loss and ecological agricultural mode were studied, at the same time, the ecological. Economical and social benefits were supervised and estimated. On the basis of these, we developed the ecological agriculture mode with high effectiveness, established the integrative and complex agricultural ecological system, and realized the harmonization and unification of ecological benefit, economical benefit and social benefit in small valley of semi-mountain area. These modes have the important appliance foreground and extensive popularization value in semi-mountain area and homoplastic areas. In the mode of ecological economical forest with the function of soil and water reservation, ecological garden had significant benefit with average profit of 7369 yuan (RMB) per hectare, profit margin of 27.53% per yuan cost and labor productivity of 53.61%. Biological output increased to above 18.2~39.2 t/ha in the year of 2000 from 11.8~19.4 t/ha in the year of 1998. The erosion modulus on slope surface declined above 70% and pathway flux also declined above 50%.

The solid exploitation mode with forest, fruit, reservoir, rice has got not only significant economical profit, but also distinctive ecological profit. Before exploitation, the clay inflowing to small reservoir every year make the bottom of reservoir get silt of 3.7~4.2 cm. That is, 1.72 kg/m² of soil was lost before exploitation, but only 0.49 kg/m² from 1999 to 2000, declining 71.5%. Because of the increment of vegetation cover degree, the quantity of soil and water loss significantly decreases in the areas of catchments. The ecological environment was protected effectively. In this mode, fish output increased to 556.3 kg/m² from 375.0 kg/m² before exploitation, rice yield increased to 6 500 kg/m² from 5 100 kg/m² before exploitation.

On the basis of the characteristics of semi-mountain area, the complex ecological system with the union of fishing, stock raising, grass, forest, fruit and grain was constructed. Within the system every links made up and promote each other, materials and energy was cyclically used in multilayer and many ways. The assistant energy out of system was devoted as little as possible, the production cost was economized and high effectiveness and low cost was realized. Therefore, this mode and technological measures could be extended and applied in analogous areas. Furthermore, the construction of ecological agriculture mode with high effectiveness is the most important content, the study group deployed the research work in three sites with an area of 308 ha, at the same time, we used the remote sensing and computer technology for supervising, reviewing, and programming entirely for Shengshui Town, started up the "greenness action" program, these all get actively radiative and driving effect for Liuhe ecological environment construction and other cities and counties.

Keywords: semi-mountainous area, small valley, soil and water conservation, ecological agriculture mode with high effectiveness

Cedar forest decline in the Moroccan Middle-Atlas Mountains: Deforestation detection and monitoring using satellite imagery

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The cedar forest of the Moroccan Middle-Atlas Mountains is the largest remnant of the mature circummediterranean forest ecosystem once distributed from Turkey to Spain through the Middle East and North Africa.

The main objective of this study was to identify areas of deforestation/reforestation in the Middle-Atlas cedar forest and monitor their temporal dynamics. The aim was to detect a detailed “from-to” change information; it targets a quantitative estimation of the extent and the magnitude of the changes affecting major identified species of the Moroccan cedar ecosystem: cedar, oak, and deciduous. The major challenge was to identify changes of interest such as identifying the change due to a selective logging which consists on cutting cedar canopy trees while sparing the understory oak trees. To address these issues and achieve our objectives, we adopted a methodology with two main stages. First, we mapped major forest species from multitemporal satellite images (Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)) using maximum likelihood classification (MLC) and spectral mixture analysis (SMA). Second, we performed change detection assessment using two procedures: (i) image products differencing to assess the overall change in the forest cover, (ii) post-classification comparisons using the outputs of the MLC and the relative abundances of forest species as determined by SMA. Results have shown the following: logging has decreased cedar area in a proportion of 12% while reforestation has yielded an increase of 8% in cedar forest; in oak forest, the increment (21%) has exceeded the deforestation effect (17%); conversely, deciduous have either degraded (11%) or remained stable (21%).

Soil nitrogen dynamics under adjacent native forest and hoop pine plantations of subtropical Australia

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Land-use change can impact soil nitrogen (N) dynamics and therefore the long-term maintenance of soil N cycling and availability. In this study, a series of laboratory experiments were undertaken to examine the influence of land-use change from a native forest (NF) to a first rotation (1R) and subsequent second rotation (2R) hoop pine (*Araucaria cunninghamii*) plantation on soil N dynamics. The study was conducted in adjacent NF, 1R hoop pine plantation (53-year old), and 2R hoop pine plantation (5-year old) in Yarraman State Forest, south-east Queensland, Australia. Results of a ¹⁵N isotope dilution experiment showed that land-use change had a significant impact on soil N availability and N transformations. The conversion of the NF to the 1R hoop pine plantation significantly reduced the availability of mineral N and decreased the rate of gross nitrification. The conversion of 1R to 2R hoop pine plantation resulted in an increase in the gross rate of ammonification. A second experiment quantified the impact of land use on soil soluble organic N (SON) pools. Results showed that the conversion of NF to 1R hoop pine plantation tended to decrease the amount of soil SON, while the conversion of 1R to 2R hoop pine plantation generally resulted in a reduction in the amount of SON. A third experiment examined the impact of land-use change on the size, activity, and composition of the soil microbial community using fumigation-extraction, CO₂ respiration, and community level physiological profiling (CLPP) techniques. Land-use change from NF to 1R hoop pine plantation resulted in a reduction in microbial biomass and activity, and a shift in soil microbial community composition. While the conversion from 1R to 2R hoop pine plantation appeared to have no significant influence on the size and activity of the soil microbial community, there were some indications of a difference in community composition. From these results, it was concluded that land-use change had a significant impact on soil N dynamics. This was possibly associated with shifts in the quality and quantity of organic inputs, soil microbial properties and microclimate conditions. Results from this study indicate that land-use change and residue management may have implications for the long-term productivity of the soil resource.

The study of soil and sediment quality indicators in different land uses of north Karun Watershed (Cheshmeh Ali)

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Soil quality assessment is necessary for identifying the effects of different management systems on agricultural and natural ecosystem including range and forest degradation. Such studies can be useful for identifying sustainable practices in each region with the intention of preventing land degradation, providing sustainable crop production and environment protection. The objectives of this study were to compare selected soil quality indices and to estimate the amount of sediment, runoff and nutrient loss in four different land uses including a pasture with good vegetation cover (> 20%), a pasture with poor vegetation cover (< 10%), a currently being used dry land farm and a degraded dry land farm which is not used. Soil samples were taken from the depth of 0–10 cm in a completely randomized design with four replications. A rainfall simulator was run for 2 hours to estimate the amount of sediment, runoff and nutrient loss. Both sediment and runoff were collected after 30, 60, 90 and 120 minutes. The results showed that a very high degradation has occurred in the area mostly due to water erosion created as a result of overgrazing in pasture, susceptibility of geological formations and more importantly, the change of land use pasture to inefficient dry land farming. With land use change, organic matter decreases and the most decrease was 68.6% in dry land farm. In both dry land farm and degraded dry land farm total N was about 43% decrease and available P content decreased 50% in dry farm land. Also cation exchange capacity, microbial respiration, MWD and total porosity decreased and their most decreasing was 37.2%, 57.1%, 72.9 and 32.2% respectively in degraded dry farm land. Soil bulk density during land use change in pasture with good vegetation cover increase considerably. The most and least infiltration rate was in the pasture with good vegetation cover and degraded dry land farm, respectively. Maximum runoff and sediment content were created in the abandoned dry land farm and currently being used dry land farm, respectively. Minimum runoff and sediment content were produced in pasture with good vegetation cover. Enrichment ratio (E. R) of soil particles in sediment was highest for fine silt (2-5 μ m) followed by clay. A minimum of E.R was obtained for sand fraction. Percentage of organic matter, total N and available P in sediment was higher in the first hour as compared to the second one. This is mainly due to the fact that fine particles are removed at the beginnings of the rainfall event. Total removal of these chemical factors was highest in dry land, intermediate in pasture with poor vegetation cover and abandoned dry land and lowest in pasture with good vegetation cover. In general cultivation and disturbance of the pasture in the area land have caused a great decrease in soil quality and made the surface very sensitive to erosion.

Rill and inter-rill erosion measurements in Tarnii Valley, Eastern Romania, after historical rainstorm events in September, 2007

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Tarnii Valley is an watershed located in Tutova Rolling Hills, Eastern Romania and was under conservation practices for more than forty years. During all that period, the study site behaved quite well, even though it seems that even now the territory is marked like a paradigm by the former traditional way of exploitation, in long, narrow, up-and-down hill oriented small plots. In the last four years, three major (low frequency – high intensity) rainstorm events have had a special impact in terms of rill and inter-rill soil erosion, by taking over in places the conservation works and resulting in spectacular erosion features.

Several techniques have been involved in order to assess the overall impact of those rainstorm events and, among them, the premiere use of ultimate GPS equipment proved to be a very useful tool, which conducted to the achievement of very interesting scientific results. The use of RTK GPS equipment, besides its accuracy and greater productivity if compared to theodolites or total stations has the advantage that measured points, polygons, etc. are already georeferenced. That means, successive measurements do not need monumented reference points and rill-inter-rill paths can easily be compared after rainstorm events, which trigger runoff.

It seems that rainstorm events with amounts like 100 mm, which were quite unusual in the area in the last one hundred years, have the tendency to become more and more frequent in the last years, and may have a special impact on soil erosion only if their rate (intensity) reaches or is beyond 180 mm/hour.

Current water erosion studies at Pullman, WA, USA

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Long-term studies on extensively instrumented experimental plots at the USDA-ARS Palouse Conservation Field Station near Pullman, WA are targeted toward obtaining a better understanding of water movement into and through the soil under freeze/thaw conditions, with the objective of improving winter process modeling. Two treatments, continuous tilled fallow and no-till winter wheat after spring barley, provide a wide contrast in management and in runoff and erosion results as well. Instrumentation includes soil water probes and temperature sensors installed incrementally to a depth of 1 m. Weather data include temperature, precipitation, wind speed and direction, and relative humidity.

Runoff and soil loss are measured throughout runoff events. These data are currently being used to validate a new energy-budget-based winter process module recently implemented in the USDA's Water Erosion Prediction Project (WEPP) model. The data can be used in development and validation of other models as well. Data and results from the first three years of the study will be presented, along with results of the new winter process module in WEPP with current and historical data.

Impact of plough direction on soil loss and runoff in the rainfed area in Iran

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Unsuitable operations in rain fed cultivation such as parallel ploughing along the slope cause in reduction of rainwater infiltration and increase the runoff in some areas of Iran. Therefore, the crops remain water-stressed and give low yield, especially in rainfed areas. This paper presents the impact of plough direction on runoff, sediment, and wheat yield at three different slopes in rainfed areas in the part of the Zanzan plain in four crop years. For this study, 18 standard plots (22.1 * 1.8 m) were stabilized in three slopes of 11, 16 and 30 % as representative of three slope classes of 0-12, 12-20, and 20-40 %. Tanks were commissioned at the end of each plot for collecting the runoff and sediment. The two treatments of ploughing along and across the slope were applied with three replications. Wheat was raised in the plots following two fallow years. During the study period, runoff and sediment outflow were measured for all rainfall events. Totally, soil erosion in plots ploughing along the slope were 23, 16 and 60 time greater than the plots ploughing across the slope in three slope rates 11, 16, and 30% respectively. Results showed that contour plowing significantly reduced the volume of surface runoff and sediment yield in all slope classes.

Interrill erosion selectivity and enrichment rate changes produced with low slope gradient

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The objectives of this work were to analyse the effect of low slope on selectivity of splash and wash, and the consequences on enrichment rate in soil particles in the sediment. Gently disturbed bare soil samples of silty loam typic Argiudoll from pasture and with 10 years of No tillage system were used in order to analyse the detachment rate with three different soil slope gradient (0 %, 3% and 5%); in laboratory a rain of 55 mm. h⁻¹ (1340 J.m⁻²) were used with special trays of 0.6 m x 0.5 m, and sediment was collected each 5 minutes. Selectivity in splash and wash was measured in percentage of particles from each size produced in the time on the total amount of particles in the sediment. The enrichment rates in particles (ER) were evaluated by recording the soil aggregate distribution before the rain simulation and to record the soil aggregate distribution in the sediment. It was found a non lineal increase in sediment production that was higher in aggregates from No tillage than in aggregates from pasture, which suggest an interaction between soil stability and slope degree; by increasing soil slope, the splash selectivity in aggregates from NT was the highest in particles smaller than 0.05 mm (colloidal size) when the slope changed from 0 to 3%, but with 5% slope, the splash selected particles higher than 0.05 mm. In aggregates from pasture, the predominant particles in splash are higher than 0.25 mm when the slope change from 0 to 3%; however, with 5 % slope the sizes of particles selected were smaller than 0.05 mm. Wash selectivity process in aggregates from NT does not change with the different slope, and always maintain a higher percentage of particles smaller than 0.05 mm. In aggregates from pasture, the selectivity is high in particles smaller than 0.05 mm until slope of 3%, but decrease with 5%, due to the predominance of particles higher than 0.25 mm. The only significant change in enrichment rate with the slope was observed with particles smaller than 0.05 mm which were increased continuously from 0 to 5 % in aggregates from pasture, meanwhile in aggregates from NT was always higher than the values observed in the pasture, but without change with a different slope. Data observed suggest that the enrichment rate was different when the splash or wash was analyzed, which could explain the interactions between the aggregate stability and the different slope.

Landslide hazards and national mitigation strategy in China

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A basic status and some typical examples of landslide hazards in China are introduced since 2000 in this paper. It is put up that landslide geo-hazard is of three basic properties consisting of natural, socio-economic and resource aspects. Landslide hazards are stem from a series of changes of geo-environments. The motive powers of geo-environment changes result from four geological processes, that is gravitation of the celestial bodies, endogenetic force in the earth, exogenetic action on the earth surface and human activity. It is discovered that humans to be hit by geo-hazards and total economic losses have been increasing while a region is in high speed of state in society and economic development, Based on the relation study between landslide hazard and human social economy activity. As a result of summing-up landslide hazards control work in China since 2000, author held up a national strategy for landslide hazards mitigation in which consists of target, countermeasures and plan based on basic properties of landslide hazards, change trend of geo-environments and socio-economic development situation in China. A partnership for reducing landslide hazards risk will be built among government, science and technology circles, engineering enterprises and public society, a rational knowledge to mitigate disaster risk will transform from controlling geo-hazards passively to develop geo-environments in a scientific and sustainable mode.

Keywords: landslide hazards, natural, socio-economic and resource properties, changes of geo-environments, strategy partnership for landslide hazards mitigation

Assessment of impacts some of physicochemical characteristics of soil on longitudinal development of gullies (gully erosion)

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This study was under taken in the central part of a sub basin of zanjan rood, located between eastern longitudes of 47° 50' 56"- 48° 3' 52" and northern latitudes of 36° 58' 57"-37° 07' 29" using data obtained from aerial photo and satellite image interpretation and field observations to locate the gullies. Collecting soil samples (161 samples) according to standard method parameters such as texture, chalk, organic matter, total lime, pH, electro conductivity, type and content of soluble ions, cat ion exchange capacity (CEC) and saturation humidity and SAR were determined in order to determine physicochemical characters of soils in the gully formation localities. Based on the results of this study there is a significant relation ship among longitudinal growth of gullies and carbon content, silt, sodium absorption and this implies that the longitudinal growth of gullies increases with the reduction of organic content an increase of ions in other word we are witnessing gully development due unallowable of environment.

Keywords: Gully Erosion, Longitudinal development of gully, Organic matter, Environment, SAR, CEC, Soil

Vegetation and Groundcover Influences on Hydrology and Erosion in Pinyon and Juniper Woodland Communities

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Pinyon and juniper woodlands have expanded 10 to 30% in the past 30 years and now occupy nearly 20 million hectares of sagebrush shrub steppe in the Great Basin Region and Colorado Plateau, USA. The conversion of sagebrush steppe to pinyon and juniper woodlands has been linked to reduced forage production, altered wildlife habitat, changes in plant community structure and composition, and increased overland flow and erosion from these landscapes. The Sagebrush Steppe Treatment Evaluation Project (SageSTEP, www.sagestep.org) was implemented in 2005 as a 5 years interdisciplinary research study to evaluate restoration methodologies for sagebrush rangelands degraded by woodland and grassland encroachment over a six state area within the Great Basin. The hydrology component of SageSTEP focuses on the relationships between changes in vegetation and groundcover and runoff/erosion processes. Rainfall simulation over small (0.5 m²) and large (14 m²) plot scales and concentrated flow experiments were applied across a gradient of canopy and ground cover to determine whether critical thresholds exist in vegetation and ground cover that significantly influence infiltration, runoff, and erosion in pinyon and juniper woodlands. Water drop penetration times and wetting front spatial patterns were used to investigate the influence of soil water repellency on infiltration rates across the vegetative gradient. Results from this study provide a dataset for comparison with runoff and erosion following future sagebrush steppe restoration treatments in the SageSTEP study.

Approche magnétique de caractérisation et quantification de la perte en sol

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Pendant les dernières décennies, on constate une émergence importante des techniques magnétiques pour résoudre des problèmes environnementaux. Le développement d'une méthodologie qui vise à quantifier le taux d'érosion n'est encore mise en évidence. Dans le présent travail, nous essayons de mettre l'accent sur la signification et l'exploitation, à des fins d'analyse de l'état de stabilité ou de dégradation des sols, des paramètres magnétiques (χ , ARIs, ARA, Hs...) et leurs variations dans les profils des sols échantillonnés, en mettant en oeuvre une approche magnétique faisant appel au magnétisme de l'environnement. En effet, les oxydes et les hydroxydes de fer, abondants dans les sols, façonnent de manière presque exclusive l'ordre magnétique dans les sols. Ils sont susceptibles de subir des altérations selon les conditions pedo-environnementales, et peuvent être ainsi considérés comme des traceurs d'évolution et/ou de dégradation des sols. L'identification de la composition minéralogique et la caractérisation de la taille des grains porteurs d'aimantation a nécessité de suivre un protocole expérimental, mis à profit, pour assurer le maintien du comportement magnétique de l'échantillon au cours des mesures magnétiques.

L'érosion mécanique des sols et leurs transports induisent des variations de la taille des grains et une nouvelle redistribution de la minéralogie magnétique à travers le bassin drainé. Alors que les profils des sols stables sont le siège d'une évolution pédologique successive à une évolution minéralogique le long des profils des sols, en particulier dans les horizons superficiels des sols. Cette approche magnétique est basée donc sur l'identification de la minéralogie magnétique et sur la caractérisation de la taille des grains magnétiques constitutifs des sols, car ces dernières constituent les propriétés magnétiques de base des sols.

Le suivi de l'évolution vertical et transversal de la minéralogie et de la taille des grains magnétiques le long des profils des sols et à travers les transects échantillonnés permet de délimiter les horizons magnétiques en particulier les horizons superficiels. Ainsi, La corrélation entre les différents profils magnétiques des sols, le long des toposéquences, nous permet de suivre la variation de l'épaisseur de l'horizon superficiel et d'estimer la perte en sol dans le bassin versant.

Application of cactus line in reducing and control runoff in a small watershed situated in the North West of Algeirs (Mediterranean climate)

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An experience was done to try the effect of the line of cactus plant in reducing the velocity and the concentration of the runoff and its capacity in shearing and carrying out the soil from rill channel.

This experience was done in area situated in a small watershed in Mediterranean climate and in witch run off cause a serious kind of channel erosion; sheet, rill. The area is situated in the west of Algiers (in the south of the Mediterranean), it's characterized by loam soil, semi arid climate with 400 mm average rainfall and a slope bigger then 10 %.

The transplantation was done in January 2000 by 10 meters length from the top to the bottom of the area and a 20 meter space between lines. The effect of the line was done by following and comparison the variation of channel dimension about 20 meter length and average large about 0.15 meter in area treated by line with an other channel with similar characteristics but without line of agave.

The result after three years shows that the shearing action is important in area without line. The volume of the channel computed by Surfer logiciel varied from 23511 cm³ (2001), 153445 cm³ (2002) and 63397 cm³ against 28511 cm³ (2001), 70917 (2002) and 20608 cm³.

The difference shows the role of the line of plant in reducing the volume of soil cutting by runoff. This can be attributed to the effect of line in reduction of the velocity, volume and energy of water in the channel.

Keywords: erosion, Channel, erosion control, line of cactus

Problem of soil erosion in Uttarakhand Himalayas, India

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In Uttarakhand, the northern most state of India, comprising sub and lesser Himalayan region, natural as well as human induced hazards casts a wide shadow over human life. Every year valuable top soil cover erodes and washes away, several places experience massive landslides and debris flow, which results in damage to human life as well as to property. In recent years the intensity of natural hazards has increased surprisingly. From last 15 years all over the hilly region of Uttarakhand, extensive and widespread damages occurred due to several massive landslides / slips and flashflood resulting into massive downward side debris flow due to gravity blocking the Alaknanda river flow which is a major lifeline for the Uttarakhand region (after reaching the plain area it is called as Ganga river), blocking the connecting roads in the hilly region and damaging the human, their property as well as the livestock. It is difficult to stop the debris flow due to natural hazards like earthquake and landslides or weather related or by man made activities like dam and road construction, which are quite common in the area but their intensity can be mitigated by taking appropriate steps, as some of the human activities had an impact on increasing instability of slopes, making them susceptible to potential degradation by natural runoff through floods, sheet erosion, slides etc. However, It is also not possible to maintain absolute conservation in the Himalayas, where the people are dependent on the forests for their basic requirements of water, fuel and fodder. But the soil erosion and landslides can be effectively controlled by putting ban on deforestation. In this regards, Chipko movement initiated by Sunderlal Bahuguna in which a human chain around the tree was made by the local people, thus, saving the trees from cutting by the traders plays an important role in restoring ecosystem in the region. The top soil can not lose its contact with underlying layer if the area is forested or vegetated. The roots of the plants hold the spoil from sliding down. Number of eco-task force have been created to conserve the forests. Nanda Devi Biosphere to save biodiversity is one of them. One of the major mitigation strategies could be through micro zonation approach. Satellite imagery can help both the monitoring and measuring of soil erosion.

