

Abstract Proceedings of the 6th International Congress of European Society for Soil Conservation

Innovative Strategies and Policies for Soil Conservation



Thessaloniki, Greece 9-14 May 2011

Thessaloniki 2011

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Cover page picture: “Flower beds” by Van Gogh

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PREFACE

Dear Colleagues,

It is my great pleasure to welcome you to the 6th International Congress of the European Society for Soil Conservation "Innovative Strategies and Policies for Soil Conservation," in Thessaloniki. After the great success of the 5th ESSC International Congress held in Palermo in June 2007, scientists from over 50 countries have expressed their interest in participating in the 6th ESSC Congress.

The scientific programme was carefully chosen and many distinguished presenters have sent their contributions to present the most recent achievements and effective policies in mitigating the deterioration of natural resources. Highly competent scientists from four continents will present and give an overview of fundamental and applied aspects of soil conservation.

The Congress is open to educators, NGO's and policy-makers in order to be informed by experts in the field of application of a series of innovative measures for soil conservation.

I would like to express my sincere thanks to all members who helped to organise this great event. The 6th International Congress of the European Society for Soil Conservation is another challenge to all of us to obtain a clearer understanding of the relationships between land conservation and the impacts of policy. Many of us have tackled issues relating to conservation of natural resources and implementing various projects to assess, monitor and address land degradation at national and international levels.

In hosting this Conference, it is sure that presentations, discussions and interventions will generate innovative ideas to tackle 'Strategies and Policies for Soil Conservation' more efficiently and effectively. I hope all of you will both enjoy this event and the cultural and social life of Thessaloniki.

I would like to express my sincere thanks to all members and reviewers who helped to organise this great event.

The President of the Organizing Committee



Dr Theodore C. Karyotis

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6th International Congress Thessaloniki, Greece 9-14 May 2011

April 11, 2011

SCIENTIFIC PROGRAM - ORAL PRESENTATIONS

MONDAY, MAY 9, 2011

15:00 – 18:00 Arrival of participants and registration

16:00 - 18:00 ESSC Council meeting

17:00 – 18:00 Coffee- refreshments

18:00 - 20.00 Opening Ceremony and Welcome - Introduction to the 6th International Congress of the ESSC

- **President of the Organizing Committee (Dr Theodore Karyotis)**
- **Ministry of Rural Development and Foods**
- **Deputy Mayor of Thessaloniki**
- **National Agricultural Research Foundation**
- **President of the European Society for Soil Conservation (Dr Jose L. Rubio)**
- Em. Prof. N. Yassoglou, former president of the National Committee for Combating Desertification

20:00 – 22:00 Cocktail reception

TUESDAY, MAY 10, 2011

SESSION 1. Policies and thematic strategies for soil protection

Chairpersons: Kosmas C., Constantini E.

09:00-09:30 Keynote lecture, Prof. Kosmas C.
Indicators and Thematic Strategy for Soil Protection

09:30-09:45 S1-0013 Bazzoffi Paolo.

Cross compliance and GAEC standards for soil erosion control in Italy.

09:45-10:00 S1-0010 Blum Winfried E. H.

Strategies for soil protection – How to bridge between science and decision making?

10:00-10:15 S1-0017 Costantini Edoardo, Bucelli P., Fantappiè M., Guaitoli F., Kalliris P., Kyriakopoulos K., Matranga, M.G., Papadopoulos T., Pellegrini S., Vasilakis E., Vignozzi N.
SOIL PRO: a LIFE+ project implementing soil monitoring and protection together with regional stakeholders of Sicily and Peloponnese.

10:15-10:30 S1-0018 Costantini Edoardo, Fantappiè M., L'Abate G.

Estimating carbon credits variations supplied from agricultural and forest soils of Italy between 1979 and 2008.

10:30-10:45 S1-0019 Dal Ferro Nicola, P. Delmas, C. Duwig, A. Berti, F. Morari.

Characterization of pore network morphology in differently fertilized soils using X-ray computed tomography.

10:45-11:00 S1-0021 Ghazavi Reza, Abbasali Vali.

Soil degradation and desertification in an arid environment affected by a salt diaper.

11:00-11:30 Coffee Break

Chairpersons: Blum W., Pateras D.

11:30-11:45 S1-0022 Ghazavi Reza, Abbasali Vali.

Impact of planted Atriplex on soil properties and soil compaction.

11:45-12:00 S1-0024 Gundogan Recep, Hasan Merdun, Nigel Hall, Mustafa Sarıkoc.

Effects of alley cropping system on soil losses and runoff on sloping pistachio orchards.

12:00-12:15 S1-0028 Manuwa Seth, Romiluyi A.V.

Evaluation of hydraulic conductivity and cone penetration resistance of selected arable soils in Akure, southwestern Nigeria.

12:15-12:30 S1-0030 Mueller Lothar, Uwe Schindler, Bruce C. Ball, Elena Smolentseva, Volker Hennings, Katharina Helming.

Comparison of approaches to assessing agricultural soil quality.

12:30-12:45 S1-0051 Napoli R., M.T. Dell' Abate, C. Galeffi, U. Neri and P. Bazzoffi.

Performance effectiveness of the CAP standard "Maintenance of soil structure with tillage conditions at appropriate soil moisture" and geographic suitability for the Italian soils.

12:45-13:00 S1-0053 Papadopoulos F., P.Tziachris, A.Papadopoulos, I.Metaxa

Specific fertilizer recommendation with the use of new technologies.

13:00-14:30 Lunch break

Chairpersons: Coutinho M., Strauss P.

14:30-14:45 S1-O043 Pérès G., A. Bispo, C. Grand, L. Galsomies, I. Gattin, M. Hedde, P. d'Hugues, M. LeGuedard, N. Ruiz, A. Alalaphilippe, T. Beguiristain, F. Douay, O. Faure, A. Hitmi , S. Houot , J.F. Vian, F. Dubs, L. Rougé, S. Taibi, D. Cluzeau.
Development of bio-indicators for soil monitoring and risk assessment at national scale.

14:45-15:00 S1-O032 Saygin Selen Deviren, Wim M. Cornelis, Gunay Erpul, Donald Gabriels.

Comparison of different wet sieving approaches for a loamy sand soil treated with different compost applications in Belgium.

15:00-15:15 S1-O045 Strauss Peter, Rosemarie Hoesl.

Linear flow paths influence the effectiveness of retention measures in agri-environmental programmes.

15:15-15:30 S1-O033 Szafranek Antoni, Maciejewska Alina, Bielska Anna.

Land use and soil protection in Poland.

15:30-15:45 S1-O034 Terzoudi C.B., D. Pateras, T.A. Gemtos.

Testing the USLE under different tillage and cultivation practices.

15:45-16:00 S1-O039 Wauters Erwin.

The cognitive foundations of farmers' attitudes towards conservation practices as a basis for policy and extension.

16:00-16:30 Coffee Break

SESSION 2. Forest fires impacts on natural resources and cultural heritage

Chairpersons: Rubio J. L., Radoglou K.

16:30-17:00 Keynote lecture. Dr Rubio J L.
Impact of forest fires on soil.

17:00-17:15 S2-O010 Antunes C. M. Coutinho.

Modelling water balance and erosion in agroforestry. the water retention and throughfall in tree and bush canopies.

17:15-17:30 S2-O011 Avramidou E. K. Mantzanas and V.P. Papanastasis.

Impact of wildfires on aboveground biomass in shrublands of Lagadas county in northern Greece.

17:30-17:45 S2-O026 Kostadinov S., R. Kadovic, S. Belanovic, N. Markovic.

Runoff and sediment transport after forest fire: Case study on the watershed of water reservoir "Zavoj" in Eastern Serbia.

17:45-18:00 S2-O016 Novotný I., I. Pírková, J. Tylová, H. Kristenová, V. Váňová, V. Papaj.

Soil conservation in the Czech Republic and implementation of GAEC 2 requirements.

18:00-18:15 S2-O025 Qadamov Aslam.

Wind erosion effect on soil properties in "protected" and "not protected" areas in GBAO region, Tajikistan.

18:15-18:30 S2-O019 Ramezanpour Hassan, Mehdi Norouzi, Babak Rabiei, Hossein Asadi.

Fire Effects on soil physical and chemical properties in Guilan province Iran.

**18:30-18:45 S2-O013 Torri D. A. Blonda, F. Chaabane, Dimitropoulos, F. Tsalakanidou
N. Grammalidis.**

Fire detection, fuel model estimation and fire propagation estimation/visualization for the protection of Cultural Heritage.

**18:45-19:00 S2-O024 Milutin Stefanović, Zoran Gavrilović, Mleta Milojević, Irina
Milovanović.** Identification and proclamation of the erosion areas on state and regional level.

09:00-19:00 Poster Session (topics 1 and 2)

WEDNESDAY, MAY 11, 2011

SESSION 3. Sustainable management of wetlands and drylands

Chairpersons: Gabriels D., Cornelis W.

0:90-09:30. Keynote Lecture D. Gabriels, J. Vermang, K. Verbist, W. Cornelis, B. Vander Linden
Vegetative buffer strips and 'erosion dams' as sediment traps.

09:30-09:45 S3-0010 Bautista Susana, Claudio Zucca, Barron Orr, Ramon Vallejo and "the Practice partnership".

The PRACTICE project: towards an integrated assessment of prevention and restoration actions to combat desertification.

09:45-10:00 S3-0012 Coutinho Miguel, C. Antunes.

An optimized methodology to estimate the UsleRusle R parameter in the Portuguese Madeira island and in the Southern Mediterranean.

10:00-10:15 S3-0033 Gertsis A., E. Hatzigiannakis, A. Ilias and S. Stefanou.

Using SOIL CARBON MANAGER- a soil organic carbon simulation model- to evaluate various soil-crop-climate scenarios for the long-term change of organic carbon in the Anthemounta basin of Greece.

10:15-10:30 S3-0017 Matsi Theodora, A. Lithourgidis, G. Strouthopoulos.

Effect of eleven years liquid cattle manure application on soil fertility.

10:30-10:45 S3-0028 Nair Shadananan.

Socio economic aspects of land degradation in the drier zones of India.

10:45-11:00 S3-0088 Yechezkel Mualem, Moty Cohen.

An alternative simplified solution for a two dimensional flow in subsurface water harvesting system.

11:00-11:30 Coffee Break

Chairpersons: Matsi Th., Arampatzis G.

11:30-11:45 S3-0021 Pulatov Alim.

Conservation agriculture experiences on irrigated areas in Uzbekistan.

11:45-12:00 S3-0023 Schönbrodt Sarah, Thorsten Behrens, Karsten Schmidt, Thomas Scholten.

Modeling the erosion risk potential of bench terraces.

12:00-12:15 S3-0031 Zlatic M. T. Andrijanic, Z. Stefanovic, M. Todosijevic

Ecologicalal and economic effects and assessment of risk and uncertainty of sustainable soil management

12:15-12:30 S3-0020 Niacsu Lilian.

Optimum land use pattern in Pereschiv catchment from Eastern Romania.

12:30-14:00 Lunch Break

SESSION 4. Soil and water management under global climatic change scenarios

Chairpersons: Runólfsson S., Ildefons Pla Sentis

14:00-14:30 Keynote Lecture S. Runólfsson, A. M. Ágústsdóttir, T. Petursdóttir

Icelandic Soil Conservation in the European Context:Laws, policies and approaches

14:30-14:45 S4-O012 Akca Erhan, Kume Takashi, Takanori Nagano, Claudio Zucca, Salvatore Madrau, Selim Kapur.

Devastating effect of water use in an arid agricultural land: Karapinar case, Central Anatolia.

14:45-15:00 S4-O035 Bilas G., G. Galanis, G. Zalidis, A. Panoras, N. Misopolinos and V. Takavakoglou.

Assessing the impacts of wastewater reuse for irrigation using soil quality index.

15:00-15:15 S4-O015 Gundogan Recep, A. Erol, A.R. Demirkiran, M. Sarikoc.

The potential of forage production in alley cropping and pro cropping in Turkey and its role on erosion control.

15:15-15:30 S4-O027 Ildefonso Pla Sentís, Nacci, F. Fonseca, X. Abreu and H. Dalurzo.

Evaluation of soil and water conservation practices in vineyards of Catalonia (NE Spain).

15:30-15:45 S4-O017 Kairis Orestis, Ch. Karavitis, Aik. Kounalaki, V. Fasouli, C. Kosmas.

The effect of land management practices on soil erosion and land desertification in an olive grove.

15:45-16:00 S4-O021 Miksikova Katerina, Vrána K., Dostál T., Strouhal L. Rosendorf P., Fiala D.

Release of sediment and phosphorus from fish ponds during their draining as important potential pollution source.

16:00-16:15 S4-O023 Moussadek Rachid, Mrabet Rachid, Ann Verdoort, Dahan Rachid, Eric Van Ranst

Effect of conservation agriculture on soil CO2 flux in semi-arid Morocco.

16:15-16:30 S4-O026 Okello J.Belle, Atambo, F.K

Soil water assessment tool (SWAT) model and application.

16:30-17:00 Coffee Break

Chairpersons: Panoras A. Papadopoulos A.

17:00-17:15 S4-O045 Øygarden L., H. Grønsten, J. Deelstra.

Climate-change- need of measures to control erosion in winter wheat areas.

17:15-17:30 S4-O036 Panagopoulos A., C. Domakinis, G. Arampatzis, A. Charoulis, I. Vrouhakis, Panoras.

Seasonal variations of aquifer intrinsic vulnerability in an intensively cultivated vulnerable basin of Greece.

17:30-17:45 S4-O037 Panagopoulos A., K. Pipera, G. Arampatzis, E. Avramidou, Th. Karyotis, S. Stathaki, A. Panoras.

Influence of lithology on groundwater quality and projected impact due to climate change. The case of wider Kopaida basin-central Greece.

17:45-18:00 S4-O040 Panagopoulos A., G. Arampatzis, I. Vrouhakis, A. Panoras.

Leachate monitoring network design in the vadose zone at Viotikos Kifissos basin, Central Greece.

18:00-18:15 S4-O038 Reintam E., K. Krebsstein, K. Trükmann, J. Kuht, J. Leeduks, H. Raave, A. Astover, A. Selge.

Effect of wastewater sediments on some soil properties under energy grasses.

18:15-18:30 S4-O028 Rusu Teodor, Weindorf David, Haggard Beatrix, Cacovean Horea, Moraru Paula, Mara Sopterean, Pop Adrian and Lavinia Pop.

6th International Congress of ESSC

Spatial soil temperature and moisture monitoring.

18:30-18:45 S4-O031 Suuster Elsa, C. Ritz, H. Roostalu, A. Astover .
Evaluation of different statistical approaches for predicting soil organic carbon stock.

18:45:19:00 S4-O043 Tzimopoulos C., A. Tsiaousis, C. Evangelides, M. Sakellariou-Makrantonaki, G. Arampatzis.
Fuzzy analysis of infiltration problem using Parlange model.

19:00-19:15 S4-O039 Verbist Koen M. J., Mauricio Lemus Vera, Guillermo Navarro Vidal, Wim M. Cornelis, Donald Gabriels.
Water augmentation techniques for plantations on sloped drylands an experimental evaluation.

09:00-19:15 Poster Session (topics 3 and 4)

THURSDAY, MAY 12, 2011

SESSION 5. Conservation and Management of Soil Biodiversity

Chairpersons: Panagos P., Gündoğan R.