Keywords: soil erosion, natural hazards, landslides, debris flow, micro zonation

Macro and micro level soil resource mapping for soil erosion assessment and conservation in Shiwalik Region of Himalayas, India

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Shiwaliks represent most fragile ecosystem of Himalayas threatened by massive soil erosion hazards. Soil erosion is being accelerated in this region due to intensive deforestation, terrace farming on steep slopes, and mining, etc. Mapping and assessment of erosion prone areas is pre-requisite for planning soil conservation and watershed management programs. Since field size, land use, vegetation, soil, slope, and geomorphology affect the severity of soil erosion losses. Therefore for better understanding of natural resources at various scales is of vital importance and thus the present study was carried out to assess the soil resources, soil erosion and conservation measures at different scales (macro and micro level), using soil resources data. Soil resource data generated through reconnaissance and detailed survey were used in the present study with in Balachur tehsil, Nawanshahar district, Punjab, India for macro level (on 1:50,000 scale) and pilot studies carried out by using cadastral maps (scale 1:4000) in three contiguous villages of the study area. Satellite images #IRS P6LISS-III coupled with GIS were visually and digitally interpreted for land use and to improvise the already available soil resource data. In addition, a slope map of the area was generated by using remote sensing data and survey of India toposheets. At macro level, the study area was categorized into seven physiographic units viz., Shiwalik hill top and slopes (eroded), *choe* belt, upper piedmont plain, upper and lower piedmont plain, recent flood plain, and active flood plain. Soil profiles representing various physiographic units were studied and classified into 15 soil series. Topography, drainage pattern and inherent characteristics of soils are responsible for major problems such as denudation of Shiwaliks, *choes* lands, severe erosion, coarse texture; water logging and salinity. Soil conservation measures (like mechanical, terrace trenching, vegetative, etc.) were suggested to restore the eroded area on sustainable basis. On the basis of above study some hot-spot areas, which need immediate attention, were selected for detailed study for chalking out the strategy to check the soil erosion losses at field level. During detailed field to field investigation, seven soil series with 33 soil mapping units were identified. Results further indicated that, 60.7% area experienced problem of moderate erosion, 22.2% area affected by severe to very severe erosion, whereas, 16.0% area is highly eroded. Leveling, contour bunding, field bunding, cultivation of thick canopy crops like green gram, moth bean and green manuring crops were suggested; construction of vegetative and masonry check dams; sowing and planting on degraded lands; terracing of lands, contour trenching, gully plugging; landslide control measures like masonry spill, waltings structure, etc. have been recommended to check the erosion losses. Water harvesting techniques should be encouraged. '*Choes*' affected sandy and nearly eroded soils (0.66%) occurring on moderate slopes with surface boulders are recommended for plantation of erosion resistant grass species Like *Sactharunm spp.* To slow down the dissection of these soils due to overflow of water, cultivation of fodder crops by adopting adequate soil conservation measures has been recommended.

Suspended sediments-discharge hysteresis during rainfall events in a small headwater catchment in the NW Spain

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In rural catchments, suspended sediment (SS) is normally transported during rainfall events. However, the relation between SS concentration and discharge is not normally homogenous during the event, often producing hysteretic loops. In this study we identify the hysteresis types of the discharge-SS concentration relationships of four single rainfall events and the relationships between the hysteretic loops and the conditions for generation of SS losses to stream, as well as associated critical source areas. To classify the events in relation to their hysteretic loop, discharge-SS graphs were drawn with linear axes for both variables.

The study catchment, located in the NW of Spain, is draining by a small stream. Land use is agroforestry. The soil parent material is schist. The soils are relatively deep medium-textures. The precipitation that caused the events oscillated between 3.8 and 47.4 mm. Water samples were collected at the catchment outlet. Suspended solids were obtained by difference of weight.

The results show that there is a stronger linkage between SS concentrations and discharge during the events. Suspended sediments values quickly increased during the onset of events. Suspended sediments were much higher at a given discharge on the rising limb of hydrograph than at the same discharge on the falling limb, giving rise a clockwise hysteresis loop for overall events. Because of the rapid response to flow, the most important processes controlling SS during the events must be near-stream or in-stream. Riverbank and areas close to the river are the main sources of SS, allowing their rapid mobilisation and arrive to the catchment outlet.

Soil Quality Degradation Processes along a Deforestation Chronosequence in the Ziwuling Area, China

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Accelerated erosion caused by deforestation and soil degradation has become the primary factor limiting sustainable utilization of soil resources on the Loess Plateau of Northwestern China. We studied the physical, chemical, and microbiological processes of soil degradation along a chronosequence of deforestation in the Ziwuling area of northwestern Shaanxi province. The results indicated that soil wet aggregate stability, mean aggregate diameter decreased with years following deforestation. Accelerated erosion resulted in soil nutrient loss, and a decrease in soil enzyme activities including notable losses of total soil N, organic C, alkaline phosphatase activity, and invertase activity. During the early time period, the rates of total soil N, organic C, alkaline phosphatase activity, and invertase activity decreasing were rapid and gradually decreased with deforestation years. Increased use of nitrogen fertilizers made determination of soil quality based on measured NO₃-N and NH₄-N inconclusive. The differences in measured parameters between the topsoil and subsoil horizons decreased with time since deforestation, soil erosion was the primary process responsible for the degradation of measured soil physical, chemical, and microbiological properties.

Keywords: Accelerated erosion, Deforestation, Soil quality, Loess Plateau, Soil enzyme activities, Wet aggregate stability

Rills and ephemeral gullies development during an extreme rainfall period in agricultural lands (NW Spain)

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Works was realized to hillslope and small catchment in NW Spain, to permit see that in different cultivates areas, the concentrated flow erosion in rills and ephemeral gullies, too are the principal component to the soil losses.

This paper is focused on the erosion systems in both, a small agricultural catchment and a hillslope in the NW Spain, giving a special attention to the influence of soil surface characteristics on rill and ephemeral gully erosion processes. The erosion measures were made in an extremely humid period, in which intensities of rain were reached superior to 10 mm/h. Moreover, the return period of the most intense event was of about 125 years. As a consequence, the frequency and severity of overland flow was much higher than in previous years. The soils show a silt-loam texture being susceptible to the crusting when they are tilled.

In 2000 autumn, a hillslope was tilled, a small part was sown with grassland and the rest was fallow. The sowing in the grassland and tillage in the fallow were between 5 and 10 October. At the end of October will form a network rill that continued later developed and originates ephemeral gullies. The importance could be observed that total values the soil losses of 40 m³/ha to finish of measurement first period, then 664.7 mm of rain and to 41.80 m³/ha in February 2001, then 1055.8 mm of rain.

During the study period, the land use in the highest part of the catchment was grassland and the lowest areas were tilled in the beginning of autumn. Part of the tilled surface was sown with grassland the day 24 October 2000 and the rest were in fallow. In the lowest part of the valley, a gully was formed. At the finish rain period (2001 February 10) besides the gully was distinguish a system rills in fallow land. The soil volume removed for gully bottom valley formation was 53.87 m³.

Study on soil erosion factors in Shanxi Province, China

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Soil erosion zoning is a basic work for ecological environment construction of soil and water conservation. Based on the zoning and further investigation, rational land use zoning can be figured out, and specific measures adopted to prevent and control soil erosion, so as to increase land productivity and ensure sustainable development of social-economy. According to topographic features, soil erosion intensity, and so on, the soil erosion areas in Shanxi Province can be classified into six categories, i.e. loess gullied hilly area, loess residual plateau gullied area, loess wind-sandy gentle hilly area, earth-rocky mountain area, loess terraced hilly area and alluvial plain area respectively. In this paper, the characteristics and distribution of each soil erosion zoning in Shanxi Province is discussed, and some typical soil erosion control measures are suggested.

Keywords: Soil erosion zoning, Environment construction, Sustainable development, Erosion intensity, Control measure

Numerical analysis of hydro-geomorphologic and environmental potentials of touristy Orumieh Lake Basin and shoreline for land planning (North-West of Iran)

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Orumieh lake causeway has an important role that can be attributed to its effect in connecting West and East Azerbyjan, but its ecological effect could not be ignored. This lake basin area is 52700 km² with 102 islands, familiar national park, with 186 species of birds, and animals. Due to economic, tourism, agricultural activities has a special role in the northwest of Iran. Where this lake is the biggest cache met in the western Asia, and due to Rio conference published Declaration in 1994, the Orumieh lake ecosystem and national park of them as known as one of the protect area among the 9 protected area. Also the National park of Orumieh lake, among the 14 national park in the world utilized from spatial limitations. The water of lake are very salty (240 gr in winter and 260gr in summer) and fluctuation of lake water level threaded 500km² of banks or shorelines lands. Water level rising in intensive rainfall years caused damage for ports instruments in shoreline and agricultures lands. This tectonically Orumieh lake, surrounded by agricultural plains and consists of 10.5 % of basin area and has 34000 million m³ water resource. The average depths of lake is 6 m and in the about 5.2 % of basin area (in marginal and mountainous area), erosion rate is very high. The result of drainage morphometric showed low density (49.8 m/km²), basin form factor and coefficient such as Gravelius 1.49 indicated little along form but basin has high adoption with Rotundity and triangle ratio. The ratio of salt in soils is from %1 an Ec 8 mmhose to %3 and Ec more than 40 in around lake expanded in vast area. For control satiation preceding and rehabilitation marginal soils due to environmental potential, some techniques suggested for land using of shoreline.

Keywords: ecological changing, soil erosion, environmental management

Using GIS and MPSIAC Model to Estimate Sedimentation and Produce Erosion Map in Rakaat Catchments of Karoun 3 Dam of Khouzestan Province, Iran

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The information assessment and development are being performed more quickly and less expensive by using Geographical Information Systems (GIS); furthermore, the maps can be produced accurately. This paper proposes a particular approach to estimate the intensity of soil erosion and generate the annual sediment yield map in Rakat catchment with application of Modified Pacific Southwest Inter-Agency Committee (MPSIAC) model. Data layers were generated from aerial photographs, field survey, barometric and digitized photographic maps. After definition of nine input factors of MPSIAC model (surface Geology, soils, rainfall runoff, climate, land use, land cover, land slope, upland erosion and channel erosion), the raster-based maps were applied to produce maps of all factors. Spatial analyst software was also applied to estimate annual sediment yield and produce the map of erosion intensity. Output maps and data were verified by field observation. According to the results, sediment yield ranges were between 3.20 ton/ha/year for low erosion category and 15.87 ton/ha/year in the region with high erosion potential. In addition, the MPSIAC output map was cross-tabulated against the slope, geology and land use factors. The result shows that the sensitive geological formations (Gachsaran and Aghajari) and land use changes are highly correlated with high erosion potential of studied catchment.

Relation of Cs-137 Fallout With Annual Precipitation In Northwestern Iran

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Cs-137 is a man made nuclide released from nuclear weapon explosions in the 1960 and 1970 decades and introduced into troposphere, where which precipitated by rain. Cs-137 has a small hydrated radius, which is attracted by negative charges on colloid surfaces strictly. It is neither leached through soil nor absorbed by plant roots so its loss in the soil is related to its translocation by tillage or runoff. Determining the Cs-137 inventory is a prerequisite for soil erosion research. Finding a typical undisturbed site for sampling is tedious and difficult. Stablishment a relation between annual precipitation and Cs-137 will facilitate determining Cs-inventory. In this study in 12 climatological stations in northwest part of the country undisturbed incremental core sample of soil in different depth were collected. Cs-activity was determined by vandograph section of Iranian Atomic Energy Organization (AEO) with a pure Germanium detector with 85% efficiency. The regression analysis between annual precipitation and Cs-137 fallout was significant at the 0.001 level with $r^2=0.88$. In this study the maximum fallout in Becquerel/m² was 2895 in Marivan station with 974.7 (mm) annual precipitation while The minimum was recorded in Dehgolan station with 270 (mm) annual precipitation.

Keywords: Cs-137, Precipitation, Radiant materials

Mapping of wind erosion threshold velocity using the W.E.Meter and geostatistical technique (A case study Sistan plan)

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Wind is a phenomenon that each year causes movement of huge amount of soil in different sites of earth. This factor has a destructive function especially in dry lands. Sistan region is one of the most windy regions and with regard to physical conditions and natural ecosystem is widely under wind erosion. Among these determination of wind erosion threshold velocity is important as basic factor in windbreak site design. In nature the phenomenon changes is always gradual. So knowing the time and position changes is more important. Geostatistic sciences are the remarkable tool in estimating of hidden pattern in these changes. In soil sciences these changes is positional. In this research wind erosion threshold velocity was determined by W.E.Meter in field. Then using the Geostatistical estimation obtained by the Ordinary Kriging, Wind erosion threshold velocity changes in this area was estimated. Results show that Exponential Variogram is more correlative with our factor and is Isotropy in different direction. Also according to provided map the speed changes ranging from 3 m/s to over 15 m/s in 20 cm height. The highest rate is related to Northern east area, beside the sand dunes, and the maximum rate is related to Northern west crusted area. Results show that Geostatistical science is the appropriate method to provide the distribution of this parameter.

Keywords: W.E.Meter, Wind erosion threshold velocity, Geostatistic, Ordinary Kriging

Modeling of sheet erosion in Fidh Ali Watershed (Tunisia)

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At watershed level in Mediterranean environments, a major portion of soil loss is generated by sheet wash, sheet erosion and gully erosion

The present report deal with:

- knowledge of water erosion processes, sheet in erosion and hydrodynamic behaviour in semiarid area catchment.
- The results were obtained through rainfall simulation experiments carried out in the field using rainfall simulator
- A model mobil was constructed among correlation between the simulation experiments infiltration, sediment discharges with and measure value from natural rain conditions.
- The value of limit rain intensity producing runoff is very important data required for the model

The experiment was conducted in Fidh Ali watershed located in central part of Tunisia. It's semiarid area. The dominant material are clay, sandstone, gypsic soil. 56% of area is cropped agricultural land, 44% are bare soil.

To estimate sheet erosion

- Runoff was related to infiltration Fn.
- Sediment discharges was related to runoff.

Experimental results allows to know the limit intensity that produce runoff for each parcelle.

Results

- Sheet erosion varies from 0.44 to 1.14 T/Ha/ year, this concern limestone and sandstone soil. And from 0.71 to 2.47 T/ ha/ year for gypsic marl soil. The value increase with rate of clay. This variability indicates erosion trend of gypsic marl due to behaviour of clay.
- Sheet erosion change from 0.4 to 2.47 t/ha / an, this represents 5% of global erosion (45 T/ha/year) calculated from accumulated sediment in reservoir. This relation indicate the importance and extention of gully network in our case.

Study of soil erosion in the small loess agricultural catchment in the light of ^{137}Cs measurements

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Because of their fertility and ease of cultivation loessial soils have been in agricultural use for ages. These soils are, however, very susceptible to water erosion processes. Even small inclinations of few degrees may result in medium to large sheet erosion of loessial soil. Additionally, an inappropriate soil tillage intensifies the soil erosion. There is an urgent need to obtain reliable quantitative data of soil erosion for agricultural areas to choose an effective method of soil conservation. The ^{137}Cs technique seems to be a valuable to study soil erosion and deposition.

In this work we present the use of measurements of ^{137}Cs activity in soil as a tool to investigate the soil erosion process in the loess agricultural field. The study area is a small loess agricultural catchment located on the Proboszczowicki tableland (near Ujazd village). Results presented in this paper were obtained on five valley profiles collected in the study area. The soil samples were measured, after drying, by the high-resolution gamma spectrometry to determine their radioactivity. The study area was contaminated by ^{137}Cs from Chernobyl accident. This study is to evaluate the soil erosion as well as accumulation for small agricultural loess catchment. Moreover the aspect related to the model for calculation of soil erosion from the ^{137}Cs activity data are discussed. This method allows to evaluate soil erosion for medium-term. The spatial pattern of the soil erosion for the catchment were obtained as well as the values of the mobilised soil in the catchment and the value of removed soil from the catchment. Finally, the influence of ^{137}Cs from Chernobyl on the calculation of soil erosion is discussed.

Determining sediment sources in the Hanalei River Watershed, Kaua'i, Hawaii

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The Hanalei River delivers suspended sediments and organic matter to Hanalei Bay with impacts on the sustainability of coral reefs and their many associated species in the Bay. Understanding the sources of sediment sources in the watershed is key for the development and design of management strategies for reducing sediment loads to the Bay. The objective of this study was to determine the source of sediments within a watershed, such as upland soils, stream bank and channel processes, and mass wasting. In order to understand the relative contribution from each of these sources, soil samples were collected from the various geomorphic surfaces within the Hanalei River Watershed and analyzed for Cesium-137 concentration. Fallout Cs-137 can be used as a tracer or fingerprint to identify sediment sources and as a marker to determine floodplain deposition patterns and rates within a watershed. For this study, recently deposited sediments on floodplains and the Hanalei bay were compared to upland sediment sources (upland soils and mass wasting sites) and stream bank samples using a simple mixing model to determine sediment sources. Cesium-137 concentration varied with upland soils > colluvial slopes > floodplain deposits > stream banks > Bay sediments. Preliminary results indicate that channel banks and mass wasting are probably the most significant sources of sediments deposited on the floodplains and in the Bay.

Hazard management lesson learned through mapping and assessing landslides triggered by Hurricane Mitch

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Landslides are a serious concern in steepland regions where powerful storms routinely occur and human settlement is expanding. The hazards associated with this combination of topography, climate, and land use were starkly evident in the catastrophic losses associated with landslides triggered by the 1998 Hurricane Mitch which was centered on Nicaragua and Honduras. Satellite images offer a unique opportunity to compare landscape characteristics before and after such an event, thereby allowing landslides and associated gully formation triggered by the storm to be mapped and assessed. We applied this approach to document landslides and associated gully formation that occurred in two provinces in northwestern Nicaragua during Hurricane Mitch. We used image enhancement and supervised classification techniques to analyze before and after Landsat and SPOT satellite images and then combine this information with digital elevation model, slope and aspect terrain variables, and land use patterns reflected by vegetation cover type and presence or absence of soil and water conservation structures. The incidence of landslides increased as slope increased. The rate of increase on forested land was significantly lower than on land that was being cropped or was recently fallowed. Furthermore, the area disrupted by any particular landslide tended to be strongly influenced by the slope and land use characteristics of where the landslide began. Landslides originating on cropped or fallow steeplands were more likely to be larger than were landslides originating on similarly sloped forested lands. Soil and water conservation treatments were effective at reducing the likelihood of landslides starting. Large landslides (< 300 m length) that occurred on sites with conservation treatments and forests tend to have started upslope of these areas. These analyses enhance landslide hazard prediction and have been used to generate hazard maps that aid targeting where soil and water conservation interventions and forest conservation activities are most likely to reduce downslope impacts.

Impacts of soil pre-treatment on the effectiveness of natural geotextiles in reducing runoff and soil loss by interrill and concentrated flow erosion processes

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On steep slopes intense rainfall can cause significant soil erosion. The establishment of a vegetative cover which can provide a long-term protection of slopes, is counteracted by the erosive forces of rain and runoff. Applying geotextiles on the soil surface is the most effective method to control erosion until a critical vegetation cover has been established. However, there are very few data on the effectiveness of geotextiles in reducing soil erosion by water and on the impacts of environmental factors (e.g. slope gradient, soil type, initial soil condition) on the effectiveness of geotextiles. The objective of this study is to investigate the impacts of soil pre-treatment on the effectiveness of natural geotextiles in reducing runoff and soil loss by interrill and concentrated flow erosion. This study is part of the EU-funded BORASSUS Research Project.

Two types of erosion plots are used in the laboratory, i.e. an interrill erosion plot and a concentrated erosion flume. On each erosion plot, four natural geotextiles (i.e. Borassus, Buriti, Bamboo and rice straw mats) and one bare soil surface (Tertiary sandy loam) are tested. In order to simulate the impacts of soil pre-treatment, all experiments were conducted on both a fine tilth soil surface (i.e. seedbed) and on a compacted soil surface. For the interrill erosion studies, three slope gradients (i.e. 15, 30 and 45 %) and two rainfall intensities (i.e. 45 and 67 mm h⁻¹) are simulated; for the concentrated flow experiments, six flow shear stresses (ranging from 4-40 Pa) are simulated. All experiments had three replicates. Infiltration rate, runoff depth and sediment yield are measured.

Preliminary results indicate that the effectiveness of geotextiles in increasing infiltration rates and reducing runoff, interrill erosion rates and erosion rates by concentrated flow is significantly higher on a fine tilth soil surface compared to a compacted soil surface. Final infiltration rates ranged from 8-17 mm h⁻¹ on compacted soil surfaces and from 16-44 mm h⁻¹ on fine tilth surfaces. All geotextiles tested, decreased relative soil loss (compared to bare soil) with 90 % on fine tilth surfaces compared to 70 % on compacted soil surfaces.

Pilot object for soil erosion protection land use in South-East Bulgaria

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In connection with fulfillment of an international project for sustainable land management and to combat soil desertification, as and with the National strategy plan for rural development (2007–2013), building of a demonstrative object for soil erosion protection land use in the rejoin of Strandja-Sakar mountain, south-east Bulgaria begun.

The object covers the territory of a farm of 53, 1 ha area. As a result of detailed analyze of the natural and economic conditions, calculation of the erosion factor parameters and evaluation of the perspective economic development of the farm, a project for anti-erosion organization of the territory and an agro ecologic plan for implementation and maintaining of a complex of soil conservation measures is worked out.

Depending on the soil and topographic characteristics, the farm territory is divided into four parcels, where the following soil conservation practices are applied: soil conservation farming with companied winter pre-crops; strip crop rotation; buffer grass strips via 40 m, and entirely soil conservation grass. Calculations of the extra expenditure and incomes decreasing as a result of conservation farming have been done. The compensatory payments, which have to be received from the European Union funds, are calculated too. A monitoring for verification of indexes for conservation and economic efficiency of the applied measures as condition for sustainable land use is set up.

Keywords: pilot object, erosion control practices, sustainable land management

Evaluation of soil erodibility under various topographies and vegetations in different agro ecological regions of West Bengal, India

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Soil erodibility factor, K, in the universal soil loss equation or its revised version, is the useful estimates to predict the rate of soil erosion based on the intrinsic properties of soil that resist detachment and subsequent transport of soil particles by rainfall splash or surface flow. The K values of soils under different micro watersheds representing hilly, red and lateritic and coastal saline agro ecological regions are evaluated in the present study. More than two-thirds of the soils under investigations lie under moderate to high categories of soil erodibility. Average values of soil erodibility factor are more in the soils of hilly regions followed by the order of red and lateritic and coastal saline regions. Much variation of K factors occurs due to variations of topography, texture and vegetation patterns under each of the agro ecological region. Various erodibility indices are analyzed to identify their suitability for predicting the K factor, of which soil aggregation indices shows most superior. Relationships of K factor with other relevant soil properties are also worked out.

Keywords: soil erosion, micro watershed and erodibility indices

Study of relationship between different type of erosion and soil properties of marls in Southern Guilan Province, Iran

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Erosional processes in relation to marls are very intensive, so that different forms of erosion particularly, badlands are the obvious characteristics at marly lands. This paper focuses attention on the some basic aspects of the role of soil characteristics such as clay mineral and Na ions upon marls behaviour (erosional forms) in the regions of 756 km². Soil sampling were carried out from 48 surface sites of the marls which located in Gilevan area in south of Guilan province, having aridic moisture regime and thermic temperature regime with different forms of erosion including sheet, rill, gully and badland. Statistical analysis with Duncan test showed that only exchangeable (Na_{ex}) and soluble sodium (Na_s), SAR (sodium adsorption ratio), ESP (exchangeable sodium percentage) and EC (electrical conductivity) have significant difference (P<0.05) between different erosional forms. These parameters were increased from sheet to badland erosion; while, other parameters had no significant difference. More investigation showed the positive effect of soluble sodium ($r=0.947^{**}$), SAR ($r=0.949^{**}$) and ratio of fine (f) clay to total (t) clay ($r=0.640^{*}$) on the depth of different gullies in badland extension as follows: $Y = 0.32SAR + 0.27Na_s + 0.161 (f.clay/t.clay) + 3.1$ and for gully erosion the correlation coefficient (r) was $r_{SAR}=0.669^{*}$, $r_{Na_s}=0.619^{*}$ and $r_{f.clay/t.clay}=0.611^{*}$ by function of $Y = 0.6SAR + 0.2Na_s + 0.18 (f.clay/t.clay) + 0.3$. The relationship between the depth of different rills with these parameters ($r_{SAR}=0.7^{*}$, $r_{silt+f.sand}=0.6^{*}$, $r_{MWD} = -0.61^{*}$) follows the equation: $Y = 0.4SAR + 0.3(silt+f.sand) - 0.4MWD - 0.7$. In sheet erosion, number of water drops that disperse the aggregates had a positive correlation with clay content ($r=0.7^{*}$), $r_{MWD}(\text{mean weight diameter}) = 0.6^{*}$, $r_{o.c}(\text{organic carbon}) = 0.6^{*}$ and negative correlation with ESP ($r=-0.7^{**}$) and silt+f.sand ($r=-0.6^{*}$) with equation of $Y = 0.19clay + 0.17o.c + 0.3MWD - 0.32ESP - 0.25(silt + f.sand) + 2.43$. Moreover, results of x-ray diffraction showed the presence of dominant expansible 2:1 clay minerals (smectite) in badland and gully erosion while area with rill and sheet erosion had no expansible clays. Hence, with respect to statistical analysis and Sherard diagram, sodium ion content, and mineralogical properties control the intensity and forms of erosion in these regions. *: $p < 0.05$, **: $p < 0.01$

Exploratory GIS & remote sensing analysis for the development of statistical correlations between environmental parameters and mass movements' occurrence

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Among the various natural hazards, mass movements (MM) are probably the most damaging to the natural and human environment in Mediterranean countries, including Lebanon which represents a good case study. This research deals with how to use Geographic Information Systems (GIS) for establishing the relationships between MM occurrence and different factor terrain parameters over a representative region of Lebanon. Parameters expressed by: 1— ancillary data like lithology, proximity to fault zone, soil type, land cover/use, distance to drainage line and rainfall quantity, and 2—derived data like slope gradient and slope aspect, were correlated with MM using GIS-approaches. The MM were first detected through visual interpretation of two stereo-pairs of SPOT 4 images (anaglyph) at 10 m resolution. This study indicates, depending on bivariate Remote Sensing and GIS statistical correlations (Kendall Tau-b correlation), that the lithology is the most influencing factor on MM occurrence. It also shows that statistical correlations to mass movements exist best between factors at the following decreasing order of importance: lithology–proximity to fault line, lithology–soil type and lithology–distance to drainage line at 1% level of significance, and soil–land cover/use, slope aspect–land cover/use, and soil–slope gradient at 5% level of significance. These correlations were verified and checked through field observations and explained using univariate statistical correlations. Therefore, they could be extrapolated to other Mediterranean countries having similar geoenvironmental conditions.

Keywords: Mass movement (MM), Mediterranean region, GIS, Bivariate statistical correlations

Effects of cropping systems and crop residues on water runoff, soil erosion and nutrient loss in the Moldavian Plateau, Romania

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The determination of water runoff, soil and nutrients losses by erosion was done by means of plots for runoff control with the area of 100 m² and on the entire area of watershed, where experiments were set up by means of a hydrological station.

The results on runoff and soil losses by erosion in different crops from the Moldavian Plateau, determined by means of control plots, have shown that, during 1980-2007, of the total amount of 558.6 mm rainfall, 353.8 mm (63.3%) produced water runoff, which was between 5.3 mm in perennial grasses, on the second year of vegetation, and 16.3-17.1 mm in maize and sunflower crops. The annual soil losses by erosion, registered at the same period, were between 0.286 t/ha in perennial grasses, on the second year of vegetation, and 9.268 – 9.794 t/ha in maize and sunflower. Erosion has affected soil fertility by removing once with eroded soil, high amounts of humus and mineral elements, which reached 16-17 kg/ha nitrogen, 1-2 kg/ha phosphorus and 2-3 kg/ha potassium, in maize and sunflower crops.

The results obtained on the potential erosion (conditioned by geo-morphological, soil and climate factors) have shown that on uncovered by vegetation fields from the Moldavian Plateau, the average soil losses by erosion were of 18.46 t/ha/year, values corresponding to a moderate erosion risk.

From the investigations carried out on effective erosion, based on direct determinations, we found out that the effective erosion in the Moldavian Plateau, in peas-wheat-maize rotation, had a mean value of 4,507 t/ha/year. These elements were necessary for establishing the crop structure and dimensioning the antierosion works, which determine the decrease of soil erosion and water runoff, soil and nutrients losses below the limit corresponding to the natural capacity of annual soil recovering, of 3-4 t/ha/year of eroded soil.

From the results obtained on erosion in different crop rotations, we have found out that in 16% slope fields from the Moldavian Plateau, soil losses by erosion were diminished below the allowable limit of 3-4 t/ha/year only in case of 4 year-crop rotations with one or two reserve fields, cultivated with legumes and perennial grasses, which protect soil.

Isotopic tracers for erosion measurements in an alpine catchment (Urseren Valley, Switzerland)

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Soil degradation and nutrient export are heavily impacting mountain slopes. An early warning tool to detect degradation before it is visible is urgently needed. It is the aim of this project to determine soil degradation by analysing isotopic tracers in erosion source and sink sites in comparison to non-degraded sites. Input of soil erosion material from uplands to wetlands at the foot of the hill slope could be detected with stable carbon isotopes. There is evidence that $\delta^{13}\text{C}$ is suitable to track down the incipencies of soil erosion, even before damage is visible. As the use of $\delta^{13}\text{C}$ to track down soil erosion is a new method, Cs-137 was chosen for validation measurements. Cs-137 concentrations can provide important information on the cumulative extent of soil erosion of the last 20 years (since the deposition of Cs-137 due to the Chernobyl reactor accident in 1986). Due to the fact that Cs-137 is bound firmly to fine particles in the soil and redistribution of Cs-137 is connected to physical processes, Cs-137 is a useful tool to detect soil degradation. It is generally assumed that initial Cs-137 distribution is homogeneous for a catchment because of the input through wet deposition. According to this, one sample should be enough to describe the Cs-137 content of one hill slope section. However, first measurements of soil samples in the laboratory have shown that differences in Cs-137 of replicate samples of the same hill slope amount up to 50%. With the objective of finding an ideal measurement routine to describe eroded and uneroded hill slopes a comparison of measurements in the laboratory (GeLi-detector) and in the field (NaI-detector) was done. Both methods show difficulties in application in alpine environments. Advantages and disadvantages will be discussed at the example of the Urseren Valley catchment.

Soil conservation and GIS in the Czech Republic

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Soil survey in the Czech Republic has a long history. Agro-geological soil surveys started at the beginning of the 20th century. Systematic soil survey of agricultural lands at a large scale was implemented in the period 1960-1970. Soil maps at a scale of 1:5000 and 1:10 000 were created. The soil map comprises taxonomic soil units, parent materials, erosion, accumulation, soil texture and rock fragments in the plough layer and their changes in the profile along with hydric groups of soils. All these worth data mention above still waiting to be transformed into the raster, vector and database form. In the period 1972-1980 additional soil-ecological surveys of agriculture land were carried out. Soil-ecological maps at a scale of 1:5000 has been updated a digitalised. Soil ecological maps display grouped soil units, relief features, content of rock fragments, soil depth classes and 10 climatic regions. There is a high use potential of these data.

In 2006 Research Institute for Soil and Water Conservation has began, in terms of grant project MZE0002704901, a particular research phase solving development and implementation of the Geographic Information System about soil (SOWAC GIS). SOWAC GIS has been primary developed to provide easy access to data of systematic soil survey and soil-ecological survey to researches. Secondly within further system development there is a question of adding additional thematic layers. The system is particularly presumed to be helping to solve problems concerning soil conservation and soil policy regulation. Generally it must be said that system of this kind will be valuable to enhance presentations and aid in decision making relating to soil and environmental issues. A SOWAC GIS map doesn't have to be strictly open only to researches, but with some limitation could be provided to educational institution, environmental planners and officers.

Current science development requires computer prepared data, information and maps, what is performable thanks to the technique and technology progress. One of courses of soil data utilization is soil and water conservation against the water erosion. Erosion threat and protective measures are modeled by the modern software tools, which works with terrain models and geographic information system layers and databases.

Relationships between gully characteristics and sediment production in the Northeast of Iran, Golestan province

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Gully erosion has occupied more than 600 sq.km in Golestan province northeast of Iran. For classification and prioritization of gullies in viewpoint of sediment production, different indices were used by researchers.

In this research gullies with an area larger than 5 sq.km were determined using historical evidence and field surveying. Climatic classification of the regions affected by gully erosion was performed by De-marton's method. From each climatic zone, two regions and in each region, 3 representative gullies were selected and morphoclimatic characteristics and soil properties were measured. The volume of gully erosion was calculated by summation of partial volumes. Partial volume was calculated by multiplying cross sectional area with partial gully length. The correlation between the volume of gully erosion and form factor (W/D) and W/L ratio was determined.

This results of this research indicate that intensive gully erosion was formed in two watersheds of six existing watersheds in Golestan province. The Atrak and the Gorgan watersheds with Loess sediment are prone to intensive gully erosion. Gully erosion covered more than 600 sq.km in this province. Gullies distributed in moderate and cold arid and semi-arid climatic zones. Soil texture is silt loam. View plan of gullies and their headcuts indicate that rangeland overgrazing produces surface runoff to cause deep and wide gullies.

The results indicate that wider gullies have more silt and silt has better positive correlation with W/D ratio. W/D ratio varies between 1.34 and 8.8 in Golestan province. Gullies in arid climate has larger W/D than those in semi-arid climates. Also, there is a negative correlation between W/D and clay content in gullies' soil profiles. Gully depth decreases with increasing clay percentage larger than 18 percent. The results revealed that deeper gullies have less Ca in their soil profiles. Also longer gullies have larger top width.

The volume of gully erosion has positive correlation with W/D. It implies that more sediment produced by gully bank erosion. It means that gully widening plays an important role in sediment production in Golestan province. Based on the findings of this study, it is concluded that to mitigate sediments originating from gully erosion, controlling gully bank erosion should be prioritized.

Keywords: form factor, gully, sediment production, Iran, classification, prioritization, climate

Sediment production by gully erosion in the south west of Iran, Fars province

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Gully erosion is a dominant process for sediment production in Fars province. Designing control measures to mitigate sediment production due to gully erosion, depends on determining the dominant factors affecting on sediment production. This paper presents the results of a research plan conducted in Fars province. Six gully regions with an eroded area larger than 5sq.km were selected in different climatic zones. In each region, 15 gullies were selected and measured. The volume of gully development was measured using historical evidence, topographic map, and field surveying. Several factors such as drainage area above headcuts, vegetation cover, bare soil, surface gravel, slope percent, clay, silt and sand and E_c were measured in the watershed above headcuts and in the lab. The form factors of watersheds were calculated using topo maps and rainfall records used from the nearest rainfall stations. The volume of gully development was used as dependent factor and others as independent variables to indicate the effects of dominant factors on sediment production. Statistical analysis has been performed using step wise regression and Duncan in SPSS software.

Results indicated that drainage area, slope above headcuts and form factor were dominant variables that have significant impact on sediment production due to gully erosion in Fars province. Among these factors, slope above headcuts has significant correlation on the 1% level and drainage area above headcuts and form factor have significant correlation on the 5% level. This result implies that surface runoff is the dominant hydrological process in gully development and sediment production in this part of Iran. The final regression equation revealed that slope, maximum daily rainfall, sand and form factor were important factors in relation with sediment volume. The most important factor was slope with coefficient β equal 0.414 and the least important factor was form factor with β equal 0.221. The final equation is as follows and modified determining coefficient (R^2) is equal to 42.6.

$$Y = 496.7 + 27.89slope - 4.68sand + 275.28formfactor - 2.36 \max \text{imumdaily rainfall}$$

Standard coefficient (β) of slope, sand, form factor and maximum daily rainfall are 0.414, 0.23, 0.221 and 0.25 respectively. The comparison of standard coefficient (β) indicated that increasing one unit of slope, increased 0.414 to gully volume ($\beta = 0.414$) and increasing of one unit of form factor, increased 0.221 to the volume of gully erosion. Increasing of sand and maximum daily rainfall had negative impacts on gully development.

Keywords: sediment production, gully erosion, Iran, Fars, slope, drainage area, form factor, gully development

Estimating sediment yield from gully erosion using easily measurable morphometric characteristics in Darehshahr region, South of I.R. Iran

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Water Erosion a dominant type of land degradation in worldwide implies on the concentration of overland flow. Worldwide, soil erosion is supposed as one of the detrimental effects of improper utilization of natural resources. Gully erosion contributes to soil loss between 10 and 94 percent in different climates. It often occurs in abandoned arable areas in Iran and degrades much amounts of the fertile agricultural top soil and therefore has to be minutely studied. Besides that, the fast and reasonable accurate estimation of sediment yield resulted from gully erosion may greatly help watershed managers, structure designers and decision makers to make proper and sound decision in controlling gully erosion and ultimately sediment yield. The present study was then accomplished in Darehshahr city located in Ilam province, southern Iran in order to delineate a simple and an applicable empirical equation to predict sediment yield from 18 frontal, digitated and axial gullies due to 5 storm events. The results of the study, obtained through precise field surveying of gullies geometric variations, revealed that the sediment yield from gully erosion in the study area can be accurately estimated using head cut height of gully with correlation coefficient of 61.82% and error of estimation of 25.49%.

Keywords: Gully Erosion, Frontal Gully, Digitated Gully, Axial Gully, Iran, Sediment yield

Comparison of mechanical alternatives for gully development mitigation – Case study: Kerman Province, Southeast of I. R. IRAN

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Gully erosion causes many problems in Kerman province southeast of I.R. Iran. It damages rangelands, croplands and infra-structures. A research project began in 2002 to compare the impacts of different alternatives for controlling gully erosion and to introduce the suitable alternative to mitigate gully development in this area.

Nine representative gullies were selected for monitoring of gully development in three years without structures and three years with structures. Morphometric characteristics such as top width, depth and length were respectively about 1.1, 1.3, 17.7 meter. View plan and long profile of selected gullies were determined by field surveying. Gully development was measured after rainstorms with significant runoff (rain which caused changes in gullies) in 3 years. From the 4th year, some mechanical structure (hedge, gabion and water diversion) established in gullies and their effect on gully development was measured.

The results of this research indicated that at the first monitoring phase gullies developed between 22.5 to 190 cm and their drainage area upstream of headcuts changed between 1.3 to 1.6 m², but after establishing the structures gully development was between 5 to 13.5 cm and drainage area changes was between 0.02 to 0.09 m². So all of these three structures was effective and reduced gully erosion but water diversion and then hedge was more effective than gabions. The results of this research in the same line has been done by researchers in the abroad (Angima (1999), Mc Donald (1999), Lenzi (2002), Xiang-zhou (2004)).

Keywords: Gully erosion, mechanical, mitigation, headcut, hedge, gabion, water diversion.

GIS: Some Models for Preparing Erosion Features Map

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The geographical distribution of erosion features is one of the most important information required for soil conservation. In this research, some methodologies for erosion features mapping by GIS were investigated taken place Jajrood sub-basin in North-east Tehran, Iran. Four methods applied for providing working units' maps by data layers integration include a. plant cover, geology and slope b. land use, geology and slope c. land use, rocks erodibility and slope and d. land use, rocks erodibility and land units layers. Erosion features intensities in 314 spots were controlled and ground truth maps of surface, rill, gully and channel erosion were prepared and then erosion features map is prepared from integration of these maps. Erosion features map has been crossed with working units' maps. Results showed that method "d" was better than methods "a", "b" and "c" from an economic and executive regards. Crossing map "d" with ground truth maps of surface, rill, gully and channel erosions showed that the greatest and least accuracy were related to preparation of gully erosion and erosion features maps, respectively. The greatest precision of map "d" was related to providing gully erosion map (coefficient of variation was 17.8%). Least precision of map "d" is related to providing erosion features map that the coefficient of variation was 33.8%. In general, map "d" is suitable for preparation of gully erosion map and it is not proper for providing erosion features map.

Keywords: Erosion features map, Accuracy, Precision, GIS

Alternative soil management techniques in Sicilian vineyard for soil organic matter recovering

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Traditional Sicilian vineyard management (up to eight tillage during the season) is aimed to the reduction of evaporation, rainfall conservation and weeds control through biomass moving.

In fact tillage may enhance soil water storage when it increases infiltration due to loosening of surface crusts or other slowly permeable soil layers, increases detention storage on the surface to provide more time for infiltration, but avoid water storage if it results in a smooth, unstable soil surface that readily seals due to raindrop impact, thus increasing runoff. Tillage also increase evaporation of water previously stored when it exposes moist soil to the atmosphere.

During 2005/2006 a vineyards, located in south-west of, were subjected to six different soil managements: “conventional” soil management using up to eight soil plowing with a five furrow plow; faba bean, vetch; durum wheat, durum wheat + vetch and two permanent meadow

A Gerlach equipment was installed at the bottom end of the slope. Each Gerlach trap was 1 m wide and was joined to the monitored soil area by metal strips inserted a few centimetres into the soil surface. For each erosive event, soil loss was measured collecting total runoff trapped by the Gerlach equipment in a storage tank. The suspension was oven-dried at 105 °C and soil loss A ($t\ ha^{-1}$) was calculated by the weight of the eroded soil particles and the surface area of the monitored strip.

Short and long term changes in soil moisture content

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Mostly the moisture content of the horizons affects physical characteristics of a soil profile. In addition water content determinates the volume and rate of biological activity and chemical reactions. There is a strong relationship between physical soil structure (porosity, water storage capacity) and surface stability against erosion.

To investigate the infiltration parameters soil moisture content was measured at a natural cambisol and a natural luvisol profile. In both cases 6 layers (10, 30, 50, 70, 100, 200 cm depth) were measured under permanent grass cover. In the depth of 10 and 100 cm four thermometers were installed as well. In addition a permanently tilled, bare surface (5 cm depth) was measured. During 2007 the data of each minute gained from the gypsum blocks were gathered and stored in a databox.

In the tilled topsoil soil moisture content changes mainly because of the precipitation volume. But according to the results moisture movement among layers has a very important role in surface drying. The moisture moves to the 5 cm depth horizon with a daily fluctuation. While the layer dries out continuously there is a daily minimum at 8 am and a daily maximum at 4 pm. With the decrease of the moisture content the fluctuation is growing.

Under permanent grass cover this fluctuation also exists during the rainless period, but it has differences. In this case the 5 cm layer is only affected by the precipitation, while the fluctuation in the 10 cm horizon is much less definite. Looking at the temperature data of the 10 cm horizon there is a strong relationship between the moisture content and the temperature: during the cooling period the horizon is getting dryer, while the increasing temperature causes more humidity.

Investigating the long term (yearly) changes the following statements can be concluded. At 2 m depth (loess) there is more or less constant moisture content, but the luvisol's humidity greater. In spite of the extremely dry year water loss did not appear at the deepest layer, where a significant amount of water was stored. At 1 m depth the cambisol dried out.

Between the layers of the luvisol there is a more rapid wetting process, while the water storage is also much higher than in case of cambisol. Therefore cambisol generates more runoff than luvisol.

Advances in determining soil matric potential using an engineered porous ceramic and dielectric permittivity

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Soil water potential, a key parameter in soil moisture dynamics, can be used to for determining water availability for plant growth, water flow, and soil stability. Although an in situ measurement of matric potential has been the focus of considerable research over the years, existing solutions still have many drawbacks such as high maintenance, limited longevity, individual calibration requirements, high cost, and small measurement range. The objective of this research was to develop a sensor that could be used in the field to accurately measure soil matric potential without the limitations noted above. The sensor, which consisted of a dielectric sensor sandwiched between porous ceramic, was tested over a range soil types, electrical conductivities, and temperatures to calibrate and characterize its output. Data show consistent calibration curves between sensor output and actual soil matric potential. Although temperature showed a slight effect on sensor output, it did not appear to be enough to affect sensor readings. Likewise, salt effects were not visible in the evaluated soils. Data suggest the sensor will be an effective and robust tool to determine in situ matric potential for use in water balances and other water management strategies.

Mechanism of Water Resources Conservation and Recharge of Forest and its Ecological Function Value Evaluation in Jinyun Mountain, China

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Jinyun Mountain, lying in tail end of Three Gorge Reservoir area, China, is a spontaneousness laboratory to study systemly water resources conservation and recharge function of forest because it has integrated coenotype of subtropical broad leaved evergreen forest and reflects natural background of tropical forest ecosystem in central Asia to a certain degree. On the base of fully study on rainfall characteristics of Jinyun Mountain area, four familiar types of forest, namely mixed broadleaf-conifer forest, broad-leaf forest, *Phyllostachys pupescens* forest, and shrub forest had been chosen as subject investigated to study water resources conservation and recharge mechanism of different forest types in Jinyun Mountain and to evaluate its value of ecological function by the means of grey correlation method, regression method, shadow price method, break-even cost method and analogism. Then, evaluating indicator system of forestry water resources conservation and recharge had been established through Analytical Hierarchy Process (AHP) and fuzzing mathematics. The conclusion not only contributes to construction project of ecological environment and Three Gorges project in the Yangtze Valley, but also has of far reaching importance to comprehensive amelioration of ecological environment and sustainable development of social economic in this region. Furthmore, value evaluation of forestry water resources conservation and recharge can offer reference to standardization of ecological compensation policy in this region.

Surface water pollution with heavy metals in Certej mining basin

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The Certej basin is situated in the North of Deva town and was an important nonferrous mining region. In present the mining activities were stopped, but the acid mine drainage is still affecting the underground water quality. Acid Mine Drainage takes place where sulphide-bearing material is exposed to oxygen and water. This drainage water is characterized by low pH, high specific conductivity and high concentrations of metals known to be toxic for living organisms. Mine drainage includes generally drainage from mines (underground and open pit), stockpiles, dumps, mined-rock piles and tailings impoundment. It is important to note that sulfides oxidation and natural acid drainage occurs as well in the absence of mining in numerous localities world-wide.