09:30-10:00 Keynote Lecture P. Panagos, S. Jeffery, I. Diafas, C. Gardi, L. Montanarella
Value of Soil Biodiversity: European policies and raising awareness

10:00-10:15 S5-0021 Babatsikou E., V. Takavakoglou, E. Papatheodorou, M. Argyropoulou, G. Bilas, N. Misopolinos, and G. Zalidis.
Developing a Biological Index of Soil Quality as an operational tool for the assessment of agricultural land management sustainability.

10:15-10:30 S5-0012 Bireescu Geanina, Jitareanu G, Ailincai C, Raus L., Sellitto M.V., Bireescu L.
Pedobiological matrix of the impact of soil tillage in some agroecosystems from NE Romania.

10:30-10:45 S5-0014 Camilli B., M. T. Dell'Abate, S. Mocali, C. Dazzi.
Organic matter and microbial community in anthropogenic soils of arid environment.

10:45-11:00 S5-0025 Kertész Ádám, Balázs Madarász, Szabolcs Benke.
Conservation agriculture as a tool for improving biodiversity.

11:00-11:30 Coffee Break

Chairpersons: Marcinkonis Saulius, Tsiafouli Maria

11:30-11:45 S5-0018 Marchione Mario Sergio, Ana Maria Conte e Castro, Eduardo Meneghel Rando, Osvaldo Sato, Clovis José Alcides Gomes and Kléber Henrique Dos Santos.
Physical attributes of soil tillage with different sources and rates of organic matter.

11:45-12:00 S5-0019 Marcinkonis Saulius, Kestutis Armolaitis.
Effects of revegetation on carbon dynamics in former arable lands in Lithuania.

12:00-12:15 S5-0022 Tsiafouli Maria, George Boutsis, Mairy Karmezi, Stefanos Sgardelis.
Agricultural land use intensification and soil nematode communities.

12:15-12:30 S5-0020 Vasenev Viacheslav, Oleg Makarov.
Approach for functional-ecological assessment of urban constructed soils.

12:30-12:45 S1-0050 Vermang J., M. De Groote, W.M. Cornelis, V. Cnudde, D. Gabriels.
Exploring the potentials of non-inversion tillage to maintain soil quality and reduce sealing and compaction.

12:45-14:00 Lunch Break

9:30 - 14:00 Poster Session (topic 5)

Free afternoon

Social events

17:45 - 19:30 Mini cruise (subject to change due to weather conditions for Friday 13/5)

21:00 - 24.00 Social Dinner (live music band, traditional Greek dancing performance)

FRIDAY, MAY 13, 2011

SESSION 6. Restoration and remediation of degraded lands - Education in soil conservation and public awareness

Chairpersons: Missopolinos N., Fullen M.

09:00-09:30 Keynote Lecture, Missopolinos N.
Challenges and opportunities in the degradation and remediation of Mediterranean soils: Focus on climate change and salt affected areas.

09:30-09:45 S6-0024 Haslgruebler Petra, Bernhard Krautzer, Wilhelm Graiss.
Establishment of semi natural grassland by using site specific plant and seed material.

09:45-10:00 S6-0020 Krautzer Bernhard, Wilhelm Graiss, Christian Partl
High altitude restoration in the Alps. The current state of the art.

10:00-10:15 S6-0016 Ghazavi Reza, Abbasali Vali.
Soil physicochemical properties and vegetation cover in an arid environment revegetated with Atriplex lentiformis.

10:15-10:30 S6-0011 Antoniadis V., K. Damalidis, and A. Dimirkou.
Effect of zeolite application to acidic and limed soil in Cu and Zn availability to ryegrass.

10:30-10:45 S6-0019 Konečná Jana, J. Podhrázská.
Soil and water conservation in the frame of the land consolidation process in Hubenov cadastre.

10:45-11:00 S6-0014 Fullen Michael, Asha Kelay and Craig D. Williams.
Remediation of oil spills using zeolites.

11:00-11:30 Coffee Break

Chairpersons: Zlatic M., Theocharopoulos S.

11:30-11:45 S6-0023 Mantzanas K., P. Platis, I. Ispikoudis, A. Iovi and V.P. Papanastasis.
Hydro-seeding with herbaceous species for road-cut slope stabilization in Egnatia high way.

11:45-12:00 S6-0029 Sole-Benet A., I. Miralles-Mellado, S. Contreras, R. Lázaro.
Irrigation, organic amendments and mulches as success factors in soil restoration in semiarid limestone quarries.

12:00-12:15 S6-0026 Theocharopoulos S. P. J.L. Rubio, K. Karatzas, A. Demedriadesç, N. Arbanitidis E. Vavoulidou, A. Charoulis, V. Epitropou, A. Bassoukos A. Papadopoulos, A. Oikonomou, P. Tziachris, P. Michopoulos, V. Kabbadias, T. Koliopoulos, D. Arapakis, J. A. Pascual, V. Andreu K. Feiden, F. Klude.
GS SOIL: Development of a GEOPORTAL to offer access to multilingual soil data to the European citizens.

12:15-12:30 S6-0028 Zlatic M., V. Milcanovic, N. Momirovic, S. Tosic, K. Lazarevic, I. Gvozdenovic, D. Ilic, M. Lekic, M. Markovic, D. Popadic.
Learning by doing: Student's Forum of World Association of Soil and Water Conservation.

12:30-14:00 Lunch break

14:00-15:00 Closing remarks (D. Gabriels, J. L. Rubio)

09:00 – 15:00 Poster Session (topic 6)

6th International Congress of ESSC

15:00 – 18:00 General Assembly of ESSC – Elections

17:45 - 19:30 Mini cruise (in case it is shifted due to weather conditions from Thursday 12/5)

SATURDAY, MAY 14, 2011

One day post-Congress excursion (Ancient Vergina-Stenimachos-Agios Nikolaos-Naoussa)

8:30 Departure from Thessaloniki

20:00 Arrival to Thessaloniki

SCIENTIFIC PROGRAM - POSTER PRESENTATIONS

TUESDAY, MAY 10, 2011

SESSION 1. Policies and thematic strategies for soil protection

1. **(S1.1) S1-P054 Bibalani Ghassem Habibi.** Comparison two plant seedling (Orange and Prunus) root development in first tree years for using in soil protection.
2. **(S1.2) S1-P014 Bueno Celia Regina Paes, C. L. Arraes, D. P. Miqueloni.** Land loss estimate and erosion prediction on soil under sugarcane management.
3. **(S1.3) S1-P015 Calciou Irina Cătălin Simota, Olga Vizitiu, Ioana Pănoiu.** Modelling of soil water retention properties for soil physical quality assessment.
4. **(S1.4) S1-P016 Capra G. F. S. Vacca, E. Cabula, E. Grilli, A. Buondonno.** Pedogenic Background Concentration (PBC) of Potentially Toxic Elements (PTE) in an industrial area. A proposal for a new pedological-oriented approach in the evaluation of Ambient Background Concentration (ABC).
5. **(S1.5) S1-P048 Chamizo Sonia, Yolanda Canton, Roberto Lazaro and Francisco Domingo.** impacts of cryptogamic crust removal on soil water regimes.
6. **(S1.6) S1-P020 Dostál T., Krásá J., Devátý J.** Application of GIS based tools for soil erosion control measures in large areas.
7. **(S1.7) S1-P055 Dumbrovský Miroslav, VEronica Hošková.** The approach to measurement of rill erosion surface.
8. **(S1.8) S1-P023 Giannoulis K.D., Molla A., Dimirkou A., Danalatos N.** The effect of Zeolite Bentonite mix to soil quality improvement of different soil types.
9. **(S1.9) S1-P012 Grigore Adriana, Iulia Anton, Ana Maria Dondocioiu, Romulus Mocanu, Daniela Dana, Daniela Mihalache, Ioana Oprica.** Quantifying the impact of nutrient losses from agriculture in the experimental point Preajba – Gorj.
10. **(S1.10) S1-P056 Hong Ma, Ju Hongbo.** The Progress and Achievement for the study on the significant Program for Conversion of Cropland to Forest in China.
11. **(S1.11) S1-P041 Hukić E., I. Čengić.** Cultivation Induced Decrease In The Organic Matter Content Of Forest Nurseries As The Contributor To The Global Warming Process.
12. **(S1.12) S1-P053 Jones Nadia.** The agrienvironmental policy in Portugal and its effects on the adoption of good soil management practices.
13. **(S1.13) S1-P026 Karlsons Andis, A. Osvalde, G. Levinsh.** Different nutrient supply effect on growth, proline and K, Ca, Na accumulation in *Triglochin maritimum* and *Triglochin palustre*.
14. **(S1.14) S1-P027 Kwiatkowska-Malina J.** The comparison of structure of humic acids from soil amended with diverse sources of organic matter using the EPR technique.
15. **(S1.15) S1-P046 Mansonia Pulido-Moncada, Deyanira Lobo, Donald Gabrels, Juan Carlos Rey, Steven Sleute, Stefaan De Neve.** Aggregate stability of Venezuelan soils sensitive to surface sealing and crusting.
16. **(S1.16) S1-P047 Mansonia Pulido-Moncada, Deyanira Lobo L., Rosana Figueroa, Donald Gabrels.** Soil sealing indicator for agricultural soils in Venezuela.

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EVENT LOCATIONS

Registration:	FOYER, GRAND HOTEL PALACE
PC Desk:	FOYER, GRAND HOTEL PALACE
ESSC Council meeting:	KALLIPATEIRA, GRAND HOTEL PALACE
Coffee breaks:	OLYMPIA HALL C, GRAND HOTEL PALACE
Light lunches:	OLYMPIA HALL C, GRAND HOTEL PALACE
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Congress Thematic Session

1. Policies and thematic strategies for soil protection

ORAL PRESENTATIONS

Indicators and Thematic Strategy for Soil Protection

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Indicators are becoming increasingly important tools for assessing threats to the soils caused by soil erosion, soil organic matter decline, contamination, soil sealing, salinisation and loss of biodiversity. The European Environmental Agency has considered that an indicator is a measure, generally quantitative, that can be used to illustrate and communicate complex phenomena simply, including trends and progress over time. Furthermore, the implementation of Ten Year Strategy Plan for Combating Desertification formulated in COP8 has adopted specific indicators for assessing the performance and the impacts for the implementation of the Convention outcomes. Practically, the implementation of an indicator system for soil monitoring necessitates a limited number of easily available and quantitatively measurable indicators in order to avoid ineffectiveness of using the system by various stakeholders.

Several European research projects have been carried out for defining key indicators for assessing the effectiveness of the various land management practices and technologies for monitoring soils and combating land degradation such as: Medaction, Envasso, Desertlinks, Medalus, Desire, Medrap, etc. Envasso has proposed a wide set of measurable criteria and indicators for monitoring soil in Europe. It has proposed no more than three indicators for each of the threats considered as the most important for soil degradation in Europe. The primary criteria of indicator selection included significance to the issue, existence of necessary measurement procedures, policy relevance, and geographical coverage. The outcome was a set of 27 issues linked at least with three top indicators for the main threats of soil degradation in Europe. Desertlinks through the Desertification Indicator System for Mediterranean Europe has made a great effort to collate and describe a list of about 140 desertification indicators drawn from various sources and related to the main threats of land degradation. Medalus project has used six indicators to define soil quality with respect to land degradation and desertification and 15 indicators for identifying sensitivity to land desertification. DESIRE has identified 72 candidate indicators for the degradation processes of soil erosion, soil salinization, water stress, overgrazing, forest fires, and soil sealing, described in 1672 field sites located along the Mediterranean Europe, Eastern Europe, Africa, Asia, and Latin America. A number of minimum indicators ranging from 8 to 16 have been defined for assessing the previous threats to the soils by this project.

The proposed number of indicators by the various projects, even though are directly or indirectly related to land degradation, is too large in many cases to be practically applicable. Some of them, easily evaluated, could substitute a number of others. Some of the indicators could be estimated from others by using pedotransfer functions. Furthermore, when crucial indicators, such as soil depth, water scarcity, reach or exceed critical thresholds values, land is leading to severe degradation, regardless of other favorable state and influx indicators.

The effects of the influxes indicators (such as rainfall, fires, land management) on the state indicators (soil depth, slope gradient, rock fragments) are usually complex and interdependent. They may also have opposite effects depending on the state indicators (e.g. land abandonment, land terracing). This makes the accurate scaling and the weighing of the indicators difficult. Scaling the indicators on experience, observations, and educated guessing could be useful tool for some practical applications and for comparative evaluations. They should, however, be checked against real situations in the field.

Based on the existing research results, even though more research work is needed, indicators may be widely, even globally, used for assessing the various soil degradation processes or causes or threats at field level. Processes of soil degradation can not be easily simplified. A reasonable number of indicators is necessary to assess the impact of the various threats on soils

and more generally on ecosystems. Indicators must be considered as valuable tools for understanding and managing complex systems, especially at stakeholder or decision making level

Cross compliance and GAEC standards for soil erosion control in Italy

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Keywords: soil erosion, GAEC, cross compliance

The system of cross compliance introduced by Regulation 1782/2003, forming part of the 2003 CAP reform, has been in operation in the EU-15 since 2005. Member States were required to define SMRs (Statutory management requirements) and GAEC (good agricultural and environmental conditions) standards that farmers must respect in order not to receive a financial sanction in the form of a reduction to their Single Payment. Minimum requirements, at national or at regional level, have been defined on the basis of 5 environmental issues and 15 standards (8 compulsory and 7 optional) described in Annex III of Council Regulation (EC) No 73/2009 and they should take into account the specific characteristics of the areas concerned, including soil and climatic condition, existing farming systems, land use, crop rotation, farming practices and farm structures. The "Report on cross compliance implementation in Italy" was delivered in October 2010. The report prepared by the National Rural Network (NRN) 2007/2013 – ISMEA, analyses the relevant regulatory framework, describing the development process of cross compliance policy standards. The analysis of GAECs impact on the agricultural and environmental system required by the Ministry of Agricultural, Food and Forestry Policies (MiPAAF) has been carried out in cooperation with the NRN-ISMEA evaluating the standards effectiveness through the preliminary experimental results of case studies. Such results are provided for by the Agricultural Research Council (CRA) through the findings of the EFFICOND project or data collected from other national researches, carried out in the past, in which the experimental design included the evaluation of the environmental effect of treatments similar to those of the GAECs standards (Ex. old experiments on the effect of set aside on soil erosion). This intense process of research, selection, collection, and harmonization of the data coming from the Italian scientific literature on agriculture, is shown within the complete reports with the answers to the questions. The evaluation results are presented as answers to precise questions phrased within the NRN-ISMEA working group in order to address the questions which can be formulated on the basis of the issues and standards of Annex III and IV of Council Reg. No 1782/2003 (Ex. To what extent the maintenance of retain terraces determines a decrease of soil erosion?). In the 6th ESSC International Congress a the evaluation of the effectiveness of GAEC standards adopted in Italy to control soil erosion will be presented. For each standard related to the soil erosion issue, observations and prescriptions will be exposed aimed at better identifying cross compliance obligations that could integrate the need for farmers to better comply with minimal agricultural obligation with the environmental protection effectiveness required by the CAP.

Strategies for soil protection – how to bridge between science and decision making?

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Introduction

Soil degradation is increasing worldwide and therefore the question arises: Is something wrong with our strategies for soil protection? Even taking into consideration that the tasks of science and technology on one side and politics and decision making on the other side are very different and admitting that science can only develop proposals based on scenarios, in order to convince politicians to take decisions and to protect soils, we need urgently to analyze our actual concepts for soil protection.

Methodological aspects

Soil degradation is a complex issue, deriving from social, economic, technical, environmental and cultural impacts, which altogether have to be considered in order to come to a conclusive concept or a strategy for soil protection. Regarding soil protection, politicians and decision makers need to be informed in detail about the complexity of the processes and especially about the social and economic impacts of soil degradation, because this is targeting their political clientele, by whom they are elected and appointed. It seems therefore necessary to use an approach which considers all the different aspects of soil degradation. One of these approaches is the DPSIR-framework approach, which looks into the Driving forces, the Pressures arising from those, the State of degradation which they cause, as well as the environmental, technical, social and economic Impacts, thus allowing for formulating Responses through politics and decision making. In the following, a concept is described, which helps science to develop sound scenarios for soil protection on this basis.

Results and discussion

The approach involves five main steps, which aim at the following targets:

1. To know the processes in the environmental system, leading to soil degradation;
2. To know where these processes occur and how they develop with time (monitoring);
3. To understand the relationship between those processes and existing land use policies as well as land use management systems;
4. to analyze and understand the impacts of soil degradation on further environmental compartments such as air, water, biomass production, as well as on the social and economic wellbeing of human societies and on human health; and finally, on the basis of 1-4,
5. To develop clear targets for combating soil degradation processes, based on arguments which are important and easily understandable for politicians and decision makers.

This stepwise approach will be discussed in detail, as well as the question which sciences have to be involved in order to make soil degradation understandable. In view of the complexity of the subject, political, social, economic, technical and further sciences will be needed to elaborate scenarios and proposals for politics and decision making.

Conclusion

On the basis of the DPSIR-approach it seems to be possible to improve strategies for soil protection, especially for the development of proposals and scenarios which are

understood by politicians and decision makers and which therefore may lead to a future improvement of soil protection.

Estimating carbon credits variations supplied from agricultural and forest soils of Italy between 1979 and 2008.

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Soils contain approximately three times the world amount of organic carbon in vegetation and approximately the double of that present in the atmosphere. However, soil organic carbon (SOC) has been found lowering in many areas, while atmospheric CO₂ was on increase. It is well known that there is a marked inter-dependence between SOC and climate, nevertheless, recent researches have demonstrated that changes of land use and management can cause gains or losses of SOC greater than climatic changes. Italy, which has joined the Kyoto Protocol, has decided to consider only forest management within the additional activities contemplated for the count of carbon credits, and to launch a monitoring campaign of SOC only in forests. The scope of this research work was to demonstrate that it is possible to estimate carbon credits variations supplied from both agricultural and forest soils of Italy during last the 3 decades (from 1979 to 2008), taking into account changes due to climate change. The soil database of Italy was the main source of information. SOC content was expressed as percentage by weight (dag kg⁻¹) analysed by the Walkley-Black procedure and converted to ISO standard. The CRA - CMA (Research Unit for Climatology and Meteorology Applied to Agriculture) database was the source of information for climatic data. We considered the mean annual temperature and mean value of total annual precipitations of the two periods 1961-1990 and 1991-2006, and we mapped them by regression kriging with elevation and latitude as predictors. The soil organic carbon stock (CS) was calculated referring to the first 50 cm, obtaining a single value for every observation. A series of geographic attributes were used in order to spatialize site information. A linear multiple regression was used to interpolate the values, using the variable CS as target and the geographic attributes as predictive variables. The model also considered the interaction between decade, land use, and climate, to take into account the effect of climatic variables on the SOC content in the different land uses. The SOC variations due to climate change were then subtracted from the total, for the calculation of carbon credits that may be attributed to agricultural and forest management. Carbon credits were calculated following the Emission Trading System (EU-ETS, EU Directive 2003/87/EC), and the exchange rate given by the Carbon Dioxide Emission Allowances Electronic Trading System (SENDECO2) at September 2010. Our results indicate that CS highly correlates with the main groups of land use (forests, pastures, crop lands), as well as with soil humidity and temperature regimes, lithologies, and morphological classes. CS diminished remarkably in the second decade, while slightly recovered between the second and third decade. Climate change influence on SOC content was limited, as a whole, but relatively more pronounced in meadows. The Italian CS passed from 3,32 Pg in 1979-1988, to 2,74 Pg in 1989-1998, and 2,93 Pg in 1999-2008. The equivalent lost of carbon credits occurred from the first to the second decade totalled some 24,260 M€, while in the following decade carbon credits recovered about 6,921 M€, mainly because of the SOC increase obtained in the arable lands. This study demonstrates the possibility to consider carbon credits from agricultural soils, in addition to forest. Therefore, Italy should extend also to agricultural soils (crop lands and meadows) the current monitoring of SOC for the time of engagement of the Kyoto Protocol.

SOILPRO: a LIFE+ project implementing soil monitoring and protection together with regional stakeholders of Sicily and Peloponnese

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According to the Thematic Strategy for Soil Protection, the LIFE+ ENV/IT/00428 SOILPRO project (<http://www.soilpro.eu>) has the overall objective of slowing down the progress of soil degradation in EU Member States, and supporting local and regional authorities (LRAs) in the identification and monitoring of risk areas. The monitoring of the on-going soil degradation processes and the evaluation of different protection measures are realized through a web-based application (SMS – Soil Monitoring System), developed according to data and knowledge obtained from the different project partners.

The SMS was initially applied on the whole Sicily (Italy) and Peloponnese (Greece) regions and then tested on two pilot areas: the south-western part of Sicily and the Prefecture of Corinth. Although the two study areas belong to the same Mediterranean region, they are very different in terms of political and administrative organization. The employment of SMS in such different contexts, will encourage its implementation in other EU Member States and Regions.

The knowledge of intensity and localization of degradation processes permits a better definition and application of the protection measures aimed at maintaining the soils in good agronomical and environmental condition. Moreover, it also supports the development and implementation of future soil and environmental policy, and the training of LRAs' technical staff, farmers and other potential stakeholders. Finally, the effectiveness of the applied soil conservation measures is evaluated, and a campaign to stimulate public awareness on soil degradation processes has been launched.

Characterization of pore network morphology in differently fertilized soils using Xray computed tomography

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Keywords: Soil structure, X-ray tomography, Image processing, Organic fertilizers, Long-term experiment

Soil structure plays a fundamental role in agricultural practices since it affects soil aggregation, root growth, liquid and gas permeability as well as biological activity. Soil aggregation is also influenced by soil organic carbon (SOC), which is usually recognized as one of the main indicator of soil fertility because it improves the structure stability. The study of pore network and its structure, at micro- and macropore scale, is one of the most common way to analyze soil characteristics. Here, X-ray micro Computed assisted Tomography (μ CT) is combined with image processing techniques to provide non-destructive measurements and 3-D visualization of the pores. In the present study the effects of SOC on pore size distribution and morphology were investigated in a field experiment, established in north-eastern Italy. Long-term application (43 years) of organic (farmyard and liquid manure), mineral and mixed (organic + mineral) fertilizers were assessed and compared. X-ray CT was performed on air-dried soil aggregates, sieved at 5-6 mm, at fine resolution (around 6.25 μ m per pixel). A region of interest of 268 x 268 pixels was manually selected, for consistency, within each stack. It represented the largest and fully covered area by the aggregates. Using ImageJ software and after normalizing the stack histograms, the images were interactively segmented using a unique threshold throughout the whole volume data. The resulting binary images representing pores/non-pores material were combined to produce a 3D visualization of the selected volume of interest (1.7 x 1.7 x 1.6 mm). Next, applying mathematical morphology operations and morphometrics, the pore network physical characteristics were quantified with 3D porosity, anisotropy, 2D connectivity, pore size distribution and shape characterization (tubular, fissure and packing pores) parameters. Soil management practices affected the soil structure. Fertilization practices pointed out differences in terms of pore shape ($p < 0.05$). Tubular pores were more present in soils inorganically fertilized, while the organic fertilizations and the control affected the percentage of fissure pores. Besides the best correlation was found between pore shape and the sodium content, which in turn was affected by the treatments. Fissure pores are called structural because they define structural units. It follows that aggregates with higher sodium content appeared to be composed by sub-structure units. Also, SOC affected both the 3D porosity, because it reduced macroporosity, and the 2D connectivity. Anisotropy values demonstrated that the structure was most widely isotropic in all 3D directions. Therefore 2D parameters could be considered representative since the soil is an isotropic medium. The results provided additional evidence of the role played by fertilization practices as they affect the soil structure.

Soil degradation and desertification in an arid environment affected by a salt diapir

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Keywords: salt diapirs, salinization, soil degradation, arid environment

Soil degradation, most notably caused by salinization and water-logging, creates formidable problems in arid and semi-arid environments. Advancing our knowledge of salt-affected soils is a prerequisite for understanding how salinization affects environmental concerns such as soil erosion, nutrient leaching, and lack of vegetation cover. The main objective of this study was to investigate the impact of salt diapirs on physicochemical soil condition to explore the relationship between halophytic vegetation and soil factors, and to describe the composition and distribution of plant species in relationship to soil salinity. The study area was divided into three units, based on different geomorphologic conditions, slopes and vegetation type. Changes in salinity, soil properties and vegetation were studied. The analyses showed that the proportion of clay increased while silt and sand decreased with increasing distance from salt diapirs. The presence and composition of ions in all samples consistently indicated high levels of Na, and moderate levels of Mg, Ca, K. Based on the soil condition, plant vegetation adapted to types with more resistance to salinity and water-logging. Typically, this results in a decrease in soil structure stability through degradation of soil aggregates and a variation in the composition of the vegetation toward undesirable species.

Impact of planted Atriplex on soil properties and soil compaction

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Keywords: Atriplex.spp, soil chemico-physical properties, Bulk density, Soil water content, Arid environment

Abstract: Vegetation deterioration decreases humus content gradually and causes rapid deterioration of physic-chemical soil properties .Versus; these are some of the ways to improve soil's physic-chemical limitations and recover the damaged plant communities. Some of the plants are believed to increase, or at least maintain the organic matter levels of soils and decrease soil salinity. Most species of Atriplex are able to accumulate a high level of sodium under salt stress conditions. The main aim of this study is to quantify soil chemico-physical properties changes under mid canopy and canopy gap positions of Atriplex.spp in an artificial shrub land, to know how litter dispersed across the landscape might influence soil properties and to suggest some management practices to remediating high levels of soluble salts. In this study, three sites were selected for sampling; protected area, grazing area, and control area. Dominant plant in the grazing and protected area is Atriplex lantiformis. The control area was selected in the vicinity of Atriplex shrub land with the same geological and soil condition. Two hundred transects were established randomly at each site. Along each transect ten 10 m² plot were located every 6 m. Changes in salinity, soil properties and vegetation were studied inside ach plot. Atriplex.spp has great potential for remediation of soluble salt in soil. According to our results, both physical and chemical soil properties were affected by planted Atriplex. For top soil layer, minimum of bulk density was observed in the mid canopy in the protected area and it was higher in the canopy gap than mid canopy in the grazing area. Soil water content was decreased with increasing of bulk density. Soil salinity in sub soil layer significantly reduced in both protected and grazing area compared to control area. Although soil ions were reduced in the sub soil layer in the area planted with Artiplex lantiformis, reductions were much less in the protected area than grazing area.

Effects of Alley Cropping System on Soil Losses and Runoff on Sloping Pistachio Orchards

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Keywords: Erosion, runoff, sloping land, alley cropping, forage production.

Soil erosion is an important problem in pistachio growing areas with low vegetation cover and steep slopes in the Mediterranean region. Alley cropping is an effective management system for soil erosion and runoff control. In this study, forage crops (vetch, barley, and mixture of vetch and barley) were grown on sloping pistachio orchard with alley cropping system for two years in the south-eastern part of Turkey. The results showed that alley cropping system had significant impact on soil and water conservation. The average annual quantity of soil losses and runoff decreased from 12.5 t/ha and 17.7 m³/ha to 0.3 t/h and 1.03 m³/ha, respectively. This management system is easy to be implemented and managed, and suitable to be extended in olive orchards and vineyards on sloping areas.

Evaluation of hydraulic conductivity and cone penetration resistance of selected arable soils in Akure, southwestern Nigeria

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Keywords: hydraulic conductivity, penetration resistance, moisture content, Nigeria.

Adequate knowledge about soil hydraulic properties has become increasingly important due to its relevance and applications in many areas of sustainable food production such as water and soil management, land application of bio solids, soil compaction and so on. The objective of this study was to determine hydraulic conductivity and cone penetration resistance of some arable soils. The soils were loamy sand, sandy clay loam, sandy clay and clay, located at the STEP-B Research Experimental Site of The Federal University of Technology, Akure (FUTA), Nigeria. Two of the soils (sandy clay loam and loamy sand) also serve as experimental soils in indoor and outdoor soil bins at the University. Field and laboratory investigations were conducted to determine hydraulic conductivity and cone penetration resistance of the soils. The parameters investigated include, hydraulic conductivity (HC), penetration resistance (PR), bulk density (BD) and moisture content (MC). They were monitored at different locations on the field. The PR was measured by Bush recording penetrometer, (Model CP 20 Ultrasonic AGRIDRY RIMIK PTY LTD TOOWOOMBA, with a standard 30 degrees cone of 322 mm² base area. Hydraulic conductivity was determined by Decagon minidisk infiltrometer. Soil textural analysis was according to the USDA textural classification. The laboratory experimentation also examined the effect of variation of bulk density on hydraulic conductivity of experimental soils. The results showed that the penetration resistance increased with depth. The moisture content (dry basis) varied from 6.04 to 25.87 % (field data) and 4.48 to 11.05 % (lab data), bulk density varied from 1.32 to 1.59 g/cm³, the mean penetration resistance (cone index) varied from 330 kPa to 1344 kPa (field data) and 318 kPa to 998kPa (laboratory data). On the field, the mean hydraulic conductivity of sandy clay, sandy clay loam and clay were; 0.24x 10⁻³, 0.7x10⁻³ and 0.23x10⁻³ cm/s respectively while in laboratory, the mean hydraulic conductivity of sandy clay, sandy clay loam, clay and loamy sand are; 0.7x10⁻³, 0.9x10⁻³, 1.6x10⁻³ and 5.2x10⁻³ cm/s respectively. These data will be useful for researchers at the center and for similar studies elsewhere. Attempts were made to correlate hydraulic conductivity with penetration resistance data.

Comparison of approaches to assessing agricultural soil quality

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Keywords: soil quality, soil productivity, land evaluation, methods

Sustainable use of soils is a vital issue in the 21st century to meet global challenges like food security, demands of energy and water, climate change and biodiversity. Maintaining and improving agricultural soil quality will be essential. Currently, the main preconditions for achieving these goals are missing. These are standards and frameworks for the taxonomic and functional classification and allocation of soils. At the 19th World Congress of Soil Science in Brisbane the creation of a Universal Soil Classification System was declared. This is a first step towards a common language of soil scientists, but internationally functional soil classification schemes are still missing. We propose the utility of an international soil functional assessment and classification framework for monitoring and sustainable management of the global soil resource. Our paper deals with the requirements of such a functional soil evaluation system and a comparison of existing approaches to meet those requirements. The production of plant biomass (productivity function of soil) is most important and associated with other soil functions like storage, filtering and transformation of nutrients and water. Amongst requirements of a global assessment framework of agricultural soil quality, consistent applicability over different scales (field method at a pedon to small scale soil maps) and plant biomass correlations are the most important performance parameters. The approach needs to be reliable, simple, logical and readily understood.