Long-term Tillage Frequency Effects on Dryland Soil Physical and Hydraulic Properties

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Soil tillage is considered one of most important practices in agricultural production due to its influence on physical, chemical, and biological properties of soil environment. The effect of a long-term tillage frequency [no-till (NT), spring till (ST), and fall and spring till (FST)] was investigated on soil penetration resistance (PR), bulk density (BD), moisture content (MC) and saturated hydraulic conductivity (Kfs) under dryland conditions. Tillage effects on these physical properties were tested after 20 yr on a Dooley sandy loam (fine-loamy, mixed Typic Argiborolls) derived from glacial till parent material. The statistical design used was randomized complete block with four replications. Undisturbed soil cores were sampled at 0 to 5, 5 to 10, and 10 to 15 cm depths and were used to measure BD, MC, and particle size distribution. Soil PR was measured using a hand-held digital penetrometer into the soil at three locations across each plot. Field saturated hydraulic conductivity was measured using a constant head permeameter. Statistical analyses indicated that soil PR at 0 to 5 cm depth was greater in NT than in ST and FST. At 5 to 10 cm depth the PR was greater in NT than in FST but at 10 to 15 cm depth, it was greater in FST than in NT and ST. The CI also increased with soil depth. The BD was greater at the 5 to 10 cm than at 0 to 5 cm and 10 to 15 cm depths and greater at 10 to 15 than at 0 to 15 cm. Similarly, MC was greater at 5 to 10 cm than at 0 to 5 cm and 10 to 15 cm depths. The data on Kfs at 10 to 15 cm depth were highly variable and tillage treatments had no effect. Long-term increased frequency of tillage reduced compaction in the surface soil, but increased in the subsurface soil. Higher BD and MC values at the 10 to 15 cm layer may likely be related to increased clay content at this layer.

Increasing water use efficiency for dryland maize in China by improved nutrient management practices

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Rainfed crop production in northern China is constrained by low and variable rainfall, and by management practices. This study explored the long-term effects of various combinations of maize stover, cattle manure and mineral fertilizer (NP) applications on maize (*Zea mays L.*) yield and water use efficiency (WUE) under reduced tillage practices, at Shouyang Dryland Farming Experimental Station in northern China from 1993 onwards. The experiment was set-up according to an incomplete, optimal design, with 3 factors at five levels and 12 treatments including a control with two replications.

Grain yields were greatly influenced by the amount of rain during the growing season (GSR), and by soil water at sowing (SWS). Annual mean grain yields ranged from 3000 to 10000 kg ha⁻¹ and treatment mean yields from 4500 to 7000 kg ha⁻¹. The WUE ranged from 40 in treatments with balanced nutrient inputs in dry 1997 to 6.5 kg ha⁻¹ mm⁻¹ for the control treatments in wet years. The WUE averaged over the 12-year period ranged from 11 to 19 kg ha⁻¹ mm⁻¹. Balanced combination of stover (3000-6000 kg), manure (1500-6000 kg) and N fertilizer (105 kg) gave the highest yield and hence WUE.

In conclusion, balanced nutrient inputs gave the highest yield and hence WUE. Possible management options under variable rainfall conditions to alleviate occurring moisture stress for crops must be tailored to the rainfall pattern. The potentials of split applications, targeted to the need of the growing crop (response farming), should be explored to further improve grain yield and WUE.

Improving the efficiency of irrigation water in command areas by increasing the performance of Water Users Association

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Irrigation management is an important component of many agricultural systems and complex dimension of resource development and conservation. Distribution of water at the command area below the outlet and maintenance of farm development works has been a neglected area falling between two stools. While the farmers expect the government agency to sort out individual disputes and spend money for maintenance. The government finds it difficult to manage and supervise due to high administrative cost and too laborious to bureaucracy. It is a vicious cycle of low water charges in return for the deteriorating services. For improving efficiency and equal water distribution of available water in the major command areas WUAs has been established. Keeping these points in view this study was conducted in southern part of India to ascertain the activities, expectations, benefits derived by the members of the WUAs along with their constraints and suggestions for making better performance of WUAs.

Results of study revealed that, the majority of the head reach farmers (85.55%) expected systematic water delivery and ensured availability of water during kharif and summer seasons, while tail enders expected elimination of unauthorized irrigation, none of the farmers had complete participation in any type of works undertaken by the committee. They either participated partially or nil. Committees in the WUAs was performing activities such as distribution of water allocated to their region equally among the users, preparation of water budget, wara bandhi schedule, maintenance of different records, conducting social auditing etc. a very less (16%) percent of the committee members implemented all decisions of the general body meetings. About one third (32%) of the tail enders and comparatively less percent of head reach farmers (16%) expressed that they did not benefit from the WUAs. Major problems encountered by the head reach farmers were very poor canal lining (93%) followed by obstruction of water flow (90%) by the tail enders. Unauthorized irrigation, poor maintenance, obstruction and destruction of water flow to the tail enders by the head reach farmers were problems expressed by the tail enders. Lack of participation cooperation timely support from authorities and funds were the problems expressed by the office bearers of the WUAs. Members of the WUAs suggested immediate repair of canals before monsoon, severe punishment for water theft, strict implementation of wara bandhi schedule throughout the command area.

Gestion durable des ressources en eau et en sol

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Compte tenu de l'importance du programme de conservation des eaux et des sols réalisé en Tunisie et vu la diversité des informations nécessaires à la préparation des études, et étant donné la complexité des processus d'analyse et de prise de décision, il est indispensable d'introduire de nouvelles techniques et outils de collectes, traitement et de gestion des données. Ainsi, parmi les objectifs de ce travail réalisé sur la dorsale tunisienne c'est de mettre une méthodologie de régionalisation de l'information hydrologique en s'appuyant sur des données spatiales et numériques en vue d'une meilleure gestion qualitative et quantitative des ressources en eau et en sol (en terme de typologie et envasement). Les travaux réalisés ont permis d'aboutir à des résultats importants à plusieurs niveaux. En terme de typologie, il semble possible de classer les petits bassins versants en fonction des paramètres de l'hydrogramme unitaire. Le SIG peut être utilisé comme système de suivi des travaux réalisés et comme outil d'aide à la décision une fois que les zones à risques, les plus sensibles à l'érosion, sont identifiées. En effet, en s'appuyant sur des cartes thématiques le décideur pourra quantifier et identifier les travaux à réaliser tout en procédant par des priorités arrêtées à l'avance. L'exemple du travail effectué sur le bassin versant du Smati de la dorsale décrit bien toute la démarche suivie dans notre étude.

Mots clés: gestion, durable, eau, sol, conservation, semi-aride

Soil water and physical properties response to Contour hedgerow system on slope land of purple soil (Inceptisols)

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Contour hedgerow is a very common and effective technique around the world, which is employed to revegetate on cultivated slope land and conserve water and soil resources. Contour hedgerow is considered an effective way of sustainable development of agroecosystem in the three gorges reservoir area. Alluvial soils in front of hedges (*Leucaena leucocephala* and *Vitex negundo*) were taken as the objects, to evaluate the effects on soil water and physical properties from different distances to hedgerows at different soil depths by technology of contour hedgerow. The results showed that the effects on water and soil conservation by hedgerows were significant, especially in the top and second layer. The soil non-capillary porosity, saturated hydraulic conductivity, saturated water content and natural water content in the hedgerows treatments were higher than in the rock ridge terrace treatment, while the soil bulk density and field moisture capacity in the hedgerows treatments were lower than in the rock ridge terrace treatment. Based on the same depth, with the extending of the distance to hedgerows (ridge), soil water and physical properties in the hedgerows treatments represented the trend of increasing (decreasing) gradually, while no apparent change in the rock ridge terrace treatment. With the deepening of the soil layer, soil water and physical properties in each treatment increased (decreased) accordingly, and their differences among treatments were also lessened gradually. The distance to hedgerow reflected the degree of effects on soil water and physical properties by hedgerow indirectly. The closer to hedgerow, the greater the effects were. Comparing *Leucaena leucocephala* and *Vitex negundo*, their effects were equivalent.

Keywords: soil water, soil physical property, contour hedgerow, the three gorges reservoir area

Évaluation de risque de contamination nitrique des eaux souterraines: Utilisation de la simulation mathématique et de l'approche lysimétrique

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Une expérimentation lysimétrique, menée avec deux types de cultures (blé tendre et betterave sucrière), a été conduite dans le Tadla dans la station expérimentale d'Ouled Gnow située au périmètre des Béni Moussa Est. Cette expérimentation vise à quantifier l'impact des pratiques agricoles sur la qualité des eaux et particulièrement sur la lixiviation des nitrates. Ce dispositif expérimental a permis de déterminer les quantités d'azote nitrique réellement lixiviées qui sont 51.2 kgN/ha et 34.6 kgN/ha respectivement pour la betterave sucrière et le blé tendre. Parallèlement, un modèle de simulation mathématique de lixiviation des nitrates utilisant les données lysimétrique ainsi que les caractéristiques hydrodynamiques du sol a montré que l'application d'une hauteur d'eau de 1 m engendre un déplacement nitrique de l'ordre de 7.1mm et de 8 mm dans les profils du sol respectivement exprimés pour le blé et la betterave à sucre. Ainsi les quantités d'azote nitrique lixiviées calculées par ce modèle de simulation sont de l'ordre de 59.8 kgN/ha pour le blé et 86.2 kgN/ha pour la betterave sucrière. Une comparaison des quantités d'azote lixiviées calculées par les deux approches a été effectuée et les avantages et inconvénients de chacune des deux approches ont été discutés.

The experience of degraded soils management in Steppe Zone of Ukraine

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The negative influencing of technogenic factors resulted considerable degradation of ecosystems and deepen the global ecological crisis: climate changes, reduction of ozone layer, contamination of biotopes by heavy metals, chemical matters, falls of acid rains and distributions of desertification phenomena. Due to these processes, 65 % world ecosystems are already annihilated or transformed. The Dnepropetrovsk region is one of most rich in species regions of Ukraine. Here it is registered about 60 % fauna and about 40 % flora of our country. Ukraine features the highest indicators in Europe as for plowing-up of agricultural lands, use of fresh surface water resources and deforestation. Pollution and degradation of the environment, particularly reservoirs and soils, atmospheric air in large and medium towns and industrial centers has become threatening. The regions with critical ecological situation have the highest density of the population. Forestry of Ukraine has not yet established the system of environmental monitoring. Therefore, we have not now full information about technogenic and anthropogenic impacts on forests at the national level.

In Ukraine all forms of soils erosion are present almost: wind, water and gully erosion. Flooding often results in salinization of soils from high mineralization of ground waters. The main processes which provides reduction of biodiversity in a Steppe areas are presents:

1. Flooding by mineral ground waters;
2. Changes of the hydrological cycle in mining process;
3. Inefficient agricultural usage.

The European Economic Commission of the United Nations has lead in Kiev (on May, 21-23 2003) the V Ministerial Conference «Environment for Europe » where the Kiev resolution on a biodiversity has been accepted. Has been solved to create an Ecological Network - the complex of reserved territories consisting of ecological nucleus, corridors, transitive and buffer zones. A perspective direction of researches is development of achievements GIS for monitoring these territories. The knowledge modern techniques of monitoring of pollution by heavy metals are especially important.

As a result of investigation, To consider the explored territory as element of antropogenic-destructive network of region;

- In connection with the necessity of realization measures on broken ecosystems rehabilitation in 2006 regional Landscape park „Bogouslavsey" was creation (total area of 6875,39 hectares).

The Regional Network has following goals:

- Artificial renewal of natural resources (soils, vegetation and others like that)
- Assistance to natural renewal of plant associations thanks to their rational use
- Revision and stopping (temporally) economic activity, which are results to degradation of planting and soils cover.

Developing the methods of Ecological Network monitoring will provide increase of the status of region, its integration into the European community due to improvement of ecological situation and harmonization of mutual relations between the human and nature.

Estimating soil water content using capacitance sensors: annual site calibration equations and comparison

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Accurate soil moisture content measurements are required for good irrigation management and measurement of crop consumptive use. Newer methods such as the EnviroSCAN capacitance based sensors, which determine soil water content bases on the dielectric constant properties of the soil often require site-specific calibration to enhance their accuracy and precision. The objectives of this study were: 1) to develop site specific calibration equations for EnviroSCAN capacitance sensor measurements using 1998, 1999, 2000 data and the three years combined data, and 2) to compare site-specific calibration equation results of soil water content to those of the manufacturer's default equation. Both the EnviroSCAN capacitance and a neutron probe were installed in a Warden silt loam soil planted to alfalfa. Site specific calibration equations for 1998, 1999, 2000 and three years combined were developed by comparing the capacitance sensors' scaled frequencies with the soil water content measured with the neutron probe. The statistical analyses indicated that discrepancies existed between soil water contents using developed site calibration equations and those estimated by the manufacture's default equation. The RRMSE values of soil water content produced from calibrated equations were 7, 6, 7, and 8%, compared with 68, 60, 66, and 64% using the manufacturer's default equation for 1998, 1999, 2000, and three years combined, respectively. These results support that the site calibration equations were found to accurately estimate individual values of soil water content compared to those obtained from the manufacture's equation.

Using thermal remote sensing data to surface and subsurface soil properties

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Temperature is important factor in understanding some physico-chemical and biological properties, which can be used for describing the state of materials. Measurement of soil surface and subsurface temperature or thermal energy quantitative and qualitative information is one of the basic inputs to the energy budget of the surface processes. Still, the utility of thermal infrared remote sensing data has not been fully realized by the larger scientific community. Therefore, we will concern ourselves with thermal infrared remote sensing of the soil science. In this study, we may identify three general thematic areas: 1) surface/subsurface characterization of daily and urinal temperature, 2) soil moisture (including evaporation, evapo-transpiration), 3) soil type classification and boundary delineation. The individual characteristics of different soil types, vegetation, rocks and water are reviewed. The main attention and examples of the processes of thermal infrared remotely sensed data are focused on soil. Finally, we will categorize the importance of thermal infrared data in the analysis and modeling of soil processes.

Keywords: Soil temperature, Thermal data, Remote sensing, surface, subsurface

Spatial distribution of trace elements and impact on groundwater in a basin of calcareous Mediterranean soils

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Groundwater represents a very significant source of fresh water for irrigation and drinking purposes and therefore preserving the availability and quality of this resource is extremely important. Trace elements in soil are not only part of its mineral composition but they can also accumulate in the top soil by anthropic activities and constitute a long-term environmental hazard. These elements can either be taken up by plants and re-enter the food chain, or leach from the top soil and thus endanger groundwater quality. The latter is of especial concern in intensive agricultural areas with increasing use of agrochemicals that receive heavy rainfall within relatively short periods, as is the case for the Mediterranean climate. Soil properties will have a mayor effect on elements mobility, whoever this mobility may be affected by the amount of water reaching the soil surface.

The objective of this study was to explore the spatial distribution of Cu, Pb and Zn in an intensive agricultural area (200 km²) of the Genil river basin in southern Spain and to assess the risk of these elements to reach the water table. Soils within the studied area cover a wide range of textural classes representative of the Mediterranean climate, with high content of calcium carbonate, low organic matter, and high spatial variability in soil properties as well as metals concentration. A systematic frame with 55 regularly spaced sampling points was used where physicochemical soil properties, total and available trace elements were determined. The results show that Pb has the highest concentration at the site with a rate close to 1 kg m⁻² year⁻¹ contribution to groundwater. Evaluation of groundwater pollution risk was based on both metals concentration and site specific soil properties.

Plant-Water demand Characteristics in the Alfisol, Zaria Nigeria

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The Nigeria Guinea Savanna zone currently witness increasing intensification of agricultural production activities. The soils are said to have ustic moisture and isohyperthermic temperature regimes implying that rainfalls during the cropping season are limited, irregular or during the dry seasons crop production would be strongly affected by available soil water inadequacy for crop use and production. Supplemental or total water supply by irrigation would therefore be necessary to avert crop failure. Also physical restriction to root elongation can reduce soil water and nutrients uptake as well as plant growth irrespective of water and nutrient supply. This study therefore evaluated soil characteristics and water extraction depth by maize (test crop) in the Northern Guinea Savanna zone Alfisol in Zaria (11⁰ 10¹N and 7⁰35¹E) Nigeria. Results show that minimal soil water was extracted by maize at seedling and crop maturity phases, and optimal at crop establishment to grain filling phases. Zone of active soil water extraction shown by the study is 10 to 20 Cm soil depth. Water rather accumulated at the shallow depths of 30 Cm and below following the presence of such sub soil free drainage obstructions as clay and plinthic layers.

Keywords: Soil and Water conservation, Soil health and productivity, Irrigation, Maize roots

Metal concentration versus water discharge during single hydrologic events in a small stream (NW Spain)

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Excess metal levels in surface water may pose a health risk to humans and to the environment. Therefore, transport of metals from rural catchments to fluvial systems merits further attention due to their potential impact on ecological health of surface water systems. Hydrological processes have been shown to exert a major control in several small and large rivers. Correlations of metal concentrations with fundamental variables including discharge may be used to infer potential mechanisms controlling trace metal fluxes.

The concentrations of metals (particulate and dissolved) in a small stream draining a agroforestry catchment in the temperate humid area of Spain were monitored during base flow. The relations between concentrations and stream discharge were investigated in four precipitation events. The resulting data indicated low concentrations of metals during base flow. However higher fluxes of trace elements were observed during precipitation events in relation to base flow.

The contribution of dissolved metals to the totals during events was below 10% for Al, Fe and Mn, whereas for Cu, and especially for Zn, exceeded 50% in some event. Particulate fractions of Al, Mn and Fe show significant and positive correlation with flow and suspended solids. The calculated metal export from the catchment by the stream occurred mainly as particulate fraction. The load of total metals in the stream varied with the events and the elements.

The role of different soil management on the distribution of heavy metals in surface waters

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Heavy metal losses at the catchment scale depend largely on land-management practices. Certain agricultural practices may increase or decrease the mobility of some pollutants and in this way affect the water contamination. It is known that the dissolved divalent ionic form of trace metals is toxic to the biota, while the adsorbed or particulate fraction is considered biologically unavailable.

The purpose of this work is to analyze the dissolved Cu, Zn, Mn, Fe and Al variations in surface waters at scale catchment during different soil management (NW Spain). The management types carried out in the catchment were: agricultural catchment with spreading of slurries using a conventional tank, agricultural catchment with massive slurry application, reforested catchment without slurry application.

The results show that there is a great temporal variability for each metal and also among metals. The mean concentrations of studied metals were highest in the agricultural period. They all present the highest concentration peaks in the agricultural catchment phase with massive slurry application. These period especially affected the concentrations of dissolved copper and manganese, as well as those of zinc and to a lesser extent those of aluminum and iron. The effects of inadequate management in the application of slurries during the period of intense agricultural activity were reflected in the metal load of the waters of the catchment.

Tillage system and water management effects on soil respiration and microbial biomass under upland rice in Brazil

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In Brazil, rice is produced in two ecosystems: lowland with flood irrigation and rainfed upland. Most rice fields are on Oxisols with low water-holding capacity and often with low fertility. Moreover, rice cropping in upland conditions is considered of high climatic risk, because of its dependency of regular rainfall. In the most risky areas, the lower productivity of upland rice as compared with flooded rice is mainly attributed to one to two dry spells (“veranicos”) during the rainy season. A field experiment was initiated in 2004-2005 rice growth season to determinate how tillage systems and water management affect soil respiration rate and microbial biomass on an Oxisol located at Selviria, MS, Brazil. Treatments were a combination of tillage systems (no tillage, chiselling plus harrowing and two successive harrowing with different loads) and water management strategies (rainfed, irrigation at the reproductive and ripening growth phases and irrigation all over the growth period, with cumulative water amounts of 720 mm, 898 mm and 955 mm, respectively) in a randomized complete block design with four replications. Soil samples were taken at the 0-10 cm depth in March 2005 during the dough grain stage. Mean soil respiration rates ranged from 8.57 to 12.72 mg CO₂ g⁻¹ soil day⁻¹. Soil respiration was significantly higher (P<0.05) in the no-till than in the two non-inversion tillage treatments and it also increased with increasing irrigation amount. Microbial biomass C was ranged from 99.2 to 236.63 mg C kg⁻¹ and it also showed a trend to increase under no tillage and complementary irrigation. Soil respiration was correlated positively with organic matter content and microbial biomass. These results indicated that no tillage plus complementary irrigation at the reproductive phase is the best management practice under the studied soil and climate conditions.

Caspian Sea Beach Sediment Erosion Vulnerability Degree comparison Along the warm and cold Period

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Now a day, the protection of ocean and marine coastal regions is a vital plan in Coastal Management Program for sustainable development. Erosion processes have been developed with high population density and economic reservoir exploitation in these areas. Hydrodynamic forces (waves & currents) also are most important agents for coastal processes changing and erosion advancing. Caspian Sea as the largest lake in the world has different reaction to above factors. In this paper we are trying to present some facts about coastal erosion vulnerability degree in southern coasts of the Caspian Sea. In Fact the evaluation of beach sediments erosion instability and their hazardous degree assessment along the annually period (warm & cold Duration) are the most important targets in this research which has been done in 6 selected stations each one including 6 points. Totally 72 sediment samples and beach geometry characteristics have been measured twice. After laboratory tests all experimental data have been analyzed in computer software in this research we have applied Universal Ranking System Model to measure instability characteristics. Finally by the help of overlaying method in GIS soft ware we come to the point of erosion and shore line changing by hydrodynamic process in varies from region to region in the Caspian Sea. Based on this result we can say that the Miankaleh area at the eastward of southern coasts of the Caspian Sea is the most stable area and Nashtaroud region at the west of Mazandaran and Anzali at the center of Gilan morphological zone are the most instable coast on view of erosion processes during the cold and warm period.

Etude comparative in situ du genre *Microcystis* entre le lac Oubeïra et le barrage Cheffia «Est Algérien» et la mise en culture in vitro dumorphotype *Microcystis* sp. du barrage Cheffia

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Dans le monde, l'eutrophisation devient un important problème. Ce phénomène qui a pour origine l'apport des éléments nutritifs notamment les nitrates provenant en majeure partie des activités urbaines et agricoles se traduit par la prolifération massive de bloom de cyanobactéries.

Des études menées sur le lac Oubeïra et le barrage Cheffia (Est Algérien) ont montré que ces milieux évoluent rapidement vers l'eutrophisation. Parmi les genres de cyanobactéries impliqués dans cette eutrophisation on trouve le genre *Microcystis* qui montre des densités importantes vers le début d'automne.

Une culture in vitro de ce genre sur les milieux BG11 et BG11₀ a prouvé l'importance de l'azote pour la croissance du genre *Microcystis*. La température et la lumière favorisent également leur croissance.

Mots clés: Cyanobactéries, *Microcystis*, BG11, BG1₀, culture, prolifération.

Water management for golf courses

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Golf is a land-based sporting activity and has an intimate interaction with the environment. No other sport occupies and manages such large areas of the countryside and utilises so many land resources. A golf course averages about 50 ha and implies different intensities of management, ranging from maximum care at greens and tees, moderated in fairways and less in roughs. Each of these zones is occupied with different vegetation and turfgrasses species, with different demands of water and nutrients and maintenance needs.

Water is an important factor of golf course management and its conservation is clearly a major issue confronting the golf industry.

In Portugal, the “golf development boom” drove reactions from public opinion concerned about the impact of new golf courses, mainly due to the water needs, although, the needs for this economic activity are of the same magnitude of many agriculture crops.

Water, soil and vegetation play an important role that must be recognized in proper golf course management. Together with the climate conditions they are the key factors to take in account for the irrigation design.

In this presentation the emphasis is oriented for the role of water, besides its importance as a major element in life and vegetation support. Also, each golf courses / landscape type require a clear recognition and identification of all the particular relations between soil, water, vegetation, other land attributes and local landscape and socio-economic assets.