We analysed and reviewed environmental factors limiting soil productivity and did fieldwork in different climatic regions. Soil classification included an allocation of typical catenas to WRB 2006 and a rating of soil productivity potentials by the Muencheberg Soil Quality Rating (M-SQR). Crop yields were analysed relative to soil attributes and climate.

We found that there are numerous methods of soil and land assessment and rating, but they are either nation-specific, not comparable, not transferrable, or difficult to handle. While methods providing a straightforward soil quality (SQ) assessment have focused on particular aspects like physical SQ, methods of overall SQ assessment meeting the requirements above generally do not exist. Data confirm the limited information content of taxonomic soil classes and WRB qualifiers for agricultural soil quality and soil productivity potentials and the need for an overall soil quality rating scheme. The M-SQR performed well. Examples of the application of the M-SQR method at different scales will be demonstrated. The reliable estimation of the soil and landscape water balance to assess drought and wetness remains a parameter for rating agricultural soil quality.

We conclude the Muencheberg SQR has potential to serve as a global functional reference framework for the agricultural soil quality of cropland and grassland.

Performance effectiveness of the CAP standard "Maintenance of soil structure with tillage conditions at appropriate soil moisture " and geographic suitability for the Italian soils

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Keywords: soil structure, tillage, CAP standard effectiveness, soil database, Italy

The Italian National Research Project EFFICOND was implemented for test the effectiveness performance of several standards inside the CAP policy, especially regarding the maintenance of soil physical and chemical quality characteristics following proper agricultural practices.

One of these research lines involved the study of the maintenance of soil structure with tillage conditions at different soil moisture contents, to find the optimum and/or maximum content of soil water fitting the support to minimize the effects of soil compaction and surface drainage. The research, through the years 2008-2010 and still active for the year 2011, was carried out on seven pilot areas, located in different soilscapes, northern sandy alluvial Po Plain, Tuscany clayey Central Hills, Volcanic Tuff Plateaux of Lazio, fluvio-lacustrine plains of north Apulia and reclaimed clayey alluvial depression of south Sardinia island,. The soil stability aggregate index (MWD) was compared in different experimental thesis with two different soil moisture levels, up and down the Upper soil tillage limit, according to characteristic retention curve function parameters (Dexter and Bird, 2001). The result showed a good correspondence between the tillage conditions at low soil moisture levels and the aggregate stability for the soils belonging to five of the seven areas, as evidence of this standard effectiveness. In two cases, there was a weak link, on soils with texture loamy sand or sandy, and on leucitites tuff soils. The first exception was explained with very low clay and silt content and a natural weak structure; these physical conditions lead to no plastic behaviour and to any difference to tillage soil moisture conditions. In the second more complex case, the particular mineralogy of soil parent material seems to be the cause of a) tixotropic characteristic of the texture and b) weathering of leucitites in allophane and analcime (natural zeolite) compounds, that could retain and fix water and nutrients inside the mineralogic structure, with no effects on the plastic behaviour.

The effectiveness levels of this standard were applied in first approximation, to the corresponding soil types at geographic level inside the CRA national soil database, for evaluate the geographic extension of the suitable and not suitable areas for the application of this standard. Suitability was evaluated taking into account the research results and showing also the upper tillage limit for each area, expressed as maximum soil water content in the arable surface horizons.

SPECIFIC FERTILIZER RECOMMENDATION WITH THE USE OF NEW TECHNOLOGIES

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Keywords: soil, new technologies, fertilization, Greece

The Soil Science Institute of Thessaloniki, NAGREF, has recently prepared soil studies on agricultural land regions of Kozani and Chios. The novelty of these studies is that, with the use of Geographical Information System (GIS) electronic interface and digitized maps and orthophotomaps, local agronomists have immediate access to a range of information, including:

- The general elements of the identified parcel.
- Physical and chemical analysis of soil.
- Rational fertilization advice for a series of crops.

The software (on CD), automatically calculates the fertilization needs for each parcel and it displays and prints a two-page form where:

- In the first page there is map of the parcel and information regarding farmer and nutritional status of the parcel to the first depth (0-30 cm), as revealed by the previous soil analysis.
- On the second page there is fertilization of the crop, based on the nutritional status of the first page.

The interest and acceptance shown by the farmers for these studies have been extremely positive so the Soil Science Institute of Thessaloniki went on further upgrading the existing software in order to transform it into a dynamically evolving tool for the Internet (no CD required for installation) and to serve the stakeholders (farmers, agronomists, agricultural services in charge, etc.).

Specifically, it developed a demo web application (in house), through which a person with the use of a personal password, could identify parcels and see their soil data from the Internet.

It is also possible to add and edit data as, for example, more recent soil analysis data, while preserving the history of the previous ones. The user can print and export reports about his parcel in PDF forms, in which relevant data appear (chemical properties, sound fertilization, etc).

Moreover, further research is carried out to incorporate in the same software other factors, such as meteorological data, irrigation, plant protection, etc. The final aim is to provide a common online platform with a uniform, friendly and integrated user interface in order to facilitate the management of the agricultural land.

The implementation of this application in practice may create conditions for upgrading the state's currently followed rural policy towards 'green growth'. At this point it has to be mentioned that the revised Common Agricultural Policy calls for the implementation of good agricultural practices (irrigation, fertilization, pest management, etc.) from growers in order to be able to be subsidized.

Development of bioindicators for soil monitoring and risk assessment at national scale

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Keywords: soil bioindicator, monitoring, risk assessment, characterization, protection

Considering the lack of bioindicators to assess the soil quality, a national research programme has been set up to develop such indicators (2006-2012) "Bioindicator" programme. The main objectives are to provide new tools for soil monitoring, characterization and risk assessment, based on soil biological properties. This programme is subdivided in 2 steps. For the first phase (2006-2009), during which 80 biological parameters were tested, interesting results were obtained but comparisons were difficult due to heterogeneity of protocols and field sites. Therefore, this phase was used to select the most promising bioindicators. In the 2nd step of this programme (2009-2012) which involved 70 partners, 47 biological parameters have been tested integrating microorganisms (e.g. biomass, genetical structure, enzymatic activities) micro-meso and macrofauna (e.g. nematodes, collembola and mites, earthworm at community level and at individual level i.e. biomarker as mt expression, total macrofauna, metal accumulation in snails and in micromammals) and flora (e.g. lipid biomarkers in the leaves, Amino acid content, Metalic element bioaccumulation). These parameters were assessed on a large number of common contexts (13 sites covering France leading in 47 contexts differing in terms of land use and agricultural practices e.g. pasture rotation, tillage impact, management, as well as soil type, contamination origin e.g. PAH or metal, pollution level). The strengths of Bioindicator programme, which is unique at European scale, are (i) to test a large number of bioindicators (47), in a large panel of situations (47 situations), (ii) to apply standardised sampling protocols managed by only one sampling team, thus ensures a high quality of biological data acquisition, iii) to manage high number of data (200.000) by using a common database thus facilitates the data analysis. Moreover, in order to relevantly answer to

stakeholders, this programme collaborates with an “advice committee” composed by scientific and stakeholders (Ministry, environmental agency, Regional Board for Industry, Research and Environment, farmers, agricultural agency...). This presentation will present in details the Bioindicator programme (bioindicators, sampling protocols and procedures, sites, database structuration, data-mining involved) illustrated by results obtained from the first sampling campaign.

Comparison of different wet sieving approaches for a loamy sand soil treated with different compost applications in Belgium

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Keywords: Compost application, soil aggregate stability, wet sieving, detachability index

Soil aggregate stability is defined as the resistance of soil against the internal forces that occur within the soil system and the external destructive forces that are exerted to the system. In literature, many methods and treatments which attempt to achieve better results in expressing this soil phenomenon have been reported. The reason for that could be explained by the fact that there is no satisfactory sole methodology to express aggregate stability which applies to all soils in any circumstance. In this study, six different methodologies were compared, using soils treated with various composts, in terms of a detachability index (DI) as a common parameter, which was formulated as the ratio of the Mean Weight Diameter after wet sieving (MWDW) to that before wet sieving (MWDD). Soil samples were collected from a field experiment at the Provincial Vegetable Research Institute, Kruishoutem, Belgium designed to evaluate various compost treatments in open air. The soil was a loamy sand (852 g kg⁻¹ sand; 105 g kg⁻¹ silt and 43 g kg⁻¹ clay) with a pH of 6.4 and organic carbon content of 11 g kg⁻¹. The experiment was laid out according to a randomized block design with 10 treatments in 4 replicates. Depending on the treatment, three different types of compost was added to the soil at various rates in 2006 and/or 2007. The three compost types were semi-mature vegetable, fruit and yard waste compost (VFYW), mature VFYW and farm compost. The used aggregate stability methods of the research chiefly involved sieving soil samples through either multiple sieves or a single sieve using operations of wet sieving, dry sieving, pre-wetting, slow wetting, fast wetting and mechanical breakdown. These were used either alone or in combination, and generally, these methodologies differed from each other in terms of wetting conditions, applied input energy and specified initial aggregate size. The statistical results showed that the mean values of DI for wet sieving by multiple sieve sizes, fast wetting and mechanical breakdown varied significantly ($p < 0.05$) from other treatments. Results clearly revealed that, depending upon the magnitude and extent of aggregate destructive forces, causes of which could be diverse in the soil system, DI could change significantly, and thus, in order to define aggregate stability, it is very crucial to simulate physical processes which could operate sequentially or simultaneously in degrading soil aggregates. On the other hand, the statistics related to the different compost applications showed that none of the experimental treatments had significant effect on soil aggregation for all aggregate stability methods ($p > 0.05$), suggesting that there were no directly detected short term effect of compost application on the soil aggregate stability.

Linear flow paths influence the effectiveness of retention measures in agri environmental programmes

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Keywords: agri-environmental measure, vegetated filter strip, effectiveness, linear flow path

Vegetated filter strips are subsidized in the Austrian agri-environmental program programme (ÖPUL). For a predefined area, subsidies are given in case farmers implement 50 m wide filter strips (VFS). In general there is agreement that potentially VFS exhibit a very positive effect on retention of sediment. VFS gain the best retention potential when surface runoff enters the strips as sheet runoff. However, surface runoff convergence may take place in linear flow structures long before approaching the river system thus limiting the effectiveness of VFS and the ÖPUL programme. Little information is available about the extent of these linear flow pathways and factors that may influence their occurrence in the landscape. To better understand the dimensions of these effects we carried out detailed field surveys in ten small headwater catchments (65ha to 422ha) in different climatic regions in Austria. The regions studied are used for intensive agriculture and are known to be highly affected by soil erosion and pollutant input into aquatic ecosystems. Ditches, channels and comparable linear structures were mapped in all ten catchments. Surface flow pathways were calculated either with or without integrating the mapped structures. Effective placement of retention structures may also be influenced by the accuracy of digital elevation model (DEM) resolution. We therefore used three different DEM's with varying resolution. The catchment areas which are connected directly to the stream network via linear drainage structures were identified for all cases studied. In seven out of the ten catchments such unprotected areas (UA) were found. Their extent varied between 8% and 38% of the total catchment area. Factors, influencing the extent of UA were annual precipitation and length of the street network. Without integrating the mapped linear structures UA could not be detected in the broad gridded DEM's (10m raster resolution). Even by using the most accurate DEM (1m raster resolution) less than 50% of existing UA could be detected. After integration of mapped linear structures, DEM resolution did not influence the calculated extent of UA.

Land use and soil protection in Poland

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Keywords: land use, soil protection, Poland

In the last years certain attention has been paid in Europe and also in Poland to rational management of the soil resources that would apply to the rules of the sustainable development policy. Soil, as the most important element of the natural environment, has to be rationally exploited and brought into cultivation because its resources in Poland diminish year by year. The registered Polish area accounts for 31268 thousand hectares: the total area of agricultural land is as vast as 19025 thousand hectare, that is 51,7% of the total country area and the forest and wooded grounds constitute 29,6%. In the last 30 years agricultural land declined by 2689 thousand hectare whereas the forest area increased by 594 thousand hectares. At the same time, a growth of areas used for other purposes has been observed. Nowadays, the amount of agricultural land falling on one Polish inhabitant amounts to 0,48 hectare while 30 years ago the number was higher – 0,53 ha aa. The soil conditions in Poland, and most importantly their quality, in comparison to other countries in the European Union, seems to be unfavorable. About 60% of the area is taken up by light and very light soils, which are still used to a certain extent in the agricultural activities. The best soils, among which we can enumerate haplic pheosems, eutric cambisols, orthic luvisoils account for merely 11,5% of the agricultural lands. According to European concept, which is emphasized by, among others, strategy of soil protection, soil quality is strictly connected with its functions. Thus, there appears a need to describe these functions in certain social-economic conditions, to identify threats and to seek solutions that will maintain soil resources and their quality. The threats to the soil may be spot, local or region-oriented. Ministry of Environment bb, referring to reports prepared by Ministry of Agriculture and Development, provides information that 12747-hectare-area was excluded from agricultural production in period of 2005-2008, of which 5430 hectares was highest quality soil, that is 43% of entire agricultural area, and 2221 hectare of forest land. This land was designated for residential areas (10340 ha), industrial areas (3304 ha), roads and communications trails (978 ha), and minerals (2538 ha) purposes. A mode and rules of excluding agricultural and forests land from production is determined by Protection of Agricultural and Wooded Land Act and other: Act of Plan and Spatial Economy, Environment Protection Law and Nature Protection Act. Protection of agricultural and forests act urges best soil security, restricts its exploit for other purposes, and lays duty upon people who degrade land to its reclamation and upon users to avert erosion and earth movements. Research run by our Department has shown a decrease of content of organic matter in multiple Polish regions. An organic carbon shortage was evidenced in these areas where livestock inventory is low and where simpler rotation has been introduced. Moreover, the boosting acidification has been proven, especially in these agricultural areas that are classified as having unfavorable farming conditions. Soil resources management in Poland forces a systematic quality control and exploit within frame of local spatial economy plans.

Testing the USLE Under Different Tillage and Cultivation Practices

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Keywords: Soil erosion; Reduced tillage; Cover Crop; Tillage direction; USLE, cotton

The USLE equation was developed in the USA to be used to estimate the soil losses due to water soil erosion. Its usefulness was proved in many research projects in the USA and in other parts of the world. In the years of 1997-2000 a field experiment was carried out in Central Greece to study soil erosion. The experiment was established in a well-drained, very calcareous silty loam, classified as Calcic Xerochrept soil with 9.5% slope. Three sets of treatments were applied: I. tillage practice for primary cultivation, three treatments: a) conventional tillage using plough b) reduced tillage using a heavy cultivator, and c) reduced tillage using a disk-harrow. For all the treatments the secondary tillage was performed by a disk-harrow. II. Cover crop, two treatments a) with and b) without winter cover crop, and III. Tillage and planting direction of cotton crop, two treatments a) along the slope, and b) along the contour. In the experimental conditions the revised USLE was applied and the estimated values were compared to the measured one. The results showed that the rainfall intensity that better predicted water runoff was the one taken for 15 minutes duration (I15 of the event). This figure was used instead of the I30 used in the USLE. The values estimated by the USLE were over estimating the soil losses compared to the measured ones by a factor of 2 in the ploughed plots, a factor of 3 for the heavy cultivator and a factor of 5 for the disk harrow. The reason for this overestimation should be attributed to the different conditions of Greece as well as the differences in the conditions of the experiment like the cotton crop and the combination of the treatments (reduced tillage, cover crop and direction of tillage and planting).

The cognitive foundations of farmers attitudes towards conservation practices as a basis for policy and extension

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Keywords: soil conservation, adoption, policy

In order for soil degradation to be halted and conservation schemes and extension efforts to succeed, it has become clear that we must understand farmers' motivations with respect to the adoption of soil conservation measures. Many researchers acknowledge the role that farmers' attitudes play in the adoption of soil conservation and, hence, the impact of attitude on the success of policy instruments and extension efforts. However, attitudes of farmers towards specific conservation behaviours have seldom been investigated. Rather, researcher relies on a general and often miss-specified and hence wrongly assessed measure of farmers' attitudes. This has been despite the progress that attitude-behaviour research has received in the field of socio-psychology on the one hand and the success of such research on other areas such as food consumption, health behaviour and leisure choice on the other hand. Partly driven by the results of some noteworthy review papers on the factors influencing adoption of soil conservation practices – which revealed that most classic adoption variables in fact are mostly insignificant – recent literature has seen a renewed interest in attitudinal variables as determinants of conservation behaviour. Most of these studies, however, still use a directly assessed measure of attitude. While this research is valuable in itself, it provides limited scope for intervention by means of policy instruments and extension effort. This paper reports on a study that was conducted in Belgium to elicit the cognitive foundations of farmers' attitudes towards three soil conservation measures. The expectancy value method was used to identify the behavioural beliefs behind farmers' attitudes. The results can be very useful in three domains: (i) for formulating policy instruments; (ii) for improving extension efforts and (iii) for developing conservation practices. The results show, for instance, that the use of subsidies will at this moment only induce a temporary intention to adopt conservation practices, since farmers' attitudes, which are a more reliable indicator of a behaviour change are not affected by the presence of a subsidy scheme. Further, the results show that the non-adoption of soil conservation practices, which is regarded by many researchers as irrational behaviour, is in fact very rational. Indeed, farmers systematically overestimate the probability of negative consequences, while underestimating the probability of positive consequences.

POSTER PRESENTATIONS

Comparison two plant seedling (Orange and Prunus) root development in first tree years for using in soil protection

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Key words: Orange, Prunus, root growth, Vegetation Roots, soil erosion

Vegetation Roots is been used for slope stability and Cause stability force versus failure that improve slope instability. For this purpose, whatever the root growth rate is much more for trees in Initial three-year growth can Cause Faster soil stability improvement. This study looked at North Iran for comparison root biomass growing in Initial three-year growth seedling of Prunus avium and Orange. Data available for 1-, 2- and 3-year-old Prunus avium seedlings indicate that rate of seedling root biomass growth was about 1, 1.57 and 3.5 gr for 1, 2 and 3- year-old, respectively. Data available for 1-, 2- and 3-year-old Persian Orange seedlings indicate that rate of seedling root biomass growth was about 0.09, 0.62 and 2.55 gr for 1, 2 and 3- year-old, respectively. Root growth rate of Prunus is about Double of root growth rate of Orange especially in first two years, that it can be important to use surface soil erosion control in natural slopes than Orange

Land loss estimate and erosion prediction on soil under sugarcane management

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Keywords: Geographic Information System, USLE , erosion, Brazil

Concerning about land degradation, soil erosion became a serious global problem in the world. Depending of the management and environmental conditions, the soil erosion may manifests in varying degrees. The aim of this study is to assess the land loss estimation and erosion prediction on soil under sugarcane management at Tijuco's Creek watershed, SP. Soil samples were collected in 500 m of spacing, giving a total of 353 points in 0 0.20 m depth soil layer in 8.008 ha of area. The geoprocessing resources and the universal soil loss equation (USLE) were used. The soil erosion prediction was calculated using the results for the R, K, LS, C and P factors (USLE). The results showed a constant spatial distribution of rainfall erosivity and soil erodibility. The topographic factor indicated a predominance of low spatial values, although some areas with high values also occurred. Higher occurrence of values greater than 100 Mg ha⁻¹year⁻¹ on land loss spatial distribution was observed in the entire watershed area, indicating the need for measures to minimize the trace processes that contributes to soil loss. The relation between parameters erosivity, erodibility, topographic factor, vegetation cover and conservation practice with the soil loss were compared by linear regression. In all cases, the dependent variable is the soil loss (A) and the independent variable, the parameters of the USLE. The highest correlation occurred with the values of the topographic factor (0.82), explaining 67.2% of soil loss (A), showing that soil loss was more influenced by the topography of the land. Then appears the canopy (0.69) which explains 47.8% of soil loss (A) this is due mainly to areas where the vegetation cover (C) is composed of riparian vegetation, forest, pasture, water bodies and urban areas, the values adopted are close to zero, reducing the loss of soil below the 10 Mg ha⁻¹year⁻¹. The conservation practice factor had a correlation of 0.68 explaining 46.3% of soil loss, probably due to the influence of terrain slope in the calculation of this factor. The correlation of soil loss with soil erodibility (0.60) and with rainfall erosivity (0.60), explained 36.6% and 37.0% respectively of data, soil loss, is due to the uniform distribution of these factors in study area. The erosion prediction resulted in large areas with positive values (6.558 ha), indicating a manifestation of erosion prediction and lower negative values (1.450 ha) that coincide mainly with areas near the headwaters and along the drainage, indicating the conditions under which the occupation does not increase the number of physical factors in order to promote soil loss by erosion. The use of the USLE, with the support of GIS, for calculating and estimate the soil loss, proved that to be feasible, since it allowed to estimate and evaluate the soil erosion, assisting in the planning of land use and conservation practices.

Modelling of soil water retention properties for soil physical quality assessment

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Keywords: Arya-Paris model, soil water retention curve, van Genuchten parameters

Because the soil water retention curve assessment requires (in terms of standardized European methodology) long time for measuring all levels of the soil water suction applied, we have used an indirect estimation methodology (deterministic) in order to have an overview of the soil capacity to retain water at different levels, which correspond to the main soil hidrophysical indicators, particularly important in assessing soil fertility status, as characterized by the ability of soil to maintain water in soil, and release the water when there are needs and / or requirements for crop plants.

In this paper we present the model of Arya - Paris, which assess the water retention curve using soil texture and bulk density data. This model is based on the analogy between the soil water retention curve and the cumulative distribution curve by soil particles size.

Parameter α introduced by Arya and Paris is an effective way to assess the length of capillaries in natural soils using as a measure spherical particles associated with the class in which was divided the solid fraction of soil. Arya-Paris model with α values calculated was applied to evaluate pairs of θ (soil water content) - ψ (matric potential). The van Genuchten equation was then used to estimate the water retention curve in the analyzed soils. We used in the paper three soil types (Calcic Chernozem, Rendzic Leptosol and Calcaro-calcic Kastanozem) located in the Dobrogea area from SE of Romania.

Parameters of the van Genuchten equation, θ_r , θ_s , α , n were evaluated using the pairs of values θ - ψ calculated by Arya-Paris model using the Solver tool from Microsoft Excel software package.

Van Genuchten equation was then used to assess some parameters that have agronomical significance. Optimum soil water content and soil matric potential for soil workability correspond to the inflection point of the soil water retention curve and were calculated using the van Genuchten parameters. Depending on the characteristics of the soil water retention curve at the inflection point the soil physical quality index, S was calculated.

Pedogenic Background Concentration (PBC) of Potentially Toxic Elements (PTE) in an industrial area. A proposal for a new pedological-oriented approach in the evaluation of Ambient Background Concentration (ABC)

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Keywords: Ambient Background Concentration (ABC), Pedogenic Background Concentration (PBC), Potentially Toxic Elements (PTE)

According to the International Organisation for Standardisation (ISO), the Ambient Background Concentration (ABC) or “usual background concentration” generally consists of both a natural pedo-geochemical fraction and a moderate diffuse anthropogenic fraction. There is as yet no agreed method by which to estimate a local or soil-type specific ABC, but three main methods are usually accepted worldwide. The first method, generally used to assess changes on a local and regional scale, is based on the evaluation of mean and range values of Potentially Toxic Element (PTE) concentrations in surface horizons of soil taxonomical units calculated from existing databases. Another method, referred to as the “enrichment factor approach”, involves taking metal concentrations measured in the deeper soil horizon (C horizons) as the local background for surface horizons. The third approach uses the relationships between trace elements and semi-conservative elements such as Fe, Al and Mn to predict forecast values of trace elements in top soils. All these methods are mainly based on a geochemical approach aiming to assess the values observed in the surface horizons (mainly A horizons), while less attention, or indeed an entire lack of data, has been generally observed on sub-surface and deep pedogenic horizons.

This research presents a new pedological-oriented approach for the estimation of ABC, called the Pedogenic Background Concentration (PBC). The PBC represent the pedogenic value of the investigated elements in the soil. Not only must the values of surface horizons be involved in this approach, but there must also be an accurate pedological investigation, with the recognition of all pedogenic horizons into the investigated soil profile.

As a case study, eleven profiles located in the industrial area of Ottana-Bolotana (Sardinia-Italy) and developed under the same soil use, vegetal cover, climate, morphologic and geological conditions were investigated with a view to estimating local/soiltype specific PBC.

PBC values were assessed through statistical analysis (principal component analysis, box-plot analysis and simple or multiple linear regression analysis) aiming to evaluate the relationships between soil physical-chemical parameters (sand, silt, clay, pH, conductivity, carbonates, N, P, CSC, Al, Fe and Mn) and PTEs (Sb, As, Cd, Co, Cr, Ni, Pb, Cu and Zn).

The study shows that in non-polluted soils, the PBC well explains the values of the different investigated PTEs along the pedogenic soil horizons. More specifically, the interquartile distance can be used as a PBC range for the investigated Co, Cr, Ni, Pb, Cu and Zn.

Impacts Of Cryptogamic Crust Removal On Soil Water Regimes

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Keywords: soil crusting, biological soil crust, soil water content, crust removal

Biological soil crusts (BSCs), consisted of a complex community formed by cyanobacteria, fungi, algae, lichens, bryophytes and liverworts, are a widely distributed ground cover in arid and semiarid regions, representing between 40-100% of the open spaces between vascular plants in these regions. Biological soil crusts play a recognized role on water processes: they influence soil porosity, absorptivity, roughness, aggregate stability, texture and water retention and by this way, affect infiltration processes, runoff generation, evaporation and soil moisture. Although there are numerous works studying the influence of BSCs on runoff generation and infiltration, there are only a few works examining their role on soil moisture and these studies show controversial results. According to some authors, soil moisture is lower in biologically crusted soils respect bare or uncrusted soils since biological crusts can darken soil surface and increase soil temperatures, thereby leading to higher evaporation and decreased soil moisture. Opposite to this, other authors have reported higher moisture in the upper layers of soils with prominent BSCs respect adjacent soils with no crust, explained by an improvement in soil aggregation induced by the crust components (cyanobacterial sheaths and anchoring structures of lichen and mosses) and by their ability to swell upon wetting, which may seal soil surface and reduce porosity thus decreasing evaporation and favouring water retention. The aim of this work is to examine the influence of BSCs on soil water content from the upper layers and the impacts of BSC removal. For that, soil moisture was examined under two different types of BSCs, a dark cyanobacteria-dominated BSC and a white lichen-dominated BSC, and in adjacent soils where these upper crusts were removed by scraping, in a badlands area over fine-textured soils in Spain SE. Moisture evolution was monitored at 2.5 cm soil depth in three plots per crust type and the soil without each crust type using Ec-5 soil moisture sensors (Decagon Devices, Inc). Soil moisture was recorded along a whole year. Soil temperature was also measured under these types of surfaces in order to analyse its influence on water loss. Our results show that soil temperature did not significantly differ among types of soil surfaces. Under high soil water content conditions, soil moisture was higher under lichen crusts than under cyanobacterial crusts. As soils dried, cyanobacterial crusts maintained moisture longer than lichen crusts. In general, soil moisture was higher under the biologically crusted soils than in the soils where the crust was removed. The higher moisture in the first centimetres of soil promoted by the presence of BSCs can be crucial for water-use efficiency and the maintenance of superior vegetation, which is especially important in arid regions where water is a scarce resource.

Application of GIS based tools for soil erosion control measures in large areas

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Keywords: soil loss, USLE, soil erosion control measures

Soil loss modelling using USLE based models built on raster GIS platform is a widely used approach. It has been adopted by many research teams as a standard for erosion mapping in large scales. Fewer publications can be found on applying the GIS/USLE based approaches to soil erosion measures designs. In the Czech Republic the effort to apply such methods in large scale to design soil erosion control measures automatically became part of the strategy of state agricultural policy. It should result in agricultural management limits with possible impact on single farmers. Therefore extensive study has been done by the authors, to approve potential of the method for such type of application. Firstly the effect of agro-technical soil erosion control measures (i.e. conversion of arable land to permanent grassland) has been modelled. The slope has been assumed as main criteria of conversion and rates of 5 – 20 % of total arable land have been simulated regarding to current situation, while graduate increment 0 – 100 % has been simulated as theoretical scenario at three catchments. In total ten catchments with variable morphology were compared. The varying morphology leads to different land-use and management type. Results clearly show that grassing is very effective and suitable in some morphological types of landscape being ineffective in others.

Other measure is limiting of crop and management factor C representing changes in crop rotation. This way a map of acceptable C factor values can be produced and can give helpful information to the farmers about suitable crops. Lastly technical control measures and their implementation have been modelled using USLE with GIS tools support. Two main types of measures were modelled: a ditch (as a universal type of linear measure interrupting the slope length) and a sediment trap (in thalwegs and valleys). Advanced mechanisms and methods of morphology analysis were used to find ways how to identify most appropriate location of measures in the landscape. Modelling tools and raster extensions of ArcGIS 10 and Idrisi Taiga GIS systems were applied.

Three experimental catchments (each approximately 100 km² in size) were used for testing. Again the catchments with different conditions and morphology were chosen. Based on presented research and simulation provided we can conclude that USLE based models with raster GIS support are very effective tool for spatial, mainly agrotechnical soil erosion control measures. But for technical measures the methods universally do not give reliable and reasonable results. The effectiveness depends highly on DEM quality and on processing of surface runoff on the slope. Available routines in current state of the art do not provide reasonable results with convergence or divergence of runoff and it leads to inconvenience with dimensions and location of the measures.

The approach to measurement of rill erosion surface

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Keywords: water erosion, rill and inter-rill erosion, erosion bridge

The Paper deals with evaluation of soil loss by measurement of erosion rills on the field plots. The principle of water erosion is the release of soil particles and water accumulation in the form of sediment, which are then transported and subsequently deposited in the morphological landscape positions, the hydrographic network and water reservoirs. The rill erosion is accelerated by the direct surface runoff with the transported solids from the inter-rill space and then concentrated runoff on a small deep in their own erosion gullies. Spatial location and shape parameters of the rill erosion are given by stability and resistance of the soil, slope, altitude and direction of runoff and vegetative covers of the surface.