Keywords: golf courses, water and environmental management

Effect of soil loosening on movement of water in no tillage system

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Knowledge of the mechanism of water movement in the upper layers of the soil is of central importance in many research areas, such as Agronomy, Civil Engineering, Hydrology and Environmental Sciences. Over the last decade tension disk infiltrometers have been increasingly utilized for the in situ estimation of hydraulic conductivity and capillary sorptivity.

In recent years in Argentina, extensive cultivation of soybean (*Glycine max* L. Merr.) with the no tillage method has gained increasingly popularity even so in the cases in which this technique was not recommended. In the most of cases this tillage method is applied continuously and without any loosening treatment. The machinery used in this system is characterized by a high axle load and often is used out of adequate moisture-range. This led to a generalized increment in the bulk density of soils. Hydraulic properties are the most affected by the process. In order to improve the situation a loosening practice is recommended.

The aim of this study was to determine the effect of soil loosening on hydraulic properties, before and after harvesting traffic. Besides, different methods to obtain saturated hydraulic conductivity (K_{sat}) and Sorptivity (S_0) using tension disc infiltrometer were evaluated. Loosening led to an increase in K_{sat} with respect to the control. After harvesting traffic K_{sat} in loosening treatment was lower than the control. Sorptivity was not affected neither by the treatment nor by the traffic. Moreover, it was concluded that basic infiltration (q_{∞}) obtained by the disc infiltrometer could not always be equivalent to K_{sat} .

Grass mulching effect on soil moisture in different swards and fertilization rates

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Mulches are known to prevent soil water evaporation and thus helps retain soil moisture. Mulches also promote crop development and early harvest, and increases yields. The study aim was assess the impact of cut and returned grass material as mulch treatment on soil moisture of turfgrass and grass-clover sward.

The soil moisture was measured at 0-20cm depth by gravimetric method in 2006. The soil was sampled by manual coring and gravimetric moisture content (%) of the soil samples was calculated on oven dry weight basis.

The summer in 2006 was very warm and dry. The mulching did not affect the soil moisture of different herbage swards soils in average of the year. The moisture content was 11.1% in turfgrass sward and 9.5% in grass-clover sward. Mulch impact appeared in turfgrass sward soil after middle summer rainfalls. In the period from August to October the soil moisture in mulched turfgrass soil was at the mean 11.9% and in unmulched soil 11.4%

The fertilization decreased the soil moisture content in turfgrass sward compare to unfertilized variants (unfertilized soil – 11.4% and fertilized variants – 9.7%). In grass-clover sward the fertilization did not affect the soil moisture.

The influences of the mining activities on surface, underground water and River sediments in Crisul Alb catchments

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The main effects of non-ferrous mining on the environment are groundwater contamination by dissolved pollutants and acidification of the soil and surface waters in the vicinity of the mines. Ecosystems and the health of the population may suffer from exposure to pollutants through water.

The Crisul Alb River is one of the most important Romanian rivers, coming from Apuseni Carpathian Mountains and joining the Tisza River in Hungary. The Tisza is itself a tributary to the Danube River that flows until the Black Sea.

In order to establish the level of water pollution with heavy metals and inorganic anions in Crisul Alb River, total and dissolved metals (Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb) and sulfate, nitrate and chloride were determined. Also the alkalinity / acidity of the water were determined. The determinations of metals and anions were done by using Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Ion Chromatography (IC).

Two sampling campaigns were done in 2005 and 2007, respectively, and a comparative study is presented taking into account that the almost of mining exploitation were closed. Unfortunately, the acidity and heavy metal pollution can de produce in a long term after mining closure.

The obtained values indicate a slight pollution of the Crisul Alb River and a variable distribution of metals in water and in particulate mater, depending of the type of the metal.

Surface water pollution with heavy metals in Baia Mare mining basin

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The Baia Mare mining basin is situated in the North West of Romania and encloses a large number of mining activities in all stages, from prospecting to mine closing and ecological reconstruction, with significant influence on the environment quality from the area. The mining activities generated huge amounts of wastes rich in heavy metals and cyanides that determined a chronic pollution of the area. The assessment of surface water pollution with heavy metals showed high heavy metal concentrations in the waters from the majority of the Someş river affluents that along with the low pH of the waters indicate that some of the mining facilities from the area represent a pollution source for the surface waters.

La modélisation hydrologique pour l'évaluation des impacts des aménagements CES sur le bilan hydrique

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Dans les zones arides, à pluviométrie faible et erratique, l'eau et le sol constituent des facteurs capitaux dans la production agricole. En effet et compte tenu de la rareté de l'eau de sa qualité médiocre, de l'aridité de climat, la restauration et la conservation des sols et la mobilisation de eaux de ruissellement constituent entre autres les orientations stratégiques du pays. A cet effet l'Etat Tunisien a établi en 1988 une stratégie nationale de CES qui est mise en exergue par un programme décennal (1990 – 2000) de CES. Les composantes de cette stratégie portent principalement sur l'aménagement d'un million d'hectare des terres érodées en utilisant les différentes techniques anti-érosives adaptées aux régions naturelles du pays et la mobilisation des eaux de ruissellement par la construction de 1000 lacs collinaires et 4000 ouvrages d'épandages et de recharge des nappes. A la fin de cette stratégie, il est important d'évaluer l'impact des aménagements CES sur le bilan hydrique. En revanche il était difficile à bien estimé les apports, vu que la majorité des bassins versants ne sont pas équipés de stations hydrométriques tandis qu'ils sont dotés des stations pluviométriques. Pour ce fait, et pour mieux comprendre en détail le fonctionnement général des bassins versants et les composantes du bilan hydrique on a recours à la modélisation hydrologique. Dans ce cadre on a pu évaluer l'impact des aménagements CES sur le bilan hydrique du bassin versant d'oued Oum Zessar par l'application d'un modèle biophysique distribué (PATTERN) développé par Mulligan (2003). Il est à signaler que ce bassin versant fait partie de la Jeffara Tunisienne à climat aride, une étude sur cette zone a été déjà entreprise par Ouessar (2005) en appliquant le modèle SWAT (Soil and Water Assessment Tool) développé par Arnold et al.(1998). L'application de ces modèles en milieu aride (bassin versant d'oued Oum Zessar) nous a permis d'attendre nos principaux objectifs qui consiste à tester, à faire la paramétrisation multi-critère et la validation du modèle hydrologique spatialisé, afin de pouvoir simuler les différentes composantes du bilan hydrique. Le long de ce travail nous avons donné plus d'intérêt aux impacts hydrologiques des aménagements CES.

Gestion intégrée des ressources hydriques au niveau du Rif occidental (Cas du bassin versant de Tahaddart)

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Situé au nord du pays, le bassin versant de Tahaddart représente la plus grande entité hydrographique de la chaîne rifaine occidentale avec une superficie de 1 190 km². Bien qu'il s'agit d'une région la plus arrosée du pays, ses potentialités en ressources hydriques et forestières sont limitées et se dégradent de plus en plus, ce qui nous amène à s'interroger sur l'avenir de ces ressources.

La présente contribution consiste à déterminer les différents usages, les ressources biologiques, les activités humaines, les composantes de l'écosystème fluvial et les phénomènes naturels caractérisants la zone ainsi que l'interaction entre cet ensemble dans le bassin hydrographique de Tahaddart, et ce, dans une vision de gestion intégrée des ressources en eau au niveau de ce bassin.

La population au niveau du bassin versant de Tahaddart s'élève à 130 308 habitants avec une forte densité de 112 habitants par km², dont 58% est analphabète et uniquement 37% qui est active.

L'ensemble des usages et activités humaines est à base de la production de l'eau potable, de l'agriculture (77 632 ha), de l'élevage (ovins : 101 652 têtes, caprins : 55 239 Têtes, bovins : 45 652 têtes), de la foresterie (56 772 ha), de la chasse, de la pêche, des activités artisanales et industrielles, de l'exploitation des carrières et des salines, de l'extraction de sable, ainsi que du tourisme.

La multiplication de ces actions engendrent des impacts négatifs sur les différentes composantes de l'écosystème fluvial de Tahaddart, à savoir : la composante eau, qui est représentée par les eaux de surface qui s'élève à 338 millions de m³ et les eaux souterraines dont la majeure partie est emmagasinée au niveau de la nappe phréatique de Charf El Akab (30 à 70 millions de m³), la composante sédiment évaluée à 3500 tonnes par km² par an et la composante habitat représentée par les forêts et les zones humides du bas Tahaddart.

L'analyse des données a permis de mettre au point les relations de cause à effet entre les usages et les activités humaines, ainsi que leur impacts sur l'évolution de l'environnement. En effet, l'analyse des tableaux de tendance révèle que l'ensemble des usages et activités humaines tendent à une augmentation ce qui pèse lourd sur la pérennité de la ressource eau au niveau de la région. La demande en eau potable est évaluée à 51,7 millions de m³ en 2004 et atteindra 78 millions de m³ en 2030. Le volume d'eau régularisé au niveau du barrage Ibn Battouta était de 43,60 millions de m³ en 1979, alors qu'en 2003 il n'est que de l'ordre de 32 millions de m³. Le volume d'eau, régularisé par les deux retenues de barrages existants dans la zone, diminue d'une année à l'autre suite aux apports des sédiments. L'envasement total au niveau du barrage Ibn Battouta est passé de 2,58 millions de m³ en 1983 à 11 millions de m³ en 2003. La dégradation des écosystèmes forestiers au niveau du bassin versant a pour conséquence l'insuffisance de la disponibilité d'eau dans la région surtout pour les villes de Tanger et Tétouan et les villages limitrophes; l'évaporation a augmenté et a été évaluée à 1500 mm et le phénomène d'érosion a augmenté surtout que la zone est très tourmentée et le substrat, à base de schistes, facilite le glissement.

Des propositions ont été formulées pour aboutir à une meilleure gestion intégrée du système fluvial en prenant en considération les composantes environnementales lors des prises de décisions, en incorporant tous les usages aux plans de gestion intégrée du bassin hydrographique afin de tenir en compte des nombreuses utilisations de l'eau, et plus précisément pour contrôler les sources de nuisances à l'écosystème.

Mots clés: Maroc, Rif, Tahaddart, gestion intégrée, usages, activités humaines, ressources hydriques, forêt.

Regionalization of soil degradation processes in Hungary

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The Commission of the EC in the Thematic Strategy for Soil Protection proposes a Framework Directive as the means of a comprehensive approach to soil protection and ample freedom on how to implement its requirements is left to Member States. Various threats occur in specific risk areas, which must be identified by them in a national or regional approach possibly on the basis of common elements. Over time more harmonised monitoring approach and methodology may be developed, exploiting ongoing work of the ESNB on harmonisation of methodologies, which elaborated common criteria and approaches to identify risk areas for five specific soil threats. Member States will be free to develop and combine approaches to combat further and concurrent threats. In the frame of Land Degradation Mapping Sub-project of PHARE MERA '92 identification, delineation and description of Hungary's major land degradation regions at 1:500.000 scale were accomplished in the late '90s. The applied GIS analysis techniques were mainly based on traditional cartographic methods and had not fully exploited the opportunities, which were later emerged in digital soil mapping. Recently the available techniques provided by DSM together with the renewed interest in spatial delineation of areas endangered by various soil threats has been combined in the recompilation of land degradation regions of Hungary. The available information related to soil degradation processes on nationwide scale was organized into an integrated digital land degradation geographic database. The following land degradation factors were distinguished: acidity, erosion, excess inland water, extremely soil texture, nitrate leaching hazard, salinity-alkalinity, shallow depth, water-logging. Territories affected by various limiting factors of soil fertility were determined by complex queries of the integrated GIS evaluating the proper influencing factors. For the overall characterization of degradation regions, indices were introduced, which can be used for the comparison of the individual regions and characterizes the territorial extension of the soil degradation processes and the grade of the required soil conservation actions. These indices can serve as spatial land degradation indicators.

Crust development on a tilled sandy loam soil under natural rainfalls in northwestern Spain

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Our study was carried out to observe the dynamics of crust formation on the sandy loam topsoil, under field conditions. Field experiments took place in agricultural plots in Northwest Spain. Two crop rotations were monitored: potatoes/winter cereal and maize/winter cereal. This experiment provided a wide range of initial seedbed states (primary tillage and seedbed preparation) as well as rainfall conditions due to the different sowing conditions and the long period during which the experiments were performed. Stages of soil crusting were recorded by visual assessment based on the estimation of the extent of structural and sedimentary crusts and on the continuity of sedimentary crusts. In addition, other morphologic changes of the soil surface referred to roughness, macroporosity, minimum diameter of the aggregates that are not yet incorporated into the crust and distance covered by runoff also were evaluated. Qualitative observations of crust development provide a good indicating surface degradation. In several occasions throughout the cropping cycle, the soil remained bare or with low vegetation cover; in such situation the soil surface was degraded due to successive natural rains. Depending on the intensity and the amount of accumulated rain on the surface, in some cases sedimentary crust were originated. Although soil surface degradation increased with successive rainfall the most significant changes were observed after the single events. Cumulative rainfall values needed for the initiation and development of the successive stages of crusts were very variable in function of the type of seedbed. To the time that the soil surface evolved by rainfalls effect, gradual decreases of the macroporosity and the roughness were observed. Depending on the conditions of the surface, diffuse runoff on different scales was generated. The greater or smaller rapidity of the surfaces evolution was controlled to a great extent by the soil roughness and the characteristics of rain. to 1 cm and suggests the presence of elluviation phenomena.

Fractal analysis of pore size distributions of a tilled surface and its crusted counterpart

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Proper characterization of soil pore size distribution is needed to quantify the various processes that it influences, i.e. the capacity to store water, water flow, and gas diffusion. Moreover, soil pore space controls soil mechanical properties and it is the location of biological activity. This work reports the results of a fractal study of the pore size distribution of a medium textured soil before and after surface crusting as induced by simulated rainfall. The effect of crusting was assessed by comparison of aggregates sampled from the freshly tilled soil surface and its counterpart disturbed by 260 mm cumulative rain applied by rainfall simulator. The solid-pore fractal dimension was estimated by a self-similar algorithm. Pore size distributions (PSDs) were determined by Hg intrusion porosimetry from 0.005 to about 100 μm pore diameters on ten samples per surface stage. Rainfall reduced aggregate pore volume, showing significant differences between the reference soil surface and the surface after rainfall activity for diameter ranges of 100-0.005 μm , 50-0.5 μm and 10 to 2 μm . Pore-solid interface fractal dimension, D_s , could be only estimated in a limited pore size interval. On average, D_s , before rainfall was 2.689 and after cumulative 260 mm rainfall it was 2.736, so that D_s increased in the soil surface disturbed by rain. Mean D_s values could be considered intrinsic measurements of the degree of pore filling. This hypothesis was validated by the fact that they were negatively correlated with values of total porosity in the 0.005-100 μm range. Aggregate breakdown by various mechanisms, including raindrop kinetic energy, slaking and physico-chemical swelling and dispersion and redistribution of elementary particles may be invoked as the underlying causes of pore-solid fractal dimension increase during soil surface crusting induced by rainfall.

Dispersible clay of selected Hamadan Soils: Role of organic matter content and intrinsic properties

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The fraction of clay particles which disperses in water, dispersible clay (DC), is recognized as an important property with respect to soil structural stability, soil sealing and crusting, runoff and erosion, and contamination of surface and ground water resources. Unstable soil aggregates will be destroyed upon wetting and the primary particles will be released into soil solution. The water-dispersed materials could be brought through the soil and intrude soil pores reducing hydraulic conductivity as well as pore continuity.

In this study, the impact of intrinsic soil properties with emphasis on organic carbon content were explored on the mechanically DC of 22 selected soil series from Hamadan Province, west of Iran. Influences of the organic matter (OM), clay and carbonate (CaCO_3) contents on DC were studied while DC values were defined as the fractions of the whole soil (DC) or as the fractions of the clay (DCF). The single linear relation between DC and OM was not significant. However, the multiple regressed relation was highly significant:

$$\text{DC}\% = -10.6 - 2.25 \text{ OM}\% + 0.939 \text{ Clay}\% - 0.071 \text{ CaCO}_3\% \quad R^2 = 95.3\%$$

The organic matter content had the highest role in reducing DC among the intrinsic properties, i.e. two and thirty one times more than clay and carbonate contents, respectively. The equation might be used to assess structural stability of the soils in the region. It is also useful to examine the effect of a soil property on DC. The fitted single and multiple linear regression equations for DCF read as:

$$\text{DCF}\% = 77.7 - 10.7 \text{ OM}\% \quad R^2 = 45.4\%$$

$$\text{DCF}\% = 14.4 - 5.62 \text{ OM}\% + 1.13 \text{ Clay}\% - 0.146 \text{ CaCO}_3\% \quad R^2 = 88.3\%$$

It is interesting that the single linear relation was significant showing the great influence of clay content on DC which was eliminated in DCF. The effect of CaCO_3 content on DC and DCF was not significant. Overall, the organic matter and clay contents are the intrinsic soil properties controlling mechanically dispersible clay of Hamadan soils.

On the stability and relative slaking indices of some soils from Hamadan, West of Iran

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Soil structural stability is a considerable subject of research in soil physics. However, there is no universally accepted procedure for determining the structural stability. This is because the soil structure has a dynamic nature and depends on many factors. A common method which has been used is Yoder wet sieving which is well-known world-wide. A problem with this method is that the aggregate ranges are not standardized. So the data on mean weight diameter (MWD) of aggregates from literature might not be compared easily. Some stability indices were proposed to overcome this problem but there is a strong need to test the capability of these new indices in characterizing structural stability.

Wet and dry sieving methods were used to characterize structural stability of 22 selected soil series from Hamadan Province. Air-dried aggregates were quickly immersed or capillary-slowly wetted, and wet sieved for 5 min. The resultant mean weight diameters of aggregates were called MWD_{FW} and MWD_{SW} , respectively. Another batch of aggregates was dry sieved for 10 min and MWD_{dry} was calculated. De Boodt–De Leenheer's stability index [$AS_{deb-del} = 1 / (MWD_{dry} - MWD_{FW}) \times 100$] and relative slaking index, $RSI = 100 \times (MWD_{SW} - MWD_{FW}) / MWD_{SW}$, were determined based on these measurements. The multiple relation between $AS_{deb-del}$ and soil properties was significant but not satisfactory:

$$AS_{deb-del} = 25.8 + 1.60 \text{ OM}\% + 0.0197 \text{ Clay}\% + 0.030 \text{ CaCO}_3\% \quad R^2 = 38.0\%$$

The relation shows non-significant little effects of clay and carbonate contents. The single linear relation between $AS_{deb-del}$ and OM was not significant. However, the single and multiple linear relations for RSI were highly significant:

$$RSI = 76.1 - 13.5 \text{ OM}\% \quad R^2 = 57.7\%$$

$$RSI = 90.7 - 10.1 \text{ OM}\% - 0.491 \text{ Clay}\% - 0.254 \text{ CaCO}_3\% \quad R^2 = 80.3\%$$

It is concluded that RSI is a good index of structural instability in comparison with $AS_{deb-del}$. This might be relevant to its relative quantity which removes the effect of absolute aggregate stability. RSI will be recommended to determine vulnerability to slaking of the soils in the region.

Investigation on soil conservation and soil stability with geogrid in the arid and semi-arid area (Varamin – Iran)

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Slope stabilization can be done using geogrid. In steep slopes, regeneration of vegetation is very difficult. The usage of geogrid in slope over 85% can be successfully technically and economically. To determine polymer net works, plots of 12×2 meters were constructed. They were enclosed with steep plates; runoff and sediments gathered and were led to gathering plots. Different treatments were considered for the research. Two slope (85% & 110%) and there replication were among the treatments 9 events were recorded. These data were analyzed in SPSS software. We concluded that there is significant difference in plots conducted in 110% but there is no significant difference in slope 85%. Different treatments along with replications were chosen. Nine events were measured. Totally plots where in geogrid were used, soil degradation shows lower rate. Conclusions and analysis proved that it is very economic compared to other treatments. So geogrid can be used with great success in arid and semiarid areas.

Keywords: Erosion control, Geogrid, Slope stability, Soil conservation, Arid and semi arid area

Do cryptogams conserve the soil? A case study in Iran using LFA method

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The study was performed using LFA method to find the effectiveness of cryptogams on soil conservation in Qara Qir rangelands in Turkmen steppe, Iran. Cryptogams occur as assemblage of lichens, mosses, liverworts, and cyanobacteria. Lichens and mosses are the two important components of cryptogams. In LFA method, soil stability, infiltration and nutrient cycling status are assessed according to the obtained scores related to the properties of litter cover, soil microtopography, soil texture, erosion feature, eroded material, surface nature, soil cover, crust broken-ness, cryptogam cover, and slake test. The seven latter properties are those which used for soil stability assessment. For this, two adjacent areas including crusted and uncrusted soil (with and without cryptogams) were chosen to do the experiment. Thirty six 1 m² plots were established in each of areas (total 72 plots). The data of each plot was recorded. At all, based on the obtained scores of plots, it was shown that there was a significant difference between crusted and uncrusted soils in view point of their stability. The results demonstrated that although cryptogam cover is considered as one property in soil stability evaluation, but its effects on other properties like soil cover, erosion feature, surface nature and slake test is of high importance.

Keywords: Cryptogam, Moss, Lichen, Stability, LFA, Rangeland

Preliminary studies on soil ingredient and plant foliar chemistry of two ultramafic sites in west Iran

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Serpentine (ultramafic) soils typically have low-Ca/Mg quotients, low-water-holding capacity, relatively high concentrations of Ni and Cr, and low-N and P contents, a suite of characteristics often referred to as the ‘serpentine problem’. Some ultramafic sites are located in several parts of west and north-east of the two main Iran’s mountains and few documented research are currently available. This study has been implemented in two serpentine areas of Haftcheshmeh and Harsin in Lorestan province in the middle west zone of country. Chemical experiments were performed on soil elements (Fe, Mg, Ni) in five replicated rocks and phytochemical elements (Ca, Co, Mg, Mn, Ni, Zn) were measured via ICP (Inductively Coupled Plasma) system on almost 50 local species. The results presented higher doses of calcium in related plant species which is the probable impact of considerable amount of surrounding lime stones.

Land degradation processes in Ciuc Depression

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The Ciuc Depression is located in the Eastern Carpathians along the Higher Olt river. It covers about 680 km².

The paper is dealing with the main land degradation processes (soil acidity and pollution, soil sheet and gully erosion, landsliding, soil waterlogging, surface-water and/or groundwater gleyzation, floating).

On the basis of data concerning these processes, a land map was prepared at a 1: 100,000 scale showing both the nature and severity of each land damaging process.

Changes in soil carbon storage in long-term rotation and tillage trials in Central-Spain

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The long-term quantitation of soil organic carbon (SOC) in relation to different types of soil and climate and under various soil management options, is of great importance in identifying the pathways of C sequestration in soils. This research presents results of SOC storage in a Calcic Haploxeralf located in the semi-arid central Spain, after 19 years of a series of continuous tillage and rotation combinations. The split-plot design included two tillage treatments: conventional tillage (CT) and no-tillage (NT). The crop rotations include (1) barley (*Hordeum vulgare* L. cv. "Aramir") and vetch (*Vicia sativa* L.) (B–V), (2) barley and sunflower (*Helianthus annuus* L.) (B–S) and (3) barley monoculture (B). With regard to tillage systems, the values for the total SOC storage in the 0-30 cm soil layer showed that the amount of SOC in the NT plots was 2.3 Mg ha⁻¹ greater than that in CT plots. Differences between rotation treatments showed that B resulted in less SOC storage (2.9 Mg ha⁻¹) than did the other two rotations (4.8 Mg ha⁻¹ and 4.4 Mg ha⁻¹ for B–V and B–S respectively). There were significant tillage-rotation interactions: after 19 years, the lowest values of SOC were observed in CT / B plots (2.5 Mg ha⁻¹). The application of NT in combination with sunflower or vetch increased SOC to 4.8 and 5.4 Mg ha⁻¹ respectively. Comparing the CT / B with the CT / B–V treatment, the C storage increased from 2.5 to 2.9 Mg ha⁻¹. This represents an increase of 0.4 Mg ha⁻¹ in 19 years *i.e.*, a SOC sequestration rate of 21 kg C ha⁻¹ yr⁻¹ strictly due to a rotation effect. The overall gain in SOC stored in NT / B–V treatment as compared to the CT / B–V combination was 2.6 Mg ha⁻¹ (137 kg ha⁻¹ yr⁻¹). The obtained results confirm that agricultural practices, such as tillage intensity and rotation, may counteract the declining in C sequestration in semiarid soils, alleviating the trend towards increasing CO₂ concentrations in the atmosphere. When continuously practiced, NT results in higher SOC storage than when CT is applied; it can be considered as an effective technology for removing C from the atmosphere and sequestering it into the soil.

Combining rain simulation and single ring infiltration test to determine the hydraulic resistance of a surface crust

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According to the analysis of Hillel and Gardner (1969) for steady infiltration, the hydraulic resistance of the soil surface crust, R_c (h) is determined by $-h_{s,c} / K(h_{s,c})$, $h_{s,c}$ (cm) being the water pressure at the interface soil/crust and $K(h_{s,c})$ (cm/h), the soil hydraulic conductivity corresponding to $h_{s,c}$. For steady infiltration, $K(h_{s,c})$ is equal to the infiltration rate so that the knowledge of the hydraulic conductivity curve allow the determination of the crust resistance in this case. The steady infiltration rate was measured during rain simulation experiments conducted in Central Tunisia. The measurement plot was a square metallic frame driven 5 to 10 cm into the soil. Runoff from the plot was collected in a reservoir and continuously measured. Infiltration rate was determined as the difference between rain intensity and runoff intensity. Soil hydraulic properties were described by a combination of Van Genuchten and Brooks and Corey expressions for the water retention and hydraulic conductivity relations respectively. The parameters of these relations were determined from analysis of both grain size distribution and single ring infiltration test. This test was performed on decapped soil in the immediate vicinity of the rain simulation plot. The relevance of the soil hydraulic properties determined in this way was tested by numerically simulating the single ring infiltration test and by comparing measured and simulated results. The crust resistance was inferred from the steady infiltration flux measured during the rain simulation experiment and from the hydraulic conductivity curve. These informations were used to numerically reproduce the rain simulation infiltration experiment. The comparison with experimental data showed that this method is reliable at least for this type of soil.

Remote sensing of slight and moderate saline and sodic soils

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Around the world, especially in semi-arid regions, millions of hectares of irrigated agricultural land are abandoned each year because of the adverse effects of irrigation, mainly secondary salinity and sodicity. Accurate information about the extent, magnitude, and spatial distribution of salinity and sodicity will help create sustainable development of agricultural resources. In Morocco, south of the Mediterranean region, the growth of the vegetation and potential yield are limited by the joint influence of high temperatures and water deficit. Consequently, the over use of surface and ground water, coupled with agricultural intensification, generates secondary soils salinity and sodicity. This research focuses on the potential and limits of the Advance Land Imaging (EO-1 ALI) sensor spectral bands for the discrimination of slight and moderate soils salinity and sodicity in the Tadla's irrigated agricultural perimeter, Morocco. In order to detect affected soils, empirical relationships (second order regression analysis) were calculated between the electrical conductivity (EC) and different spectral salinity indices. To achieve our goal, spectroradiometric measurements (350 to 2500 nm), field observation, and laboratory analysis (EC of a solution extracted from a water-saturated soil, and soil reaction (pH)) were used. The spectroradiometric data were acquired using the ASD (*Analytical Spectral Device*) above 28 bare soil samples with various degrees of soils salinity and sodicity, as well as non-affected soils. All of the spectroradiometric data were resampled and convolved in the solar-reflective spectral bands of EO-1 ALI sensor. The results show that the SWIR region is a good indicator of, and are more sensitive to, different degrees of slight and moderate soil salinity and sodicity. In general, relatively high salinity soils show higher spectral signatures than do sodic soils and non-affected soils. Also, strongly sodic soils present higher spectral responses than moderately sodic soils. However, in spite of the improvement of EO-1 ALI spectral bands by comparison to Landsat-ETM+, this research shows the weakness of multi-spectral systems for the discrimination of slight and moderate soils salinity and sodicity. Although remote sensing offers a good potential for mapping strongly saline soils (dry surface crust), slight and moderately saline and sodic soils are not easily identified, because the optical properties of the soil surfaces (color, brightness, roughness, etc.) could mask the salinity and sodicity effects. Consequently, their spatial distribution will probably be underestimated. According to the laboratory results, the proposed Soils Salinity and Sodicity Indices (SSSI) using EO-1 ALI 9 and 10 spectral bands offers the most significant correlation (52.91 %) with the ground reference (EC). They could help to predict different spatial distribution classes of slight and moderate saline and sodic soils using EO-1 ALI imagery data.

Keywords: Salinity, Sodicity, Electrical conductivity, Remote sensing, Spectral indices, spectroradiometric data, EO-1 ALI sensor.

Salinity effects on Growth and Na Accumulation in Medicinal Plant *Matricaria Chamomilla*

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Many metal hyperaccumulating plants have to tolerate abiotic stresses in their native soils such as high salinity, low nutrient status and drought. *Matricaria chamomilla* is a medicinal plant that is widely cultivated in salt-affected soils. Chamomile is horticultural crop with socio-economic significance. This investigation was undertaken to study the effect of NaCl concentration on Na accumulation in shoot and root of this plant. Therefore a greenhouse experiment was conducted using complete randomized design with four replications in order to evaluate the effects of salinity on the growth and shoot and root Na concentrations of chamomile. Hydroponic solutions are used for salinity experiment at five levels of NaCl concentrations (0, 40, 80, 120, 190 mM). Plant growth significantly increased with increasing NaCl concentration up to 40 mM while decreased at higher salinity levels proportional to the salt rate. In fact, the highest and lowest shoot and root dry weight was found in 40 and 190 mM NaCl treatments, respectively. Sodium ions were concentrated mostly in the roots. Overall, *M. Chamomilla* is a tolerant to moderately salt tolerant crop during growth whose response to salinity is associated with maintenance of high Na⁺ accumulation in roots. The implications of the findings are discussed for the development of metal phytoremediation technologies on saline soils or where brackish water could be used to irrigate phytoremediation chamomile. Field studies will be undertaken to validate our greenhouse results suggesting that chamomile could be used.

Landslide hazard in central Zagros region in Iran

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Mass movement is considered an important land degradation event which occurs in different areas under the influence of climate, topography, soil, plant cover, geology and tectonic factors. In recent years 250 landslides in the Chahar Mahal Bakhtiari Province has occurred. The purpose of this study was to investigate some parameters that could affect landslide occurrence in the study area. Two kinds of marl formations known as Oligomiocene 1 (OM₁) and Oligomiocene 2 (OM₂) which are susceptible to landslides were chosen. After morpho-genetical description of soils and underlying regolite, samples were taken along two transects on slide cuts exposure of OM₁, OM₂. Results show that the texture of marl formations was mainly silt-loam and amount of silt increased to downwards. On the other hand the porosity in deep layers decreased which leads to reduction of matric potential and infiltration rate. Upper horizons of soils in both formations showed good infiltration rate. Mineralogical study indicated that about thirty five percent of clays in soils consist of Smectite and expanding minerals which show an increasing trend downwards. Although Smectite and expanding minerals are inherited, we can conclude that increase of those minerals on depth may occur due to water table. According to mineralogy characteristics, when Smectite and expanding minerals swell because of water absorption, it is clear that shear strength would decrease. In addition to geological formations, active tectonic of the area and relatively high precipitation influence landslides occurrences. Human activity was also important factor in mass movement in the study area.

Keywords: Landslide hazard, Mass movement, Mineralogy, Zagros, Iran

Genetic variability for salt tolerance within different geographic location of wheat (*Triticum aestivum* L.)

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Salinity is one of the most damaging agro-environmental problems limiting plant growth and development on most parts of the world. The problem of salinity existed long before the human beings and start of agricultural practices and today it has become a very serious problem for crop production, particularly in arid and semi arid regions, which constitute about one third of the world land surface. In order to determine the magnitude of genetic variation for salinity tolerance in spring wheat and broad sense heritabilities estimated, calculated at different salinity levels. The 68 genotypes responded differently to increasing salinity levels in the growing medium. The response of different genotypes growth reduced to increased salinity levels were found with those originating from Australia exhibiting significantly increase salinity tolerance than other, which are originating from Pakistan. The plant vigour and salinity tolerance were found positive correlation measured by relative growth rates in non-saline environments. Various crop species have been examined for salt tolerance, which suggests that different genes may be controlling the character, from single major dominant or recessive genes. The purpose of this study was to determine genetic and phenotypic relationships between plant performances in the presence of NaCl at three developmental stages in wheat. These results suggest that improvement in salinity tolerance in the spring wheat is possible through selection and breeding.

The influence of intensive horticultural plants cultivation on degradation of Hortic Anthrosols properties from in greenhouse of Copou – Iassy

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According with the data presented on Agricultural and Rural Development Ministry site a constant increase of field area intensive cultivated with vegetables is observed. Thus, the area cultivated with vegetables species increase in 2004 with appreciatively 28 000 hectares towards 1995 year. The main criteria for the locations of the greenhouses are the existence of heating and water sources. The location of greenhouse near the market in order to diminish the transport costs is another main criterion. Due to the compulsory location imposed by the above conditions, many greenhouses were placed on soils considered with a low capability but then through the application of land improvement works satisfactory results have obtained. The soil morphological, chemical, physical and biological properties degradation is determined by large application quantity of organic and mineral fertilizer. Under recently preliminary research data obtained in the location of traditional legumes plants cultivation is clearly evidenced an soluble salts accumulation, specially in the wetting front border area. After 27 years of exploitation of the horticultural anthrosols from greenhouse Copou, one impermeable horizon with brittle blocky angular structure aggregates was formed on the depth of 40 cm. The subsurface drainage at the depth of 90-100 cm became out of order due to the presence of compacted horizon, which function like a barrier for water movement from upper part of soil to the filter bed and drainage pipe. This impermeable horizon favors also the high accumulation content of soluble salts. The main objectives of this paper concern to the presentation of the physical and chemical soil properties which determine development of the impermeable horizon and decreasing of the Horticultural Anthrosols fertility.

Soil degradation as a cause of brushwood clear-cutting and grazing in Mediterranean forests

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In Mediterranean regions soils developed on limestone are widespread and often represent important resources, supporting several types of land use. These soils are characteristic of landscapes often dominated by forest coverage. In these environments human impact is often significant, due to factors such as fire, grazing, tourist pressure and wrong silvicultural management. The most important impacts on soil are caused by grazing (mainly goat and swine) and brushwood clearcutting (practised with the intent of reducing fire risk), especially in steeply-sloping areas. In these conditions, soil degradation phenomena are often observed, with important consequences on the whole ecosystem.

This research shows the early results of a pedological study developed in carbonatic areas of central-eastern Sardinia (Italy). Investigated soils show evident influence of human activity. In particular, the degradation is a consequence of intense grazing and unplanned brushwood clearcutting (by the indistinct and non selective cutting of grass and shrub land).

Evident stages of soil involution are observed, mainly caused by erosive phenomena that often lead to a definite decrease in the thickness of organo-mineral surface horizons. In these conditions a substantial regression can be seen: from orders typical of more natural pedoclimatic conditions (Mollisols) to orders that often show regressive phases (Alfisols) or marked degradation phases (Entisols).

Floodwater spreading for carbon sequestration in deserts

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Most deserts of the world with temperate and warm climate offer potential sites for growing adopted plants. Thus greening the denuded land, desertification control; at its highest level, shall result in carbon sequestration. A case in point is extension of plant cover of the Greh Begone plain (GBP) in southern Iran with self-grown species of shrubs. The forced sedentarization of a scrubland by transhumant nomads in the GBP, with the mean annual precipitation and the class pan evaporation of 240 and 3200 mm, respectively, desertified the plain. Floodwater spreading and planting of adopted shrubs, bushes and trees have reclaimed about 3000 ha of the GBP. This research was conducted on the effects of floodwater spreading on carbon sequestration by dominant self-grown species of shrubs. The result of this study shows the carbon sequestration in floodwater spreading plot for dominant self-grown species of shrubs has been significantly more than controlled plot. This indicates the vast potential of the deserts with ephemeral floods for carbon sequestration, and the related activities that improve the well-being of the poverty stricken desert-dwellers.

Sowbug (*Hemilepistus shirazi* Schuttz): The Crust Boring Crustacean that Sustains a Desertification Control Project

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Mankind is facing starvation in about 100 years if the present trend of desertification and population growth continue unchecked. The inevitable Malthusian dilemma may be delayed through application of the artificial recharge of groundwater (ARG) methods using the turbid floodwaters which abound in the deserts. While soil building is a highly desirable outcome of the ARG activities, formation of hard crusts that substantially decrease infiltrability is a negative aspect of application of this method. The appearance of sowbug (*Hemilepistus shirazi* Schuttz) in the sedimentation basins of the artificial recharge of groundwater system in the Gareh Bygone Plain in the southern Iran is considered as ecological breakthrough in desertification control. This crustacean, which drills 7-8 mm holes down to 1.8 m in the freshly – laid sediment and sand, facilitates preferential flow of water towards the aquifers. Therefore, the presence of sowbugs may be considered a valuable indicator of land suitability for ARG activities.

The circular burrows made by the sowbugs are 0.7 cm in diameter and reach a depth of 185 cm. The infiltration rate of the sowbug invaded area is 7.3 cm hr⁻¹ as opposed to 1.7 cm hr⁻¹ for the control. The burrowed materials are highly concentrated in organic - C, K, P, total N, Mn, Zn, Fe, and Cu; the EC is highly increased; the CaCO₃ content is somewhat decreased and the pH is lowered by 1.4 units. Cautious introduction of plant species attractive to this marvelous crustacean is highly recommended. Domestication of this organism, a souvenir of the ARG systems, seems technically practicable, environmentally sound, economically feasible and socially acceptable. The higher soil organic carbon (SOC) in the burrowed material, as compared with those of the original soil and the freshly-laid sediment, represents a potential for carbon sequestration when viewed as a long-term management system.

Contribution à un inventaire des populations et organismes d'un sol steppique non cultivé

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Support du cheptel Ovin, les régions steppiques algériennes couvrent de très vastes superficies, qui sont actuellement menacées de désertification par les changements climatiques conjugués à des pratiques humaines défavorables.

La mise en culture d'un sol steppique est sans aucun doute un des principaux paramètres de sa dégradation, qu'en est-il pour un sol non cultivé, ou qui a été pendant des décennies mis à l'abri de pratiques humaines dégradantes.

Un sol non cultivé peut-il être assimilé à un biotope non fragilisé?

C'est dans ce sens que le travail que nous voulons présenter est orienté. La fragilité et la pauvreté d'un sol sont des critères liés à sa structure physico-chimique, en est-il de même pour sa biodiversité?

Le sol mis en étude est situé dans la région de Laghouat dans une zone steppique à caractère pastoral, où un inventaire des populations et organismes qui l'occupent est réalisé en périodes annuelles climatiques différentes.

Mots clés: Sol, climat, steppe, micro-organismes, animal, végétal, biodiversité

Land degradation in Algerian Steppe, analysis of desertification indicators by using remote sensing and GIS

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The degradation of the natural resources in the arid and semi arid land has drastically been emphasized during this century because of the demographic growth and the transformation of the land use systems. The extension of the cultivated areas in the marginal land and the cattle growth led to different processes of degradation, green cover destruction, over pasture land erosion and their fertility deterioration. The steppe in Algeria is presented in the form of pathways or Alfa and for the majority; these pathways are degraded with low recovery. This, under the aridity affect of the medium and the over pasture which is being forced on this pathways makes the degradation process worse for the physical medium and then lead to desertification. All the time, the politicians have been searching with more or less success to master the natural resources and to diminish the aggressive effects exerted by man in a conscience or no conscience manner on the medium. With all these problems, to which the Algerian steppe, allowing the determination of the lands being damaged by desertification and also to better use the pastoral resources. The work is mainly based on the classification criteria of the arid lands and the steppe, these criteria are numerous, climatic, phytogeographic, pedology and agronomic. The approach is based on the Land sat data images completed with terrain observation. With regard to the ecosystem fragility a synthesis chart was designed classifying land in to five classes. A deserted class, a very sensible to desertification class, a sensible to desertification class, a more or less sensible to desertification class, a little or most sensible to desertification class.

Investigation on soil and water indices for desertification assessment in Dehloran of Iran

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At present desertification as a problem involves many countries, especially developing countries. This problem beside of arid and semi arid regions can be observed in parts of semi humid region. Desertification includes some process that caused by natural factor as well as human uncorrected activities. Aim of this research was investigation on water and soil indices for desertification assessment in Ayn-Khosh of Dehloran and finally preparing desertification map. For this purpose MEDALUS methodology that prepared by European commission (1999), was used. More accuracy, GIS application in layers combination, increase in assessment and desertification mapping rapidity and fewer experts' error are most MEDALUS benefits that make it more useable than other prior models. In order to indicators access, produced indicators by arid and mountain regions reclamation group of natural resources faculty of Tehran university, that have collected for all region of Iran, and some of ICD modified indicators was used. Finally for each of water and soil indices, eight indicators were determined. Results show that desertification intensity is high and going to develop. Water and soil indices respectively classified to intensive (1.517) and moderate (1.381) classes.

Keywords: Desertification, MEDALUS, ICD, Indicator, Water, Soil

Comparison of gully erosion in two different climatic and land use conditions in the Central Iran, Markazi province

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Water erosion as the dominant type of land degradation worldwide plays an important role in producing sediment and damaging infrastructures and landuses in Central Iran. Field observations and measurements by different researchers indicated that the causes of gully erosion and characteristics of gullies are not similar in different climatological conditions. In this research, gully erosion with an area larger than 5 km² was determined using anecdotal and historical evidences and intensive field surveys. The climate of the regions affected by gully erosion was determined using De-marton's method. In each climatic zone, two regions with gully erosion and within each region three representative gullies were selected for measuring their characteristics.

To investigate this subject in Markazi Province two climatic zones, mediterranean moderate zone with Solab and Deh-kaeed as representative regions and desertic arid zone with Robattork and Peak Zarand as representative regions were selected. In each region the morphometric characteristics, soil and morphology of selected gullies were measured. This paper aims at comparing the characteristics of gully erosion in two climates.

The results indicated that the desertic arid region had low rainfall and soil structure is weak. Also the amount of EC, ESP, SAR and alkalinity were in high level. This arid climate experienced larger area and more dense gully erosion. In this climatic condition, human impact is more obvious on the incidence of gully erosion. Gullies in the desertic arid climate are longer with general dendritic view plans and vertical head plans. Most of the gullies were formed in the rangelands.

In the mediterranean climate as the humid condition, gullies experiencing linear view plan on the plateaus and upper terraces were formed on the croplands with higher rainfall. Usually the length of the gullies are smaller than arid climates but their width and depths are higher than arid zones.

The results imply that ecosystems in arid zones are more prone to gully formation and development due to less vegetation cover and increasing bare land area. In the case of gully erosion, a combination of control measures are needed and applying only structural measures would not be successful. In humid regions, due to higher rainfall and better soil characteristics, management and vegetative measures should be prioritized.

Keywords: gully erosion, climate, markazi Province

The complexities of discussing soil vapor extraction techniques with non-scientists

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The Centre County Kepone Site is approximately 32.2 acres on which a chemical manufacturing plant and a portion of the Spring Creek watershed are located. Kepone and mirex, were custom manufactured between 1959 and 1974. Earthen lagoons were used to manage onsite waste disposal. Concrete lagoons were later constructed and macadamized with asphalt. Treated water was also sprayed on open grassy areas or spray fields. Thorton Spring, a part of the watershed, was later found to be impacted by the plant's waste water treatment efforts. The complete aftermath was a National Priority Listing and contaminated groundwater, surface water, soils, sediments, and fish tissue which present both a carcinogenic and non-carcinogenic risk to human health. The cleanup effort was divided into two phases: groundwater remediation and soil remediation. In the Record of Decision (RD), the soil remediation effort was soil extraction. The company petitioned the EPA to amend the RD to consider both soil vapor extraction (SVE), which is a method that applies a vacuum to the unsaturated soil, or soil that is groundwater free to induce the controlled flow of air and remove volatile organic compounds and soil limited excavation. Explaining how soil vapor extraction works and presenting the results of a 5-year pilot study conducted to gain EPA support to a non-scientific community can be difficult. This presentation describes the science and communicative aspects.

Application of induced phytoextraction on soils extremely polluted by heavy metals. Case study in Almásfüzitő, NW Hungary

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Phytoremediation is a new and promising method for decreasing water and soil pollutions. Within the method numerous different technologies are applied that can decrease the concentration of pollutants of the soil or can stabilize their transport in acceptable risk level with help of special plants and related microbes.

The aim of the investigation was to find the optimal and effective technology to decrease metal content of the extremely polluted soil in Almásfüzitő, NW Hungary. During the recultivation works of the waste material (10-12 m thick “red sludge”) it was covered by a 1-1,5 m thick layer of soil-like material originating from industrial and communal activities (dross, sewage sludge, heavy industrial waste, etc.).

The 3 main directions of the investigations are the followings:

1. Identifying the heavy metal forms with different mobility in the soils with various types of extraction (from distilled water via EDTA to aqua regia).
2. Managing growth chamber pot experiments, polluted material was mixed with warp at different rates in order to decrease metal concentrations. *Helianthus annuus* and *Festuca arundinacea* were planted into the pots and one of each mix and plant combinations were sprinkled with chelating agents in order to intensify metal uptake by plants.
3. Gathering information on the chemical, physical and hydrophysical properties of soils treated with phytoremediation.

The results show that besides of the high heavy metal content the extreme hydrological, chemical and physical properties can limit to the plant growth. The studied 5 heavy metals showed various mobility in the “soil”: Pb was the most stable, plants can uptake max. 5 % of the total Pb content of soil. This ratio is the biggest (40-60 %) at Zn and Cd. Sprinkling the various mixtures of contaminated soil and warp with EDTA has increased the plant uptake: 1:1, 2:1 and 1:2 ratio were optimal, the highest growth in uptake was shown by *Festuca arundinacea* in mixed material with ratio 2:1 (174 % growth of Cu and 146% growth of Zn).