As a case study area were selected cadastral territory in South Moravia region, very typical by its sloping relief with soil loess cover. Measurement is performed directly in the field of research plots, which were situated on land with a slope of above 10%, with corn sown up-downhill. With the erosion bridge technology there was targeted several hundred cross-sections of land, which was calculated by volume of erosion rills.

It is an equipment which helps to determine soil loss at given areas. The device of square-shaped frame with size of 2 m x 2 m is placed on setting spots which ensures always the same position in terrain when surveying. The construction serves for sections survey to realize volume quantification of erosive rills on the soil surface.

Data, which are needed for calculation of soil loss, are gained directly from the case study area. Cross-sections of terrain are surveyed in experimental site. It is possible to notice, thanks to measurement directly in field, how it comes up to dynamical increase in volume of the soil loss and to changes structure of erosion rills after every rainfall.

The method of direct measurement of rill volume in field enables to detect the value of soil loss after every rainfall. It is possible to evaluate the length, width and depth of erosive rills, and by this way we can quantify the soil loss volume in the given plots.

The effect of Zeolite Bentonite mix to soil quality improvement of different soil types

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Keywords: Zeolite - Bentonite, denitrification, soil improvement, Greece

The objective of this work was to investigate the effect of a Zeolite - Bentonite mix (in range of 3:1) to soil quality improvement of different soil types (i. Peat, ii. Sandy). For this purpose, a greenhouse pot experiment was established in central Greece (city of Volos). 24 pots contained 1 kg of peat and 24 contained 3 kg of sandy soil (48 pots in total) were prepared receiving N – NO₃- up to a concentration of 44 ppm. In the half pots, a zeolite-bentonite 3:1 mix was added (total 10 gr per peat pot and 20 gr per sandy pot). Switchgrass (*Panicum virgatum L.*), variety Alamo was sown in each pot and a three level of ammonium nitrate nutrient solution was supplied to correspond to N dressings of 0, 80 and 200 kg N/ha. The above mix had a decreasing effect to the soil denitrification as the nitrogen supply was increased in both soil types. This indicates that the current amount of the above mix can reduce specific quantity of N – NO₃- . Especially in case of peat the effect of the soil improvement mix was helping the denitrification in high percentages reaching the value of 70%.

Quantifying the impact of nutrient losses from agriculture in the experimental point Preajba – Gorj

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Keywords: soil, erosion, nutrient losses

Applying fertilizers without a scientific system based on knowledge of physiology and biochemistry of plants, soil conditions, agricultural chemistry and genetics does not guarantee high and stable crop or soil fertility maintenance.

The main macronutrients with an important role in plant nutrition are humus, nitrogen, phosphorus and potassium and the essential trace elements are Fe, Mn, Cu, Zn. These nutrients are lost through the following manners:

- losses through the eroded soil contributing to the movement of these elements on the slopes and deposition in floodplains or in reservoirs;
- losses of elements with water leaking from the surface soil. These losses are directly proportional to the solubility and quantity of the element in the soil;
- movement of the elements in the soil profile along with the water which infiltrates into the soil.

In order to quantify the impact of nutrient losses from agriculture on the environment, a study was performed in Preajba Gorj experimental point, in 2009. Samples were taken from two soil profiles, one in the upper third and second in the lower third of a slope. The analytical data reveals a number of issues related to the ecological and fertility characteristics of the soils in the area. Several measures are proposed to improve the soil quality.

Cultivation Induced Decrease In The Organic Matter Content Of Forest Nurseries As The Contributor To The Global Warming Process

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Keywords: Forest nurseries; SOM loss; CEC; aggregate stability; soil productivity; CO₂ evolution

Arable land of the forestry nurseries is attributed to a great loss of the soil organic matter (SOM), where management activities accelerate decomposition, and further during harvest a whole plant, including roots, is being removed from the soil. We aimed to investigate intensity and influence of changes in the total organic C and N parameters, in the top 10 cm of the adjacent cultivated and a grassland soils, in silty loams and loams of two different landscapes, on the cation exchange capacity (CEC), aggregate stability and evolution of the CO₂. Results indicated that approximately thirty years of conifer seedlings production had caused marked decline in the SOM at both examined locations. At the hilly landscape nursery (altitude above 850 m) organic C decreased 48.1 % and N 46.7 % and at the valley nursery (approximate altitude 235 m) C decreased 48.9 % and N 44.3 %. Thus, CEC was significantly lower in the arable land in silty loams and significant differences were not found in sandy loams. Unlike to cultivated soils, CEC of the grasslands at both locations, was substantially related ($R^2 > 0.7$) to C content. Organic matter was assigned as an important factor for resistance to erosion processes, especially at the hilly landscape nursery with highly erodible silty soils. Estimated CO₂ evolved from silty loam nursery soils due to 2.58 % organic matter loss where, after 32 years of cultivation, was 6.3×10^4 kg ha⁻¹. In loams of the valley nursery, after 31 years of cultivation, due to loss of 1.08 %, 3.0×10^4 kg ha⁻¹ values were detected.

The agrienvironmental policy in Portugal and its effects on the adoption of good soil management practices

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Keywords: Keywords: CAP, agri-environmental policy, soil management, good practice adoption, Portugal.

Well adjusted farming systems are in some areas, particularly in Mediterranean climate, a precondition to avoid desertification and erosion. To a certain extent CAP support has granted the continuation of environmentally beneficial farming systems. In Portugal the agri-environmental measures encouraging good farming practices have been in force since 1994. However only in 2003, soil quality became a specific target of those measures. In addition to agri-environmental contracts, also afforestation measures have been supported in order to encourage the conversion of marginal agricultural land into forest. The impact assessment of agri-environmental and afforestation measures on the adoption of good soil management practices is essential for the design of future measures in the framework of post 2013 CAP reform. Interviews have been conducted in two research areas in order to assess the changes in farming practices as a result of agri-environmental contracts. The results indicate that although forest is a suitable land cover for the enhancement of soil quality in marginal areas, the conversion is not suited for farmers depending on animal production, because the measure does not consider agro-silvo-pastoral use. The sustainable management of pasture land seems to be a key issue to optimise the trade-off between farm income and environmental conservation in these marginal areas.

Different nutrient supply effect on growth, proline and K, Ca, Na accumulation in *Triglochin maritimum* and *Triglochin palustre*

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Keywords: mineral nutrition, *Triglochin maritimum*, *Triglochin palustre*

Growth, proline and nutrient (K, Ca, Na) accumulation status were studied in two species from Juncaginaceae family: *Triglochin maritimum* (L.) and *Triglochin palustre* (L.). The plants were cultivated in substrate supplemented with three different levels of nutrients: 1. control (nutrient levels suitable for most of plant species), 2. control/natural medium (nutrient levels average between control and natural medium), 3. natural medium (nutrient levels similar to these found in natural habitats with suboptimal nutrient content and elevated salinity). After 1 month of treatment, plants were harvested and the dry weight and length of leafs and roots as well as the proline and nutrient concentrations in tissues were determined. The results obtained indicated that soil composition similar to natural medium caused significant reduction in growth parameters of plants such as leaf weight and length in both studied species. Differences between species were found for root weight and length, shoot/root ratio as well as for proline accumulation in plants. In conditions of natural medium *Triglochin maritimum* demonstrated higher root weight, length and proline accumulation to compare with *Triglochin palustre*. Proline seems to be involved in osmotic adjustment in halophyte *T. maritimum*. In natural medium *T. palustre* showed higher shoot/root ratio to compare with control as *T. maritimum*. Plant exposure to unbalanced nutrient content and elevated salinity in substrate resulted in different impact on nutrient accumulation in leaves and roots of studied species. Although conditions similar to natural medium showed negative effect on K uptake in roots of both species, no significant changes of K accumulation were stated in leaf tissues of *T. palustre*. Interestingly that such condition caused considerably higher uptake of K in leaves of *T. maritimum*. Plant species studied exhibited differences also in the ability to accumulate Ca. In natural medium *Triglochin maritimum* accumulated lower concentrations of Ca in roots, but significantly higher content of Ca were found in *T. maritimum* leafs to compare with *T. palustre*. Our research revealed that halophyte *T. maritimum* demonstrated higher Na storage capacity in leaves to compare with *T. palustre*. The obtained results indicate that higher proline accumulation and better maintenance of Ca and K in *T. maritimum* could be one of the adaptation mechanisms to nutrient imbalance and elevated salinity in growth medium.

The comparision of structure of humic acids from soil amended with diverse sources of organic matter using the EPR technique

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Keywords: EPR, humic acids, peat, cow manure, brown coal, brown coal-based preparation

Natural processes of organic matter transformation in soil may lead to the formation of humic substances. Under aerobic conditions (humification in terrestrial ecosystems) the main components of the formed humic substances are fulvic acids (FAs) and humic acids (HAs). HAs are complex, dark and paramagnetic biopolymers. Macromolecules of HAs contain conjugated olefinic, aromatic, phenolic-semiquinone-guinone structures and wide spectrum of functional groups, mainly carboxylic (COOH), phenolic (OH), alcoholic (OH) and carbonyl (CO). HAs reveal unique physical-chemical properties: multifluorophore systems capable of excitation energy transfer, paramagnetism, chemical and microbiological resistance, and antioxidative and free radical scavenging activity. Chemistry of the humification process involves formation of free radicals mainly of the semiquinone type in polyphenolic or Maillard type polymeric matrices. Soils in many areas of Europe are characterized by low contents of organic matter as a result of anthropopression. In the Communication "Towards a Thematic Strategy for Soil Protection", depletion of soil organic matter is mentioned as one of the eight main hazards for soils. Therefore, new unconventional sources of organic matter other than traditional ones (e.g. manure) are investigated for enriching soil with humic substances. The study was aimed at comparing the structure of HAs formed during humification in soil amended with cow manure and various sources of organic matter. Quantitative electron paramagnetic resonance (EPR) probing of free radicals concentration and g-values of HAs extracted from amended soil allow for monitoring the humification processes. Changes of g-value of free radicals in soil organic matter under natural conditions may be used as an indicator of aromatization, oxidation and coalification processes during humification. Soil samples originated from Haplic Luvisols, WRB were amended with farmyard manure, and peat, Tertiary earthy soft brown coal from Konin Basin deposits and the brown coal-based preparation Not amended soil was used as a control. HAs were extracted using the IHSS standard method. Free radicals concentration and g-values of HAs were studied by the EPR technique. The EPR spectra of HAs isolated from all soil samples consist of a broad signal and narrow lines at $g = 2.0035$ (soil and soil + brown coal) and $g = 2.0034$ (soil + cow manure, soil + brown coal-based preparation, soil + peat, and brown coal). The g-values for HAs fractions are characteristic for mature organic matter with oxygenated groups. Also the free radicals were mainly oxygen-rich groups (e.g. semiquinone). Results showed that HAs from all studied sources: peat, brown coal and brown coal-based preparation had the same structure as cow manure. Moreover, they are resistant to biodegradation, thus undergo slow mineralisation. Therefore, they may be an equivalent to natural sources of soil organic matter in terms of ecosystems and agriculture.

The Progress and Achievement for the study on the significant Program for Conversion of Cropland to Forest in China

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In 1999, the Chinese Government undertaken an initiative and launched the Six Key National Forest Programs in China aiming at combating desertification, improving national ecological environment, and promoting the sustainable economic and social development, and to bring soil erosion and flooding under control. The Program Conversion of Cropland to Forest, which is one of most significant actions. The Program for Conversion of Cropland to Forest included several types of lands which eligible the standard: (1) The land that has serious soil erosion and wind erosion.

(2) The degenerated steep slope farmland. (Gradient >25°)(3) The drought land and the serious desertification land.

(4) The land that is ecological significance but with low grain yield.

The programme for conversion of cropland to forest has started in 2001 and finished in 2010. The area of forest converted from cropland is planned to reach 220 million mu, and the area of afforestation in non-agricultural land is 260 million mu. Another task of the Program is the afforestation in barren hill. In general, the goal is to convert all steep sloping farmlands into forest, and to protect all the cropland currently facing severe desertification. The Program for Conversion of Cropland to Forest has involved more than 100,000 villages, more than 15 million farmer household, and more than 60 million people. It has become the biggest forestry development program in China. The monitoring and assessment of the program for Conversion of Cropland to Forest is a burdensome task that needs to invest a lot of money. To suggest an effective and accurate method for the Program much attention has be paid to attract a large number of skilled scientists. The study has provided a scientific basis for the decision-making, methods on programming, proper management for conversion cropland to forest. At present, the applied technology was based on remote sensing monitoring and assessment of each step of the project. The project, enables the transformation of the area to a natural ecosystem for recreation aims and to enhance biodiversity.

Characterization Physics, Chemistry And Agrochemistry For Some Organo-Mineral Fertilizer

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Keywords: organo-mineral, fulvic, FT-IR, DTG, tomato

It is known that the use of humic and fulvic substances that have chelate properties for elements like iron, copper, zinc, calcium, magnesium and manganese ensure their easy absorption by the plant and animal bodies.

Using some extracts of natural substances from vegetal origin, represented by salts of humic and fulvic acids into a complex matrix with chelates macro and microelements, leads to stable fertilizers from physical and chemical point of view. Fertilizers can be applied both extraradicular and drop wetting.

Extraradicular fertilizers obtained experimentally in order to characterize and achievement testing agrochemicals were NPK and NP type with salts of acids fulvic and humic and chelated micronutrients.

There were obtained from laboratory phase three variants of extraradicular fertilizers with organic substances composition with simulating role, obtained by extraction and separation and fulvic and humic acids from coal mass. Experimental fertilizers have been tested experimentally, by extraradicular application in the House of vegetation on tomato culture, variety Dacia - Pontica on chernozem soil.

Fertilizers, raw materials and intermediates in the process of obtaining were characterized chemically and physically with the methods of differential thermal analysis (TG, DTG, DTA, DSC) and FT-IR analysis.

They were tested against a blank without foliar fertilization (M0), two organic fertilizers "ECO" and a fertilizer extraradicular classic F 111.

A total of 14 variants were created with 3 repetitions and experimental fertilizers were applied as 0.5% solution concentration, the total of 3 treatments at intervals of 10 to 15 days.

Present paperwork shows the results of agrochemically tests carried out in the House of vegetation on a tomato culture using new variants of organo-mineral fertilizers with possibilities to be used both in conventional and ecological agriculture.

Investigation of soil pore continuity by using image analysis technique

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Keywords: Oxisol, tillage, irrigation, macroporosity, soil impregnation

The soil structure influences important soil, hydrological and agronomic processes. The soil with a favorable structure has suitable quantity and size of the pores and has greater water infiltrate rate and water retained. Concern the macroporosity the most important effects are on water infiltration and gas exchange in soils. The soil permeability to water and gas depends of continuity of pores. The pore continuity is destroyed with the agricultural operations. Structure close to ideal is found in soil under old pasture and forest. The problem in cultivated soils is to maintain a structure as near as possible to ideal despite the various stress applied. This study aimed to evaluate the impact of management systems (tillage and irrigation) on soil macroporosity continuity, under conventional tillage, two irrigation systems and potato (*Solanum tuberosum L.*) yield. The treatments were: three years under potato conventional cropping system, irrigated by a center pivot (CCP); three years under potato conventional cropping system, irrigated by a gun type sprinkler (CCC), natural pasture and native forest. The study was conducted in Paranapanema, São Paulo State-Brazil, located at latitude 23° 23'19"S and longitude 48° 43' 22"W, 610 meters above sea level, having a 0-0.03 m.m-1 slope, in an Oxisol, clay texture. According to Koppen's classification the climate is Cwa type, tropical humid with dry winter and rainy summer. Undisturbed samples were taken from the surface soil layer, between 0 to 0.30 m, with three replications. The impregnated soil image analysis method was used to evaluate the shape of soil macroporosity. The samples were prepared in the laboratory, placed in containers to which resin polyester was added by capillary action and left to harden. The samples were cut, one of the cut faces was polished and illuminated with ultraviolet light. The samples were photographed and the images obtained were analyzed allowing the identification of the soil macroporosity. Under forest and pasture conditions the aggregate formation was favorably influenced by biological activity resulting in a more homogeneous, m). In a strong pore system, with a considerable proportion of macropores (50-500 µm²) areas with conventional tillage for potato crop the cultivation degrades the physical soil properties causing the rupture of aggregates with formation of bigger and less porous. The association with the water impact from the self-propelled irrigation systems and less organic material in the soil surface layer result in the formation of horizontal fissures (> m) without connection between each other. In these situations water infiltration rates may be severely reduced, resulting in increased risk of surface runoff and erosion and/or water shortage in the root zone. The oxygen diffusion in this situation should be reduced causing some problems for plant growth and some chemical and physical processes in the soil.

Geographic information system about soil in the Czech Republic SOWAC GIS

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Keywords: GIS, soil conservation, map server, metadata, WMS

In 2006 Research Institute for Soil and Water Conservation has began, in terms of grant project of Ministry of agriculture, 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. The system is particularly presumed to be helping to solve problems concerning soil conservation and soil policy regulation. Structure of SOWAC GIS is divided into 3 application levels. First application level is Data Browser, where Web Archive of Systematic soil survey (WA KPP) and Web store of BPEJ maps are available. The aim of this application is to provide access to digitalized data of Systematic soil survey of agricultural land (<http://wakpp.sowac-gis.cz>). Second application is Map server within thematic map layers (<http://ms.sowac-gis.cz>). Open public thematic map layers are grouped into two projects. One of them "Basic Characteristics of Evaluated Soil Ecological Units" display complex kind of information based on Evaluated Soil Ecological Units. Second map project "Water and Wind Erosion of soils in Czech Republic" focus on soil erosion problematic including GAEC 2 implementation. Integral part of Map server is metadata catalog service MICKA that stores descriptive information (metadata) about soil data. At present there are accessible 2 Web Map Services which are free of charge. Third application is Web Map Service (WMS). Using WMS users can integrate data from a map server with own GIS applications (ArcGIS, GRASS).

Nitosol Porosity under two management systems by evaluated by computed microtomography and micromorphology

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Keywords: soil physical properties, soil micromorphometry, Brazil

The geometry of the pore space directly affects the growth of roots, soil aeration, infiltration, water supply and drainage, factors that determine the vegetative growth and consequently plant development. Thus, the size, shape and continuity of the pores affect many important processes in the soil. Consequently, it is important to characterize the pore space for the study of soil dynamics and its relations with plants. The micromorphology and microtomography are techniques for obtaining quantitative information about the structure and soil porosity by image analysis. In this sense, it was characterized the porosity of a Nitosol, under forest vegetation and annual crops (no-tillage) systems, in Botucatu/São Paulo/Brazil. For the study undisturbed soil samples were collected as volumetric samples and clods, respectively for micromorphological and microtomographic analysis, from the layer 0–0.15m. The results of the total porosity were analysed using the Tukey test at 5% probability. The results obtained by micromorphological analysis showed a predominance of complex pores under forest vegetation, while the area with annual crops showed 48.08% and 46.88% complex and rounded pores, respectively. Concerning annual crops there was a decrease of large complex pores of 12.69% in relation to the forest, and an increase number of rounded pores being 3.39% for large, 4.43% for medium and 5.11% for small, as a result of agricultural machinery, breaking the ramifications of larger complex pores and forming small rounded pores. The microtomography analysis showed difference between the managements: total porosity was 13% under annual crop and 23% under forest vegetation. For the pore size distribution it was found that annual crops area had pores with radii of up to 385 µm and the forest area pores with radii up to 1527 µm. It can be seen that the micromorphological and microtomography analysis are valid together, allowing the characterization of the porosity of the soil with complementary data, creating the possibility of integrating and synthesizing processes and understand the effects of the soil diversity.

Soil porosity evaluation by microtomography image analysis with Image J CTAn and Imago software

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Keywords: microtomography, soil management, soil physical properties

The methodologies for processing and image analysis have been shown to be extremely useful with a wide range of applications. One major advantage of image analysis is the ability to eliminate the subjectivity of human analysis and the possibility of extracting quantitative data that would be either very difficult or even impossible to obtain otherwise. The structure and porosity of soil can be qualitatively and quantitatively characterized by image analysis using different software. This study aimed to compare the image analysis with Image J, CTAn and Imago software for characterization and detail of the pore space of two soils and under two situations. For the soil class Red Nitisol were studied one area with secondary forest vegetation and other with annual crops under no-tillage. For the soil class Typic Quartzipsamment were studied one area with forest vegetation and other under pasture. Soil samples for microtomography analysis were collected in triplicate for each management system, with an average size of 2 cm by 1.5 cm. The sample images were obtained with a microtomography SkyScan 1172, located at EMBRAPA/CNPDIA. Nine hundred and twenty images per sample were generated in the process of image reconstruction. The reconstruction of the soil samples projections for images 2-D was made by the software NRecon. The results of the total porosity were analyzed using the Tukey test at 5% probability. The same statistical analysis was used to compare the different software in the quantitative study of the porosity. The software Image J and CTAn allow simultaneous processing of all generated images. The Imago presents a limitation on the number of images processed. The software usually works with about two hundred images. If the number is higher than this the computer may stop responding. The three programs allow to select the region of interest. This selection in the CTAn and Image J software can be done in various formats with the ability to enlarge the image at the time of selection. The format of the selection areas should be square or rectangular for Imago software. The images generated by microtomography are in grayscale, with no need for a new conversion programs for CTAn and Image J for adjusting threshold. However, for the Imago software the images must be converted back to the program to continue the process of image analysis. The binarization of the images is made easier with the software CTAn and Imago. Concerning the total soil porosity there was no significant difference between treatments. The averages generated by the software Image J and Imago were quite close. The software Imago also allows classify the pore size distribution. The CTAn and Imago software allow the reconstruction of 3-D models of the soil samples. The three software allow adequate evaluation of porosity using image analysis.

Aggregate stability of Venezuelan soils sensitive to surface sealing and crusting

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Keywords: aggregate stability, surface sealing and crusting, aggregate size fraction.

Soil aggregation results from the rearrangement, flocculation and cementation of soil particles, through the action of binding agents affected by soil characteristics such as organic carbon (OC), biota, ionic binding, clay and carbonates. However, there are other factors promoting the fragmentation, dispersion and degradation of aggregates, with soil surface sealing and crusting as a result. The objective of this study was to evaluate the effect on aggregate stability of soil physical, chemical and mineralogical characteristics of Venezuelan agricultural soils sensitive to surface sealing and crusting problems. Five agricultural soils (El Salao, Quíbor, Danac, Turén, El Sombbrero) were sampled to a 0-5 cm depth range. Among the characteristics were particle size distribution (texture), clay mineralogy, pH, electrical conductivity (EC), exchangeable cations, cation exchange capacity (CEC), calcium carbonate (CaCO_3), and OC associated with mineral particles. El Salao soil had the highest aggregate stability with high values of clay, CEC, Mg and clay sized OC and a dominance of kaolinite; whereas the others soils presented low aggregate stability with high values of silt, pH, EC, CaCO_3 , Ca^{2+} and silt sized OC, and a dominance of smectite and micas. The aggregate stability was evaluated by the wet sieving method. Soil physical, mineralogical and chemical characteristics were determined for evaluating the aggregate stability.

Soil sealing indicator for agricultural soils in Venezuela

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Keywords: soil sealing susceptibility, indicators, surface degradation, and structural stability, Venezuela

Soil sealing is a degradation problem that involves different factors, processes and mechanics. Different methods and methodologies to assess those factors and processes can reflect different results and levels of soil structure degradation within the same soil, under different climate and management conditions.

Standardized methods were evaluated for assessing soil sealing in five Venezuelan soils, with different texture and organic carbon content. The objective is to select indicators for predicting soil sealing.

The results showed that the amount of water stable aggregates (WSA), the medium weight diameter (MWD) of the aggregates, the particles with diameter < 0.25mm (P250), the absolute sealing index (ASI), the consistency index (C_{5-10}) and the soil losses from simulation rainfall were able to evaluate the stability of the soil surface structure. However when all the methods were compared based on the classification criteria of each method, the MWD and C_{5-10} had a discrepant class of soil sealing degradation when compared with other methods. The WSA, P250, ASI methods and soil characteristics as SOM chemical fractions and particles between 2 and 100 μm diameters, had high correlations among each other but all had good relationship with soil losses under simulated rainfall.

From this study it can be concluded that a simple laboratory method is enable to evaluate soil surface sealing susceptibility but the method needs to be validated under field conditions as well.

Effectiveness of buffer strips in the Austrian agri environmental programme

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Keywords: VFSMOD, filter strip, effectiveness

In the period 2007-2013, the Austrian agri-environmental programme (ÖPUL) subsidizes installation of buffer strips along permanent streams as means to reduce sediment and nutrient input into water courses. Subsidies are linked to certain management restrictions (50 m grassed buffers, no fertilisation, only one cut per year). To evaluate the potential for this kind of buffer strips to reduce sediment input into water courses we attempted to apply a scaled modelling approach. VFSMOD, a plot scale filter strip model with high spatial and temporal resolution was validated and used to obtain buffer strip effectiveness for a wide range of combinations of those input variables with highest sensitivity to sediment delivery. Using these results, a retention effectiveness matrix was built. Main parameters of this matrix were slope of the filter strip, soil texture and amount of sediment input. To apply the matrix to large areas we used an erosion model as surrogate for sediment input. Soil information was obtained from available digital soil maps and slopes were calculated from DEMs. Due to the very low participation levels of the subsidy program a comparison between potential and actual effectiveness turned out to be a rather useless exercise. The low participation levels stimulated the search for optimisation of the present subsidy scheme. Using VFSMOD again we explored the possibilities of reducing buffer strip length.

The impact of parent material on nutrient availability in two litho sequenses of alluvial Greek soils

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An investigation was conducted in the province of Elassona (Central Greece) and the surveyed area consists of 105000 ha. This area is irrigated and cropped to vineyards, winter wheat, almond trees and alfalfa. Data were obtained from soil determinations of two lithosequenses developed in different parent material under similar topographic, climatic conditions and deposition time. According to data provided by the local Meteorological Station, the mean annual precipitation exceeds 580 mm per year, the soil moisture regime is *xeric* and the soil temperature regime is *thermic* (Soil Taxonomy, 1999). The first set of soils was developed by the weathering of hard limestone and the second one is originated from gneiss-schist material. Results have shown different degree of soil development and degradation in the examined parent materials. The coexistence of *Alfisols* (Soil Taxonomy, 1999) in different parent material, the degree of evolution with pronounced variability of certain properties were also investigated. Differences in nutrient availability were recorded in the following nutrients and trace elements, such as: calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), manganese (Mn), iron (Fe), cooper (Cu), zinc (Zn), lead (Pb), cadmium (Cd) and nickel (Ni). Low content of soil nutrients recorded in the examined soils denotes to some extend the degree of soil degradation. Furthermore, the content of exchangeable bases and trace elements was increased in the soils derived from lime material in comparison to those originated from gneiss-schist. This degradation can be attributed mainly to leaching of cations and metals and secondary to human activities by means of land management techniques. Land degradation has been strongly affected mainly by nutrient depletion, soil erosion and overgrazing. However, taking into account all other soil-forming factors relatively constant, the observed differences in soils across the study area can be attributed mainly to parent material. The following measures and practices are suggested for the maintenance and enhancement of soil fertility and protection from degradation, such as: cover crops during the winter period, rational management of irrigation water, proper tillage practices, application of rotation schemes, and recommendation of rational fertilization practices.

Digitization georeference and unification of the analog soil survey reports and maps in Thessaly Greece

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Keywords: Soil survey, soil maps, digitization, unification

Soil surveys are detailed reports of the soils of an area, including maps with soil boundaries and photos, descriptions and tables of soil properties and features. Soil surveys are used by soil scientists, agronomists, engineers and farmers and other who desire information about soil resources.

Almost all soil maps in Greece and elsewhere surveyed till the '90 are in analog form. Due to this fact, it is not very easy to access their information and obtain the maximum potential using them. Today, soil surveys are processed digitally using the GIS and remote sensing technologies, are published to the web and accessed worldwide. This allows for easy access and rapid flow of the latest soil information to the user. In the past it could take years to publish a paper soil survey and today it takes only moments for changes to go to the public.

The objective of this paper is to present the flowchart and the results of the digitization and geo-reference of the analog soil survey reports and maps in Thessaly, Greece, and the unification of their spatial and descriptive data in a practical manner. The method comprises the following steps: collection of the already digitized 'Soil survey reports and maps', of several sub-areas in Thessaly, digitization of the analog 'Soil survey reports and maps', of the rest sub-areas, scan and geo-reference of maps, import of descriptive information on cartographic units and points of sampling, digitalizing scanned archive maps, building of topologies and unification of spatial data with descriptive information.

The delineation of the unification procedure of the digitalized maps, in the level of Thessaly and the location of the overlapped and un-surveyed areas are among the most important results. The soil survey of the un-surveyed areas is the next step.

Influence Of Bulk Density On Soil Resistance And Yield Of Tobacco

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Keywords: bulk density, soil resistance, tobacco

During the two years period, research was done on the effect of bulk density on soil resistance and yield of tobacco. The two year long research was carried out in the green house of the Faculty of Agriculture in Zagreb, in an experimental model in Mitscherlich vegetation pots.

Three levels of soil compaction (1.2, 1.4 and 1.6 gcm⁻³) were randomised by the block method in four repeats. In the experimental model alluvial soil taken from the A_p horizon (0-28 cm) was used, this is typical for the soil used in tobacco cultivation in Croatia, the bulk density in the field amounted up to 1.46 gcm⁻³. The tobacco was harvested six times, dried in the shade, and after the last harvest the root was rinsed on a sieve and weighed. During flowering, the soil resistance of the soil and the momentary moisture content were measured. According to the increase in bulk density of the soil there was a significant increase in soil resistance and a decrease in root growth. At the lowest bulk density the soil resistance came to 1.85 MPa, at the mean bulk density to 5.1 MPa and at the greatest to 9.05 MPa, with a momentary moisture content of 14,7%, 13,1% and 18.8%. The increased soil resistance found with the mean and greatest bulk density resulted in the first, and 15.3 and 37.2% respectively in the second year of research.