Comparison of soil properties on slopes under different land use forms

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Water erosion is a natural process and occurs on almost every open-air field. In, close-to-natural conditions soil degradation and soil formation reaches its climax, reflecting the environmental factors of a certain area. In case we start agricultural production, forest and pasture or meadow management on an area, the threat of accelerated soil erosion occurs, thus the rate of soil degradation will exceed the rate of soil formation.

In our study we have chosen slopes with pairs of contrasting land use (e.g. arable land with forest or arable land with meadow or meadow with forest etc.) where the slope length and angle are similar under the different land use types. These circumstances allow us to compare the soil properties under two land use types.

For methods we chose the methodology of the Hungarian Soil Information Monitoring System and took soil samples from the upper and from the lower third of the slopes in order to compare the soil properties on these slope tiers. We had laboratory measurements of basic soil parameters (e.g. pH, SOM, P₂O₅, K₂O, CaCO₃ etc.).

A good example of the results is with phosphorus because this is one of the best indicator for analysing the effect of water erosion because it is connected with the soil particles, so it is washed towards the lower slope tierce with soil particles if water erosion occurs. According to our measurements, the amount of the P₂O₅ is 2,6–680,3% more on the lower slope tierce and the land use types are not always behave as we expect them: the lowest value belongs to maize and the highest belongs to acacia forest!

The measurements provide help for farmers to reduce the nutrient loss (save fertilizer), hold the nutrient at the right place and thus provide their crop with the necessary amount of nutrients to reach better yields, and this way they save the purity of surface water, too.

Effect of tillage systems on glomalin related soil protein and physicals characteristics of an agroecosystem

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Glomalin is a glycoprotein produced by arbuscular mycorrhizal fungi (AMF) which is accumulated in the soil due to a high recalcitrance. Its presence in the soil profile might contribute with a significant percentage of the carbon sequestered into the soil. Conventional tillage systems affect negatively the soil structure by the rupture of soil aggregates influencing soil bulk density, hydrophobicity, glomalin content, C flux and other microbiological characteristics, therefore diminishing the C storage in the agroecosystems. All these constraints are overcome when no tillage systems are applied.

We evaluated the influence of two tillage systems on glomalin related soil protein (GRSP), C content, AMF spores number, bulk density, aggregate water stability and soil hydrophobicity. All these parameters were contrasted in an experimental agroecosystem managed for 6 years by conventional tillage (CT), and no tillage (NT) in a wheat-corn rotation in a Mollisol (Entic Haploxerolls) in Central Chile.

Mean values in the surface soil (5 cm) for GRSP were CT=3.96 and NT=8.16 mg g⁻¹. C content were CT=1.7% and NT 2.6 %, where the glomalin-C represented 6.9% and 9.9% of total C for CT and NT, respectively. The AMF spore numbers were lower in soils under CT than NT system. The soil bulk density was 0.884 g cm⁻³ in NT and 1.005 g cm⁻³ in CT. Soil hydrophobicity increased under CL compared to CT. The aggregate water stability was higher in NT, with 59% in contrast to CT with 32% of aggregation. Results showed that the conservation tillage systems exert a positive effect on all the characteristics measured but soil hydrophobicity was not significantly affected by management systems.

Effet combine des feuilles de *Thitonia Diversifolia* et des engrais inorganiques sur les rendements du maïs et les propriétés d'un sol ferrallitique au Centre Cameroun

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Une étude a été conduite sur un sol ferrallitique du Centre Cameroun en vue d'évaluer les effets des feuilles de *Thitonia diversifolia* (FTd) et des engrais inorganiques (NPK et Urée) sur les rendements de maïs et sur les propriétés du sol. Le dispositif expérimental était le bloc complet randomisé à trois répétitions et six traitements : T₀ (0FTd, ONPK et 0 Urée); T₁ (0FTd, 150 kg 20-10-10 et 150 kg d'urée/ha); T₂ (0FTd, 75 kg 20-10-10 et 75 kg d'urée/ha); T₃ (2.5 t/ha FTd, ONPK et 0Urée); T₄ (5t/ha FTd, ONPK et 0 Urée) ; T₅ (2.5 t/ha FTd, 75 kg 20-10-10 et 75 kg d'urée). Les feuilles de *Thitonia* (FTd) étaient incorporées dans le sol deux semaines avant les semis du maïs. Les échantillons de sol étaient prélevés à une profondeur de 0-15 cm au début et à la fin de l'étude et analysés pour la texture, le pH, le carbone organique, l'azote total, les bases échangeables, l'acidité échangeable et le phosphore assimilable. Des différences hautement significatives ($p=0,0067$ et $p<0,0001$ respectivement) ont été obtenues entre les traitements en première et deuxième année en ce qui concerne les rendements de maïs avec des rendements variant de 1,5 à 6.4 t/ha; les traitements T₄ et T₅ ayant donné les moyennes les plus élevées. En ce qui concerne les propriétés du sol, des différences hautement significatives ($p=0.04$ et $p=0.008$) ont été obtenues entre les traitements pour les teneurs en argile et en limon respectivement. Aucune différence significative n'a été observée pour les autres propriétés de sol testées. L'analyse économique des résultats montre que les marges bénéficiaires les plus élevées ont été obtenues avec les traitements T₄ et T₅. Les résultats de cette étude montrent que les feuilles de *Thitonia diversifolia* peuvent être une alternative viable aux engrais chimiques pour une amélioration des rendements de maïs.

Mots clés: *Thitonia diversifolia*, sol ferrallitique, maïs, engrais inorganique, fertilité de sol

Tillage, cropping sequence, and nitrogen fertilization effects on dryland soil carbon sequestration and carbon dioxide emission

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Long-term conventional tillage and wheat-fallow systems have resulted in reduced dryland soil organic matter and crop yields in the northern Great Plains. Therefore, novel soil and crop management practices are needed to increase soil C storage, reduce greenhouse gas emission, and sustain crop yields. The study started in eastern Montana in 2005 compared no-tillage and continuous cropping with conventional tillage and crop-fallow systems to examine dryland soil C storage and CO₂ emission. Main treatments were continuous no-till malt barley (CNTB), no-till malt barley-pea (NTB-P), no-till malt barley-fallow (NTB-F), and conventional till malt barley-fallow (CTB-F), with split-plot treatment of four N fertilization rates (0, 40, 80, and 120 kg N ha⁻¹). Total soil C concentration at the 0- to 120-cm depth was not influenced by treatments and decreased from 14.5 g kg⁻¹ at 0 to 5 cm to 12.5 g kg⁻¹ at 10 to 30 cm but increased to 31.5 g kg⁻¹ at 30 to 120 cm because of presence of high inorganic C. As a result, total C content varied from 9.3 Mg ha⁻¹ at 5 to 10 cm to 143.6 Mg ha⁻¹ at 60 to 90 cm. The CO₂ flux increased from 13.0 kg CO₂-C ha⁻¹ d⁻¹ on 5 May to 142.7 kg CO₂-C ha⁻¹ d⁻¹ on 25 August during the crop growing season in 2006, as soil temperature and water content increased. On 25 August, CO₂ flux was greater with 80 than with 0 kg N ha⁻¹. Averaged across sampling dates, CO₂ flux was greater in CNTB with 80 kg N ha⁻¹ than in CNTB with 0 kg N ha⁻¹, in NTB-P with 80 kg N ha⁻¹, and in NTB-F with 0 kg N ha⁻¹. Similarly, CO₂ flux was greater with 80 than with 0 kg N ha⁻¹. Although management practices did not influence soil total C, continuous cropping with N fertilization increase CO₂ emission compared with crop-fallow without N.

Effect of different agricultural managements in the chemical fertility of cultivated Tepetates in the Transmexican volcanic belt

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Tepetates are defined as volcanic tuffs partially altered and indurated due to geopedological processes. These substrates occupy large extensions in Central Mexican Highlands and, in occasions, have been habilitated for agricultural use after a mechanical breaking up of the hardened material. Initially tepetates contain only traces of C, N and available P. It is therefore necessary to add fertilizers to improve soil chemical fertility. In the present work, changes in some chemical and physico-chemical soil properties of cultivated tepetates were studied in the short (2002-05) and medium (1986-02) term scales. Experimental plots situated in Tlalpan (State of Tlaxcala) were subjected to different agricultural managements: Traditional (Tt), improved (Ti) and organic (To). After 16 years of traditional cultivation the tepetates showed an increase in soil pH values and a decrease in exchangeable Mg^{2+} and K^+ which produced a decline in the base saturation percentage. These results show the fragility and low buffer capacity of these systems. In contrast, it was also observed a tendency of SOC, Nt, and available P (P-Olsen) accumulation with the years of cultivation, influenced by the agricultural management applied. In the short term (4 years), the To agricultural management, where organic fertilizers were incorporated, allowed for a decrease in the acidification tendency with cultivation, the recovery of initial exchangeable K^+ levels and an increase in the SOC, Nt and available P concentrations in the *Ap* horizon. The Tm management, where crop residues were incorporated and more chemical fertilizers were applied, was specially efficient in increasing the concentration of available P. The tepetates habilitated for agricultural use evolve, therefore, toward more fertile soils with increasing years of cultivation.

Forest rehabilitation techniques in China toward soil erosion control

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To tackle with the ecological and environmental problems along with the rapid economic development, six large scale national forest rehabilitation programs have been implementing known as Natural Forests Protection Program, Protection Forest Planting in the “Three North” and Lower Reaches of Changjiang River, Agricultural Land Conversion to Forest and Grass, Desertification Combating in the Vicinity Area of Beijing, Wildlife Protection and Nature Reserve Program, and Commercial Forest Bases Development in China. Techniques for forest rehabilitation across the country are of critical importance to achieve soil erosion control objective of forest establishment. We summarized the forest rehabilitation techniques developed in China for soil and water conservation during the past two decades in different geographical regions of the country. We concluded that the techniques developed in China could be identified as: 1) forest landscape rehabilitation planning for soil and water conservation, 2) structure design and regulating at stand and small watershed scales, 3) sustainable and high yield management techniques of agro-forestry system, 4) tree planting and restoration methods on bad sites, 5) anti-drought species selection, breeding, and propagation, 6) low function protection forest improvement and restoration, 7) forest disease, insect, and forest fire control, and 8) large scale forest program monitoring, evaluation, and information management. Future recommendations for integrating all those technical components as a whole for effective forest rehabilitation towards soil and water conservation were made at the last part of the paper.

Keywords: Forest Rehabilitation Techniques, Soil and Water Conservation; Recommendations; China.

Aerobic method of rice production: A promising cropping system for soil and water conservation

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The availability of freshwater for agriculture is declining in many parts of India, thus affecting lowland rice production. Water-saving management option in irrigated lowland rice systems is to reduce the amount of irrigation water per rice cropping season. Although farmers are traditionally growing rice by flooding the fields from the day of transplanting till harvesting, which results in severe deterioration of soil health, hence water-saving techniques are receiving more and more attention. Aerobic rice is a new way of cultivating rice that requires less water than lowland rice. It entails the growing of rice in aerobic soil, with the use of external inputs such as supplementary irrigation and fertilizers, and aiming at high yields. Case studies showed yields to vary from 4.5 to 6.5 t per ha, which is about double that of traditional upland varieties and about 10–20% lower than that of lowland varieties grown under flooded conditions. However, the water use was about 60% less than that of lowland rice, total water productivity 1.6 to 1.9 times higher, and net returns to water use 2 times higher. Aerobic rice requires less labor than lowland rice and can be highly mechanized. Farmer's participatory trials and experiments over seasons have identified genotypes that can yield on an average of 4.0 to 4.5 tons/ha and farmers can afford to grow rice like any other cereal. This gives options to farmers to grow rice with limited water availability. This technology, though known to some farmers and many farmers has not adopted aerobic method of rice production when they have water scarcity. There is a need to apply **farmer's participatory methods** to refine and validate aerobic method of rice production so as to make the farmers aware, popularize and also disseminate the seeds by adopting proper extension methodologies.

Removal of Pb, Zn and Cu ions by zeolite/soil models treated with urban wastewater

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Urban wastewater may contain heavy metals such as Cr, Cu, Pb, Zn, Cd, Ni, etc. derived from human activity. When the wastewater is directly discharged into natural waters (streams, rivers, lakes, etc.), it represents a considerable risk for aquatic ecosystems. In addition, this discharge into the sewage system may damage biological treatment causing economic loss. Furthermore, the presence of toxic heavy metals in the natural water may be responsible for several environmental and human problems. For this reason, in recent years, the removal of heavy metal ions from urban, industrial and mining wastewater has been widely investigated.

One of the most common methods by which to reduce heavy metal concentration from wastewater, is based on the different ion exchange capacity observed in minerals with absorbent properties. Natural zeolite are non-toxic, ecologically advantageous and affordable, due to their structure, ion exchange, catalytic and absorption properties.

This research focused on the removal performance of Pb, Zn and Cu ions by the use of zeolite/soil models treated with urban wastewater. Two different types of zeolite (clinoptilolite and yellow Neapolitan tuff) and soil (sandy soil and clay soil) in different percentages (0%, 25%, 50%, 100%) were used. The models were treated with two different kinds of urban wastewater: urban wastewater following sewage treatment system and urban wastewater artificially polluted with standard reagent.

The study shows that the removal capacity of Pb, Zn and Cu ions by zeolite/soil models is not only due to the kind of zeolite but also to its percentage in the model.

Benefits of Integrated Soil Fertility and Water Management in semi-arid region

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Unreliable rainfall, inherent low soil fertility, and crust prone soils affect crop growth in Burkina Faso, resulting in low crop yields and recurrent food shortage. Increasing population pressure requires improved soil, water, and nutrient management. More efficient use of rainwater and soil nutrients is essential in this region. The synergistic effect of soil and water conservation (SWC) measures and nutrient inputs emerged as the best way to reduce runoff and soil loss and to improve nutrient use efficiency and crop yield in Burkina Faso. This can be best illustrated through work conducted at Saria agricultural station (INERA-Burkina Faso) on the combined use of runoff barriers (stone rows or grass strips) and organic or mineral nutrient sources. Compared with control plots, stone rows alone reduced runoff by 71% while the reduction was 60% with application of compost and 48% with urea application. On average, the reduction in runoff was 59% in plots with barriers alone, but reached 67% in plots with barriers + mineral N and 84% in plots with barriers + organic N, as compared with the control plots. Plots with no SWC measure lost huge amounts of soil (about 3 t ha⁻¹) and nutrients. The results of two years of experimentation showed that annual losses from eroded sediments and runoff reached 84 kg OC ha⁻¹, 16.5 kg N ha⁻¹, 2 kg P ha⁻¹, and 1.5 kg ha⁻¹ K in the control plots with no SWC measures. The total soil loss from plots with stone rows and grass strips were only 30% and 42% respectively of the losses from control plots. The application of compost led to the reduction of total soil loss by 52% in plots without barriers and 79% in plots with stone rows as compared to the losses in control plots. The application of urea in plots with and without soil conservation barriers also resulted in significant decreases in soil loss. Stone rows or grass strips without N input did not significantly increase sorghum yield. Application of compost or manure in combination with stone rows or grass strips increased sorghum grain yield by about 142% compared to a 65% increase due to mineral fertilizers. Yields increase did not cover annual costs of single SWC measures while application of single compost or urea was cost effective. The combination of SWC measures with application of compost resulted in financial gains ranging from 145,000 to 180,000 FCFA ha⁻¹yr⁻¹ while the conservation measures with urea yielded a gain of 70,000 FCFA ha⁻¹yr⁻¹ under adequate rainfall condition. Under adequate soil moisture condition, the application of compost was more efficient than the mineral N fertilizer as the farmer provided not only nutrients but also contributed to moisture conservation through improved soil structure. Results show the importance of combining SWC and nutrient management in increasing sorghum yields. Without nutrient inputs, SWC measures hardly affected sorghum yields, and without SWC, fertilizer inputs also had little effect. However, combining SWC and nutrient management caused an increase in sorghum yield.

Impact of improved soil and in-situ water conservation practices on productivity in rainfed foothill region of North-west India

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In India, the problem of soil erosion is quite serious as about 18.5 % of the total soil erosion occurs here and about 5334 million tonnes of soil is being lost annually. Soil erosion decreases crop productivity due to reduced infiltration and soil aeration and may also accompany progressive erosion. In Punjab, the foothill region covers about 10 % of the total area of state (4.7 Mha) where maize-wheat rotation is dominant, is seriously suffering from the problem of the soil erosion due to uneven topography, high soil erodibility, low fertility of the soil and high erosivity of the rains. Rains are highly erratic and are often of high intensity. Runoff ranges from 35 to 45 % of rainfall and soil loss is estimated to be 25 to 225 Mg ha⁻¹ year⁻¹. The major part of the tract is rainfed because of more annual evapo-transpiration compared to annual rainfall. The water table is deep to very deep and rainfall is the only scarce source of water in the area. The lack of irrigation facilities and large scale erosion put main limitations to the agricultural economy resulting in poor socio-economic status of the farmers in the area.

On farm studies showed that soil moisture storage increased to the tune of 2.25, 4.01 and 10.77 % at 60 days after sowing (DAS) with shallow tillage, deep tillage and ridge and furrow sowing treatment over the farmers' practice during maize. The application of mulch on the whole plot resulted in 48.4, 61 and 138 % higher soil moisture content at 40, 60 and 80 DAS respectively. Fully covered plots had 156 % higher dry matter yield of maize compared to unmulched plots. There was 10.6 % increase in maize grain yield in ridge and furrow sowing over farmers' practice. Mulch spread on the whole plot increased the grain and straw yield of maize by 58.6 and 35.0 % as compared to unmulched control.

Studies on the characteristics related to symbiotic nitrogen fixation of legumes and the Rhizobium resources in the arid area of the Northwestern China

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The Northwestern China is surrounded by high mountains. Rainfall in this region is rare, while evaporation is high, therefore the climate is dry. The temperatures show daily and monthly variations. It is a typical inland arid region. The nodulation and nitrogen fixation of major cultivated and wild legumes dispersed over 36 genera, 98 species have been studied in some regions of Gansu province and Ningxia Hui Autonomous Region in the Northwestern China. The result of investigation about legumes nodule indicated that the life habit of legumes was various and the nodules have many characters. Most of the legumes which always grow in hilly meadow, native grassland and forest marsh were annuals. The annual nodules were always round or long circle and pink, while the nodules of perennials legume arbor and frutex which distributed in sunny zone were generally long cylindric-shape, furcellate, white, brown or yellow. The nodules were generally inserted on branch roots, fibre, and few on taproots. 360 strains of root nodules bacterial have been isolated from about 400 samples. The most of isolated strains were tested infecting 22 model species that belong to 20 genera as host, 81.2% strains of tested rhizobia can nodule with host plants. Above 85% of those nodule samples were effective for nitrogen fixation. The result showed that the activities of nitrogen fixation in nodules of various species varied greatly and all of them were generally low. 46.6% of them were under 1 μ mol C₂H₄/g_{FW}h and more than 10 μ mol C₂H₄/g_{FW}h was 6.8%. The nitrogenase activity was closely related to the growth period of plants.

Keywords: Legumes; Rhizobium; Symbiotic Nitrogen Fixation; Resources

Species composition and classification of natural vegetation in the abandoned lands of the hilly-gullied region of North Shaanxi Province

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Loess Plateau, with serious soil and water loss, is the most fragile ecosystem in China. Vegetation restoration, as a kernel component of ecosystem, plays an important role in the controlling of soil and water loss. Natural vegetation restoration attracts more and more concern for its little price and higher ecological meanings. And the existent combinatorial structures, successional progress and direction, and significantly affecting factors of natural vegetation are very meaningful for choosing proper measures to accelerate vegetation restoration. Thus, based on the survey of 174 samples of natural vegetation in Yan'an, An'sai and Wuqi in the abandoned lands on the hilly-gullied Loess Plateau, the vegetation combinatorial structures, the main vegetation types, revolution progress and direction in different vegetation zones and aspects, and the interaction between plants and environmental factors are analyzed by using the methods of TWINSpan, CCA and PCCA. The main results are as follows:

1) 140 species were found from 174 sampled plots, which belong to 100 genera and 51 families; The proportions of growth forms are herbage groups > shrub group > arbor, life forms are hemicryptophyte > annual plants and phanerophyte > chamaerhyte > geocryptophyte, and water ecological types are xerophytic-mesophytic > mesophytic > xerophytic > strong-xerophytic and hygromorphic; There are 11 area-types and 6 subtypes of genera, the temperate genera are dominated, and the percent of species and genera belong to north temperate and old world temperate are 50.0% and 46.1% respectively; and there are 45.1% of genera and 54.5% of species belong to gramineae, compositae, leguminosae and rosaceae, and these four families are cosmopolitan. These indicate the vegetation in the area have the growth features of temperate plants.

2) The percents of species of which the frequency >25% in 174 samples and the coverage >25% in single samples are about 16% respectively, this shows that the species with higher frequency and higher coverage are not more. In these plants, only the species of *Lespedeza davurica*, *Heteropappus altaicus*, *Stipa bungeana*, *Artemisia scoparia*, *Artemisia gmelinii*, *Leymus scalinus*, *Artemisia giraldii*, *Bothriochloa ischaemun*, has higher frequency and coverage, act as dominate species and main company species, and constitute different vegetation communities. The species in the late successional stage, such as *Syringa pekinensis*, *Ostryopsis Decne*, *Hippophae rhamnoides*, *Rosa xanthina*, *Acer buergerianum* Miq, *Sophora viciifolia*, *Quercus liaotungensis*, *Potentilla acaulis*, *Artemisia frigida*, could has higher coverage, but the frequency is very low, so they are not the main vegetation types on the hilly-gullied Loess Plateau.

3) The evolution of vegetation in the three vegetation zones are similar in the early stages from annual or biennial herbage groups to perennial herbage groups, but the direction of late stages in the three zones are quite different. In forest zone (in Yan'an), the late communities could be *Rosa xanthina* and *Quercus liaotungensis* in the shady slopes, and *Sophora viciifolia* and *Biota orientalis* communities in the sunny slopes. In forest-grass zone (in An'sai), the community of *Rosa xanthina* and *Syringa pekinensis* could be found in the shady slopes, and the community of *Sophora viciifolia* in the sunny slopes. In grass zone (in Wu'qi), there are no significant differences between the sunny and shady slopes, the main communities are dominated by *Lespedeza davurica*, *Stipa bungeana*, *Artemisia gmelinii*, *Artemisia giraldii* respectively, and zonal species e.g. *Thymus mongolicus*, *Potentilla acaulis*, *Artemisia frigida* can be found.

4) The results of CCA and PCCA show that soil water content, soil organic matter, total N, total P, available P and K, soil urease, soil aggregation degree, soil bulk density, aspect, slope and years since abandonment were the most important factors significantly affecting the vegetation variation on the hilly-gullied Loess Plateau.

The above results indicate that it is not under the environment conditions for the restoration of shrub and arbor in a large scale on the hilly-gullied Loess Plateau nowadays. Therefore, the vegetation restoration in the abandoned land should obey the vegetation regionalization, site condition and ecological types of species. In the scientific research on the vegetation regeneration issues on the area, the investigation on the ecological vegetation distribution spectrum in different environments should be stressed, and the corresponding model of the ecological vegetation distribution spectrum and topographical environment can be the practical references for accelerating vegetation restoration.

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Keywords: Natural vegetation; Vegetation combinatorial structure; Vegetation classification; Vegetation ordination; Hilly-gullied Loess Plateau

Sensibilité à l'érosion des sols du bassin versant de l'oued Sbaihia et aménagements antiérosifs

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Le bassin versant de l'oued Sbaihia (354 ha), au nord du la Dorsale tunisienne, est caractérisé par un climat semi-aride. Des pluies rares et irrégulières, le plus souvent à caractère orageux, combinées à l'existence de formations argilo-marneuses sur de forts reliefs et au développement des cultures, provoquent une érosion sévère, de l'ordre de 11 m³/ha/an, malgré un reboisement sur 43% de sa superficie et des aménagement antiérosifs en banquettes sur 25% de cette même superficie. Sur ce bassin versant, nous avons développé une méthode de caractérisation et de réhabilitation des aménagements antiérosifs à partir de la réalisation d'une carte de sensibilité des sols à l'érosion et d'une analyse du dysfonctionnement des aménagements existant.

La carte de sensibilité des sols à l'érosion du bassin versant de Sbaihia a été établie en utilisant l'équation universelle des pertes en terre pour croiser, à l'aide d'un SIG, trois facteurs d'érosion: l'agressivité des pluies, l'érodibilité des sols, la pente et sa longueur. Cette carte permet ensuite d'estimer l'érosion des sols sans couverture végétale, en dehors de toute pratique antiérosive. Au dessous d'une sensibilité à l'érosion de 5 t/ha/an, il n'apparaît pas nécessaire de développer des pratiques antiérosives. Entre 5 et 10 t/ha/an, nous proposons le développement de pratiques culturales conservatrices par accroissement de la couverture végétale. Au dessus de 10 t/ha/an il apparaît nécessaire de développer des aménagements physiques sur les sols cultivés, à l'exception des sols argileux et des très fortes pentes, et le reboisement ou la mise en défens sur les sols non cultivés. Par ailleurs, en utilisant des orthoimages rectifiées et en réalisant des enquêtes de terrain pour localiser et caractériser le dysfonctionnement des banquettes, nous avons cherché à déterminer les principales causes de dysfonctionnement des aménagements antiérosifs afin d'élaborer une carte de réhabilitation de ces aménagements sur le bassin versant de Sbaihia.

Mots clés: sensibilité à l'érosion, aménagements et pratiques antiérosives, réhabilitation, Tunisie, zone semi-aride.

Comparison of litter characteristics between three plant species in Vard-Avard

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The aim of this research was investigation of relationship between litter quality and soil characteristics on carbon, nitrogen, potassium and phosphorous of three range species: *Artemisia sieberi*, *Aretimisia aucheri* and *Acantholimon spp.* After identification of the species site in Vard-Avard the end of growing season (2004 autumn) soil and litter in mentioned species were collected in this site. Sampling was conducted in the key area of each site based on randomized Systemic pattern. Number of determined plots was based on the characteristics of the studied sites. The results showed in *Acantholimon sp.* litter the characteristics of C, N and P rather than the other species. But in generally *Artemisia sieberi* litter quality was the best.

Keywords: Litter quality, Soil, Vard-Avard, *Artemisia sieberi*, *Aretimisia aucheri*, *Acantholimon spp.*

Heavy metals availability for plants in an mining area in North-Western Romania

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An important concern for human health is the uptake of contaminants by plants from soil and their consumption by humans. The concentrations of heavy metals (lead, copper, cadmium) in the soil and plant samples collected from a village near sedimentation ponds, north-western Romania have been determined by inductively coupled plasma atomic emission spectrometry after *aqua regia* digestion and water extraction for soil, and acid microwave digestion for plants. Plant uptake factors were calculated for home grown vegetables (tomatoes, carrots) in this area. Correlation analysis identified a strong relationship between metals concentrations in soil and vegetables. The results of this study revealed that the consumption of vegetables grown in the vicinity of industrial areas pose a significant health risk to humans.

A process-oriented, landscape-scale approach to soil and vegetation restoration in a degraded Sahelian agroecosystem

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A landscape characterized by lateritic plateaus bisected by valleys with deep sandy soil occurs throughout the Sahel. Grain crops grown in the valleys are intermingled with the shrublands of the plateaus. At the study site in Hamdellaye, Niger, heavy grazing and fuelwood harvest have fragmented the banded shrubland mosaic that is typical of the plateau vegetation cover in this region. The soil structure that enabled high infiltration rates under the shrub cover degraded to crusted soils with very low infiltration rates after the vegetation cover was removed. This degraded the hydrologic function of the plateau shrublands to the point of generating extensive runoff that resulted in severe downslope flooding and erosion which disrupted agronomic activity in the valleys. A restoration approach was adopted to reestablish the banded shrublands on the plateau and thereby reestablish hydrologic function of the agroecosystem landscape. A network of microcatchments was established in a pattern that reconnected the remaining fragments of native shrubland. These microcatchments harvested runoff, suspended nutrients, and sediment thereby creating an environment conducive to vegetation reestablishment. Planted seedlings of native shrubs grew very slowly but planted seedlings of *Acacia holosericea* (a hardy, rapid growing, nitrogen fixing, exotic species that had been introduced to Niger in the 1950's) was able to thrive within the microcatchments. Within three years, the *A. holosericea* had grown to 3 m height and created a favorable microenvironment promoting the autogenic succession of native herbaceous and shrub species. Hydrologic function of the plateau improved to the point of reducing flooding and erosion hazard downslope. Eleven years after the establishment of *A. holosericea*, most soil chemical characteristics represented by pH, total carbon, and exchangeable bases have recovered to similar levels as those found in native shrub bands. Microbial activity in the soil has recovered to the level of native shrub bands.

Responses of soil quality indicators to three crop rotation systems in paddy soils in Northern Iran

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Rice is the second main food consumed in Iran, with wheat being the main staple for most of the population and its consumption dates back more than 25 centuries. Iran's average area under rice cultivation is over 500,000 hectare and average output is 4 tons/hectare. The wet Caspian lowlands in the northern provinces of Gilan and Mazandaran are the primary growing areas, where heavy rainfall typically facilitates paddy cultivation in this sub-tropical, humid region. In paddy soils of Mazandaran province The most important crops including rice (*Oryza sativa*), bean (*Vicia faba*) and clover (*Trifolium repens*) defined three crop rotation systems as following: 1) Rice-Fallow (R-F) 2) Rice-Clover (R-C) and 3) Rice-Bean (R-B). In two later crop rotation systems clover and bean cultivated after rice harvesting. Although for a long time, the described crop rotation systems have been performed in the study region, but few studies have taken into account the rotation system of rice and legumes on soil quality indicators. Soil quality as a concern for sustainable global development was defined to conserve soil productivity and water, air and human health under sustainable land uses. Soil quality investigations are needed to provide information for management and regulatory decisions. Soil quality indicators usually are used to assess soil quality in an ecosystem. This study conducted to estimate effects of rice crop rotation with two species of legume on soil quality indicators in compared to rice-fallow rotation system in Amol area, Northern Iran. Three studied plots were located adjacently and managed over 10 years (since 1995 till 2005) similarly by a farmer. Surface soil samples from 0-30 cm depth were collected from forty randomly selected points in each three rotation systems using a hand auger in October 2006 after harvesting. A total of 120 samples were air-dried and passed through 2 mm sieve to remove stones, roots and large organic residues for chemical, biological and some physical measurements. The laboratory measurements included pH, EC, CaCO₃, total N, available P, available K, CEC, OM, MWD, microbial respiration, microbial Carbon biomass, and bulk density. Statistical analysis was done using SPSS. Statistical results revealed that frequency distribution of most data was normal. The lowest CV% was related to pH. Analysis of Variance (ANOVA) and comparison test showed that there were the significant differences in soil quality indicators between understudy crop rotation systems. Results of multivariable regression analysis revealed that soil respiration and microbial biomass carbon had high correlation coefficients with soil organic matter and MWD. Overall results indicated that the rice rotation with legumes such as bean and clover over a long time improved soil quality in compared to rice-fallow rotation.

Keywords: Soil Quality, Indicator, Rotation system, Rice, Bean, Amol, northern Iran.

Rehabilitation of two different soils in Central Spain using treated sewage sludges

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Anthropic activities and climatic conditions in Mediterranean countries generate environmental impacts that lead to create degraded sites with uncovered soils that must be rehabilitate to minimize the related erosion problems. The first step to restore these degraded ecosystems is to improve the soil characteristics in order to facilitate the colonization of native vegetation. The use of sewage sludges as amendment has been identified as an important issue in European Environmental policies. This practice constitutes a favourable sewage sludge recycling system, improving the establishment of vegetal cover, which plays an important role as starter in natural processes of ecological succession.

The aim of this paper is to evaluate the effect of sewage sludges application to improve the establishment of two different kinds of introduced vegetation, grasses and shrubs in two different soils. The field experiments were carried out with a randomized complete blocks design in two degraded soil with different physico-chemical properties, located in Central Spain. Two different treated sewage sludge (composted with pruning wastes and treated by thermal drying) were applied as soil amendment. One year after residues application a sowing of herbaceous species and a plantation of shrubs, adapted to the soil and the climate in each area, were realized. In both types of soils, the preliminary results have shown increases in organic matter and nutrients content, and some changes in the physical properties, due to the rapid mineralization of this type of residues in the soil. Moreover, an important development of the vegetal cover was observed in the amended plots in relation to the control soil.

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Keywords: rehabilitation, sewage sludges, degraded soils, native plants

Long-term effect of cropping systems, crop residue and organo-mineral fertilization on production and soil quality in the North-Eastern Romania

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The experiments were carried out at the Agricultural Research Station of Podu-Iloaiei, Iași County, on a 14% slope land, with Cambic Chernozem soil-type, which has a loam-clayey texture (420 g clay, 315 g loam and 265 g sand), a neuter to weakly acid reaction and a mean nutrient supply. Placing winter wheat in 3 and 4- year crop rotations with annual and perennial legumes has resulted in getting yield increases, in comparison with continuous cropping, of 34 – 39 % (832 – 963 kg/ha). Applying high fertilizer rates (N₁₄₀P₁₀₀) in maize has determined, in the last 10 years, an average yield increase of 93 % (3086 kg/ha), and the use of low mineral fertilizer rates (N₆₀P₄₀), together with 30 t/ha manure, resulted in getting an yield increase of 95% (3156 kg/ha). The combined use of mean rates of mineral fertilizers (N₇₀P₇₀), together with 40 t/ha manure or 6 t/ha crop residues from wheat and maize crops, has resulted in improving soil physical and chemical characteristics and getting yield increases in wheat of 2313-2214 kg/ha (136-130 %), on weakly eroded lands, and 2074-2001 kg/ha (178-172 %) on highly eroded lands, compared to the unfertilized control.

In comparison with 4-year crop rotation, in the wheat-maize, rotation with ameliorating plants (annual and perennial legumes and perennial grasses), the average humus content from soil has diminished from 3.18 to 2.84 %, and the content in mobile phosphorus decreased from 50 to 35.4 ppm. The mass of total carbon from Cambic Chernozem in the Moldavian Plain has registered significant increases at higher than N₁₄₀P₁₀₀ rates, in organo-mineral fertilization and in 4-year crop rotation, which included ameliorative plants of perennial grasses and legumes. In maize continuous cropping and wheat-maize rotation, very significant values of the carbon content were found only in the organo-mineral fertilization, in 4-year crop rotation + reserve field cultivated with perennial legumes and in N₁₄₀P₁₀₀ fertilization.

The 39 year use of 3 and 4- year crop rotations has determined the increase in the mass of total carbon and mobile phosphorus from soil by 10% (1.7 C g/kg) and, respectively, 31% (11.8 P-AL mg/kg), in comparison with maize continuous cropping.

The effects of polymers/polyelectrolyte utilization to decontamination and remediation of soils polluted with heavy metals

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In this study we follow the utilization effects of some polymers / polyelectrolyte (polyethylene glycol, copolymers of maleic anhydride and acid with vinyl acetate or isobutene) for decontamination and remediation of soils polluted with heavy metals (Pb, Cd). In generally, the polyelectrolyte, like other categories of polymers, contributed to the amelioration of soils properties by one or more from following effects: **(i)** increasing of structural elements aggregation degree of soils with degraded structure; **(ii)** prevention of earth crust formation in period between seed and plants transplant, in special in case of plants with low seeds, which are very vulnerable; **(iii)** increasing of resistance to hydric and eolian erosion of soils situated by slopes and those with raw texture (clay low than 12 %); **(iv)** permeability increasing of soils with deficit intern drainage, such as luvisols, vertisols, gleice and stagnogleice soils.

The obtained results have indicate that by utilization of organic polymers / polyelectrolyte as additives for “washing solutions” are eliminated most inconvenient of chemical and electro-kinetics methods for decontamination of soils polluted with heavy metals: **(i)** stabilization in reasonable limits of ionic exchange and buffering capacity of soil; **(ii)** minor perturbation of electrochemical regime from soil; **(iii)** significant reduction of mineral and organic substrates degradation from soil; **(iv)** diminishing of heavy metals amounts irreversible retained in soil, etc. On the other hand, even has not obtained spectacular increase of separation efficiency (in comparison with usual decontamination methods), has been remarked that in presence of polymers / polyelectrolyte the separation selectivity increase significantly.

Disturbed and degraded lands of Republic Kazakhstan

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The total area of Republic Kazakhstan is 272, 5 mln.ha. Agricultural lands make up 222, 5 mln.ha. They include 33, 7 mln.ha of arable lands, 187, 0 mln.ha of pastures and hay lands, 1, 8 mln.ha of perennial plants and useless lands.

According to land estimate, the total area of disturbed lands in the republic is 169, 7 th.ha. They are disturbed in the course of industrial objects and other enterprises construction, under the development of mineral deposits, processing of minerals and realization of prospecting works. 49, 3 th.ha of the area are exhausted and liable to recultivation.

The greater part of the disturbed lands is registered on the Ministry of power and mineral resources of Republic Kazakhstan. Vast territories are occupied with tailing dumps, quarries, industrial dumps. They are polluted with heavy metals, emitted from the concentration mills and plants. Erosion processes were revealed close to the mining and processing industries of the East Kazakhstan.

The exhausted dumps of Zyryanovsk and Tishinka deposits were recultivated for nature protection and sanitary-hygienic purposes. The rate and direction of soil formation processes are studied after 27 years of dumps recultivation, presenting unique experiments. The biological recultivation of the industrial dumps enables to solve some theoretical and practical problems of the disturbed lands rehabilitation.

According to the data, received by the Institute of Soil Science, about 60% of soil cover relates to a different degree degraded soils depending on the peculiarities of natural conditions and their economic use. The degradation in all the regions of Kazakhstan is caused by 3 basic factors: extensive development of agricultural industry; intensive development of mining industry; wide net work of former (period of the Soviet Union) military test sites.

The control of land degradation is of great importance for Kazakhstan. About 43% of population (6, 47 mln.) lives in rural regions and the majority of people depend on the incomes, directly or indirectly connected with the agrarian sector and land use.

According to the qualitative characteristics of lands (Agency of land resources in Republic Kazakhstan), washed-off soils are distributed on the area about 5, 0 mln.ha, arable lands make up 1, 0 mln. ha of them. The soils, subjected to wind erosion, occupy 25, 5 mln.ha, arable lands make up 594, 6 th.ha of them. A negative balance of humus and nutrition elements is observed in the majority of the regions in the republic. Annual loss of humus is estimated within 0, 6 -1, 2 t/ha on the average. The humus loss especially increases in the eroded lands. In these conditions, the level of soil fertility decreases by 30 % in weakly eroded soils, in moderately eroded soils – by 50% and in strongly eroded soils - by 70 %. The basic part of humus is used for yield formation; and its receipt with annual cereals is small; the humus balance in soil is broken. Together with it, the arable lands lose humus up to 57% due to erosion processes.

The effect of the conservation tillage on soil protection

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Arable land is not only the area of production, but also the habitat of many wild plant and animal species. In Hungary, 48,5 % of the land is under agricultural crop production and it is important to consider these areas also as habitats. On arable land intensive soil management can lead to severe soil erosion and loss of biodiversity. Conservation tillage is a sustainable farming practice; its main advantages are the protection against water and wind erosion, preservation of soil structure, retention of soil moisture, increase of soil organic matter and protection of soil life. This research is part of the SOWAP (SOil and WAtEr Protection) project¹, carried out in the Western Catchment of Lake Balaton (at Szentgyörgyvár and Dióskál) between 2003-2006. The main objective is to compare the impacts of conventional and conservation tillage on soil erosion and on ecosystem. Ploughing cultivation was applied on the conventionally tilled plots. On the conservation tilled plots a non-inversion shallow tillage was applied, where the residue cover was about 30% and the number of passes by combined machines was reduced. For the soil erosion survey 4 plots were installed at Szentgyörgyvár (2 conventionally tilled, 2 conservation tilled), each 50 x 24 m in size. The runoff and soil loss were measured by a dual-channel collecting system, which was own developing. With the help of this we can measure the smallest and the biggest amount of runoff. The size of the bigger channel was determined according to the 1% probability rainfall. For the terrestrial ecology survey and rill measurements 24 plots (12 conventionally tilled, 12 minimum tilled, each between 3-5 ha in size, in total 107 ha) were selected. The project demonstrated the conservation tillage had a beneficial result on soil erosion and nutrient-loss with respect to conventional tillage in all cultures. The runoff decreased by 62% in average and the soil loss was reduced by 96%. The organic carbon, nitrogen, phosphorous and potassium loss became 70-90% smaller, according to the 3 years measurements. In Hungary, the tolerable value of soil loss is determined to be 2 t/ha, while, it was only 0,09 t/ha in the conservation plots. The mentioned 62% decrease of the runoff water at the conservation plots implies that this amount of water infiltrated into the soil and helped the survival of plants in drought periods. The presence of this excess moisture was verified by gravimetric measurements, and about 2% more moisture was stored on average, in the upper 15-20 cm of the soil. As a result of climate change due to global warming, annual precipitation will probably decrease, but it will arrive in form of more and more intensive rainfalls. On sloping areas conservation tillage is able to retain major percentage of the precipitation, because of the drainage capacity of the earthworm channels and because of crop residues. Accordingly, the soil is able to provide moisture for the plants for longer time in a drought period and soil loss is reduced. On the whole, conservation tillage proved to be more favourable in every respect regarding soil erosion on luvisols and in winter wheat sunflower and maize crops.

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Hunting the weakest link: Increasing the adoption of sustainable technologies to enhance the effectiveness of agricultural development projects in South-East Asia

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Many agricultural development projects have been implemented in South-East Asia since the 1970s. Most projects tried to implement new/modified/alternative technologies to increase productivity and/or improve the sustainability of agricultural systems. However, relatively few projects have led to measurable long-term benefits, especially where conservation goals have been identified. In addition, low adoption rates after project completion is a recurrent problem, even when the developed technologies were effective. This study aimed at identifying the weaknesses of development projects and to suggest improvements for future projects. The study was conducted while evaluating an EU-funded agricultural research and development project (SHASEA Project) in China. The SHASEA Project was very successful in achieving its scientific goals. However, post-project monitoring indicates that adoption of some technologies may be low and many long-term potential benefits for improved sustainability may not be realized. Thus, the possible causes of poor adoption were investigated, including participatory evaluations of the farmers' perceptions of project outcomes.

The study revealed that some introduced technologies were inappropriate. Investment of resources could have been optimized if farmers had been more involved in project development. This would have also increased farmers' ownership of project outputs. Furthermore, farmers had small (0.1-0.3 ha) and fragmented (1-16 parcels) land holdings, so they had little interest in investing extra resources for relatively small increases in total income. Similarly, stewardship towards the land resources and investment of resources for longer term benefits were adversely affected by poor land tenure security.

Funding agencies are tending to fund shorter-duration projects, so projects are becoming progressively shorter (r (years v duration) -0.593 , $P < 0.001$, $n = 719$ projects). However, short projects are usually not as effective as longer term projects, as it is difficult to produce tangible outputs from agricultural and soil conservation projects within five years. Thus, emphasis should be given to longer term projects with clearly defined goals and outputs.

An assessment of the current environment policies and efficiency of existing legal and institutional mechanisms in controlling land and water degradation in Kerala

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Recent modifications in government policy and changes in social, economic and political scenarios accelerate the land and water degradation in Kerala, creating food and water crisis. Development of special economic zones as a result of globalisation and associated industrialisation destroys rich cultivable land and deteriorate water resources. Land reformation for hill tourism and gravel mining and farming in riverine environments makes perennial rivers seasonal and pull down the groundwater table. Surface and groundwater in the state is polluted far above safety limits by the untreated effluents from houses, industries and farms. Situation is worse in urban centres due to migration. Sand mining in the coastal zones salinates coastal aquifers. Destruction of paddy fields and wetlands affect the natural recycling and storage of water. Increasing seasonality and intensity of rainfall causes more soil erosion and create serious water shortage in dry season. Conservation of land and water resources is of utmost importance for the securities in food and water in the already food deficit state. Water crisis in this heavy rainfall area is due to improper protection, conservation and management measures. The state lacks an adequate policy for environment and an efficient mechanism for its implementation. Slow and corrupt bureaucratic system, lack of finance and vested political interests are hurdles in the protection of natural resources. A comprehensive study of the of land and water degradation, its socio-economic impacts, the state environment policy and efficiency of existing legal and institutional mechanism in policy implementation has been made in this paper. Guidelines for a suitable and updated policy for the environment, with special focus on soil and water, ways to effectively implement them and the adaptation strategies in a changing environment have been presented.

No-tillage systems in semi-arid Morocco: Achievements and prospects

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In semiarid Morocco, as well as in neighbouring Mediterranean countries, increasing concerns about soil and environment quality degradation have raised the need to review existing tillage management systems and develop new systems for seed-bed preparation. 25-year on-station research projects found that no-tillage system ameliorates simultaneously crop production and performance (i.e. yield and its components and water use efficiency as well as farm's productivity) and soil quality (i.e. carbon sequestration, aggregate formation, water and nitrogen conservation...). In addition, 10-year farming system research/development program contributed to a confirmation of agronomic research results. No-tillage system guaranteed a durable production for farmers' vis-à-vis climate variation, while conventional and traditional tillage depressed both yields and incomes. It is urgent as ever to promote the no-tillage systems while studying its financial sides and sociology as well as their relations to land suitability and soil's potentials to crop diversification when shifting to these systems. In other terms, no-tillage systems may intensify and diversify food production while protecting marginal lands and vulnerable farming systems. These relations and effects will be discussed in this paper.

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