The research results obtained from experimental models carried out in the green house strongly suggested that soil compaction is a cause of reduced yields obtained in the field.

Crop residues management on soil fertility and crop yield for winter wheat cultivated in Southern Italy

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Keywords: vertisol, winter wheat, crop residues

In Southern Italy, as in the other typical areas of Mediterranean region, the cultivation of winter cereals in continuous cropping rotation could determine significant decrease in soil organic matter and availability of main soil nutrients. Soil management procedures, addressed to soil conservation in terms of chemical, physical and biological properties, can be useful tools if they preserve or increase the productive level and the economical sustainability of the entire cropping systems. In this framework the loss of soil organic matter can be alleviated by ploughing in of crop residues, with positive effects on structure stability and nutrient availability Nevertheless, stubble and straw burning is a practice not completely disappeared in Southern Italy with the objective to reduce the crop residues loads in soil surface.

The Research unit for cropping systems in dry environments of CRA (Italy) is carrying out a long-term field research started in 1978 regarding the study of the effects on crop productivity and soil fertility of different straw and stubble management practices for a continuous cropping of durum wheat (*Triticum durum* Desf.). The field research is located in the Northern part of the Puglia Region (Southern Italy) on a silty-clay Vertisol of alluvial origin and classified as fine, mesic, Typic Chromoxerert. The experimental field design is a randomized block with plot units of 80 m², 5 replications and 9 treatments involving burning and ploughing in of wheat residues with and without: (i) nitrogen applications on residues (3 levels of urea) and (ii) irrigation (500 m³ ha⁻¹). This paper reports the effects on soil fertility and crop yield of these treatments after 30 years of continuous wheat cultivation. Chemical indicators (total organic carbon, total extracted carbon, humic and fulvic acid contents, humification ratio and humification index, degree of humification, pH, total nitrogen, contents of ammonium and nitrates, phosphorus, potassium, calcium magnesium) of two soil layers (0-20 and 21-40 cm) were subjected to statistical analysis performing an one-year (2009) analysis of variance by fitting the general linear model based on linear and orthogonal contrasts involving all nine treatments. The main relationships of the chemical parameters and indicators of crop productivity were discussed and related to the studied agronomical practices and the climatic conditions of Mediterranean regions.

Strategies for Measuring Wind Erosion at the Regional Scale, Observation of Wind Erosion in Khanasser Valley Region, Syria

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Keywords: Measuring wind erosion, Regional scale, Wind-blown mass flux

Windblown sediment transport is mostly measured at field or plot scale due to the high spatial variability of its values over the tested area. On the other hand, regional scale measurements are often limited to measurements of the change in the elevation providing information on net erosion or deposition. Therefore, for the calibration and validation of regional scale wind erosion models, insight in windblown mass fluxes at the regional scale is essential. The objective of this research is to develop a measurement strategy that provides insight in regional scale windblown mass fluxes, and observational data that can be used to calibrate and validate a regional scale wind erosion model.

So far, equipment for direct observation of windblown mass fluxes at the regional scale does not exist. Instead, to retrieve insight into mass transport at the regional scale information needs to be collected on mass fluxes at various land use types found in the area under test, and information on the effects of the borders between present land uses. This information can be combined by using model units of the size of arable fields in a regional scale model in order to predict the mass flux and soil loss.

Here, we use a portable plot strategy to maximize the total number of measurement plots with limited equipment, time and money. Measurements on windblown mass transport were executed at 17 plots in agricultural stability zones 4 and 5 in the Khanasser valley, Syria in 2009 and 2010. At each plot 16 MWAC (Modified Wilson and Cooke) sediment catchers were installed. In addition to the sediment catchers, a full metrological station to record wind regime, temperature and relative humidity was installed at each plot during the measurement period.

The results of the current research show that the values of mass transport ranged from 0 kg.m⁻¹ inside the harvested-no grazed wheat fields to 64.43 kg.m⁻¹ inside rangelands area. Resultantly, with the strategy of portable equipment installed on different plots, information on mass transport for different land uses in the region can be obtained. Consequently, this knowledge is adequate to be used for calibration and validation of a field scale model under different land uses present in the region, taking into account border effects.

Congress Thematic Session

2. Forest fires impacts on natural resources and cultural heritage

ORAL PRESENTATIONS

Impact of forest fires on soil

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Introduction

Forest fires are a complex phenomenon, with enormous socio-economic and environmental impacts, and likely to be aggravated by the evolution of climate change. In understanding the dynamics of wildfires, there are clear climatic implications, as demonstrated in the year 1998 and other drought periods in different regions and occasions. Dry environmental conditions, tinder-dry vegetation and hot and desiccating winds are a dramatic combination, which initiate and rapidly propagate fires, leaving little possibility to control them. Probably the influence of climate change in drylands will exacerbate the problems of wildfires. The last IPCC Report (November 2007), indicate worse predictions than in previous reports. The aridification trend of Mediterranean climate probably will exacerbate synergic interaction and feedback mechanisms between fire and land degradation

Fires are a permanent characteristic of the Mediterranean forest environment. Fire is a natural component of Mediterranean terrestrial ecosystems as part of contributing to modelling landscape and forcing adaptive responses of vegetation. They have long been present and probably will remain an enduring menace. Despite the relative abundance of burning activities, over time, in the Mediterranean the number of fires had maintained a relatively low level that somehow gave options for the recovery of the affected areas. However the situation changed during the seventies of last century. From that time the number of forest fires and the extent of the affected area have grown tremendously in southern Europe. Only recently, due to significant financial resources and the creation of an important human infrastructure and technical resources, the extent of the affected area shows a tendency to decrease while the number of fires shows a worrying trend of increase. This pattern is applicable to the whole European Mediterranean region. However, this relatively positive trend often shows frequent severe fire emergencies through the Mediterranean basin

Mitigation study raises important conceptual, technological and management challenges and opportunities. This presentation describes some of the most important effects of forest fires on the physical, chemical and biological soil properties, along with their effects on vegetation cover and hydrological processes associated with the production of runoff and erosion. The information is based on long experience in the Department of Conservation and Land Degradation in the CIDE (Valencia, Spain), mainly from the use of permanent experimental stations for the study of forest fires.

General trends

Humans have always had a long and intense relationship with fire. There is a complex pattern of relationships, sometimes utilitarian, sometimes catastrophic, between society and the fire. Even some authors who believe that fire management was the most important factor in the leap from hominid to homo sapiens, considering fire at the starting point for the development of humanity and civilization. Forest fires are a phenomenon of global dimensions. They are spontaneous, provided there is cover, both north and south of 70 degrees latitude and the natural factor are normally trigger by the action of lightning. Annually and globally burn between 300 and 600 million hectares, the largest percentage of these figures correspond to areas of savannas and cleared forests. The WWF called the year 1998 as "the year in which burned the world" This year, one of the warmest of the last century, intense and prolonged

drought led to the drying effects of soil and vegetation in affected areas, supposedly influenced by the oscillation of El Niño. In total, the fires affected some 10.000 million hectares, many of them in USA, South Asia and Indonesia. In the USA the year 2006 was rated as the most destructive period since records began. That year burned more than 3.3 million hectares as a result of some 96 000 fires and damage was estimated at more than 1.5 trillion dollars. The Mediterranean basin is also one of the worst affected areas. Fires are a permanent feature of Mediterranean environments and are likely to remain with us as a regular threat. However in the last three decades there has been an abnormal escalation in the number and extent of forest fires. In Spain, this increase began in the mid 70's and reached its peak in 1994. That year, only in Valencia (Spain), burned about 100 000 hectares. After this zenith, has been producing an attenuation of the extent of the area affected, although not the number of fires, which shows an increasing general trend. This pattern applies to the whole of Mediterranean Europe. Every summer there is serious fire situations scattered throughout the basin. We all remember the dramatic TV pictures showing serious fires in Portugal during the summers of 2003, 2004 and 2005. In 2005 the total area burned in five Mediterranean European states (France, Greece, Italy, Portugal and Spain) was 589 559 hectares. In that year the number of fires was 73 325. Both figures are well above the average values of the past 26 years (European Communities, 2006) recently also recalls the situation of Galicia in 2006, with thousands of fires threaten towns, roads and rural settlements. In August 2007, in Greece more than 200,000 hectares were burned and the economic damages was estimated in 3 billion € equivalent to the 0'7 of the GDP of the country.. Recently., In Agust 2009 also in Greece, uncontrolled fires surrounded Athens with serious environmental, socioeconomic and cultural heritage impacts.

The study and evaluation of forest fire dynamics reveals certain climatic implications as highlighted during 1998 and in other periods of drought in different regions. Environmental conditions dry and warm and drying winds are a dangerous combination that produce kindling effect on vegetation and can lead to easy ignition and rapid spread that leaves little to control the spread of fire. Therefore, along with the impact of fire on current situations, it is also necessary to consider the implications of the global warming trend. The record of historical data in the Mediterranean shows significant overlap between the periods of drought and the number of forest fires. The tremendous increase in fires in Portugal in 2004 and 2005 coincided with a long period of marked drought. These circumstances may be a premonition about a troubling perspectives related to climate aridification trend and its likely impact and synergies in increasing the risk of fire.

Impacts on soil properties

A key aspect of the effects of fire on the land is the severity of the fire. Severity is the determinant of the degree of impact and consequences of fire. The severity is related to the energy released during combustion of biomass, the values of the temperatures and time spent by them.

Fire severity depends on several factors. The type of biomass and its characteristics. Including availability and quantity of biomass fuel, the type and distribution pattern of plant cover, chemical composition and degree of ignition and flammability. The type and amount of litter and humus layer is also an important factor. Also important are soil conditions including for example stoniness and wet conditions. Other factors that influence the severity of the fire are the weather conditions at the time of fire (temperature, humidity, wind) and topographic conditions that can significantly influence its spread.

A general level of fire severity classification considered moderate severity temperatures between 200 and 400 ° C and a high severity fire when temperatures exceed 400 ° C. In these two ranges of severity there are different consequences for vegetation and soil hydrological processes. In high severity fires, chemical physical and biological soil properties, suffer major changes while with moderate severity fires physical properties have few changes meanwhile chemical and biological properties are affected. As erosion and runoff is concerned, fire always tend to produce significant changes and enhancements, which can be very significant in high-severity fires and especially when these occur in steep topography and erosive rainfall post-fire.

The fire affects directly the soil through the thermal shock and its impact on living and dead plant biomass. The passage of fire charred part of the cover and removes the superficial layer of mulch, resulting in the deposition of a heavy layer of ash. The removal of biomass leads to losses in the ability of rainfall interception and lost in the water storage capacity in the litter. On the other hand, there is a water loss decrease by leaf transpiration and evaporation. The biological impact is important for the sudden reduction in both biomass and soil organic matter resulting in severe disruption of biogeochemical cycles, microbiological processes and the emission of large quantities of CO₂ into the atmosphere by the mineralization of organic compounds. The loss of biomass also leads to changes in surface roughness and changes in the albedo of the soil surface. Albedo change has important implications for their effects on radiation balance and its implications for the thermal regime of soil and microclimate conditions.

Another important aspect is the implications of the phenomena of hydrophobicity or water repellence. The hydrophobicity reduces or prevents the infiltration and consequently may lead to increases in runoff and concentration of runoff which would be enhanced erosion. This is a research topic that is receiving much attention recently with studies that demonstrate the complexity of the issue (Doerr et al., 2000). In general we can consider that the fire at temperatures below 300 ° C, leads to the development of hydrophobicity in the soil surface and when temperatures exceed 300 ° C the hydrophobic layer may develop in subsurface horizons.

As indicated above, **soil physical properties** (texture, structure, bulk density and porosity) are often less affected than the chemical and biological properties. In particular, the texture is only affected up to high temperature thresholds. In particular, the internal structure and hydration of clays only begins to collapse from 400 ° C. Changes in soil structure are linked to impacts on cementing substances and compounds, of which the most important and sensitive is the organic matter, which start combustion even at temperatures below 100 ° C. The iron and aluminium oxides and carbonates are much more resistant. The structure also influences the processes of flocculation and dispersion of clays and the development of hydrophobic substances.

The bulk density tends to increase due to the destruction of organic matter promotes the weakening of aggregate structure and compaction.. As a result, the overall trend is also reducing the porosity (mainly macropores). The soil surface can be further compacted by the effect of the impact of raindrops on post-fire rainfall. The accumulation of ash also tends to clog the pores and therefore the overall effect is a partial effect of sealing the soil surface and reduced infiltration capacity, facilitating the increase of surface runoff and erosion.

In the set of **chemical properties**, perhaps the effects on organic matter are the most significant because it also affects the physical and biological properties. As noted, the organic component of soil is very sensitive to the heat impact and the level of affection is closely related to the severity of the fire. Organic matter is particularly important in the supply of nutrients from soil, cation exchange capacity, water holding capacity, biological activity and soil resistance to erosion.

Changes in soil pH occur primarily because of combustion of organic matter releases soluble cations in general tend to raise the pH. The intensity of change depends on the original soil pH, amount and chemical composition of the ash released, and rainfall. However, changes in pH are usually temporary. Gradually, the soil tends to return to their initial reaction.

The most important nitrogen losses occur through volatilization (from 200 ° C), thus producing a net loss of this crucial nutrient. By contrast the majority of other nutrients such as potassium, calcium, magnesium and phosphorus returned to the soil with the ashes. Also there are substantial changes in the dynamics of nitrogen affecting the transformation of organic nitrogen to mineral N trough nitrification.

With regard to biological properties, the passage of fire, affects especially the microorganisms, an micro and meso fauna fauna of the soil surface horizons and litter layers. The sterilization effect destroys bacteria and fungi that carry out important functions of biomass decomposition, humification and biogeochemical cycling of nutrients such as nitrogen or phosphorus. Also affected microrizas associations and biological surface crusts, which play such an important role in protecting the soil against erosion effects. Another important consequence is the alteration of enzyme systems linked to soil biological activity.

After the fire the soil is unprotected because the disappearance of vegetation cover and some of its basic characteristics are altered, as a result there are changes in its functions in relation to the water cycle that affect basin water balances. Burned soils show a general surface sealing effect owing to the combination of the effect of the ashes deposition, hydrophobicity and alteration of the structure that carry a strong increase in surface runoff and a significant increase in the erosion process (Rubio et al, 1997). These effects are widely documented in the literature and have also been studied in detail in the permanent stations of Porta Coeli and La Concordia (Valencia, Spain). There is a very significant increase in the intensity of the erosive process after repeated fire, denoting an increase in vulnerability of the system and a reduced ability of resilience.

After the fire, the system starts a slow recovery that may take decades to return to its starting position. This recovery process is usually associated with a loss of biological quality. After the fire it can occur severe soil degradation processes by heavy runoff, erosion, loss of organic matter and alteration of soil properties (Rubio et al, 2003). But usually recovery is possible and this has been occurring over time in the Mediterranean. However there are circumstances in which the impact of fires is particularly damaging affecting the survival of the affected forest area and increasing the risk of desertification. These circumstances occur when the fire is accompanied by other unfavourable circumstances. Among others it can be included the fire occurrence in areas with steep slopes; when it occurs on shallow soils, usually in rocky areas with plenty of rocky outcrops; in soils with difficulties of self recolonization owing to their unfavourable properties; when fires occur repeatedly over the same area in a short interval of years that do not allow recovery of the system and, finally, when a high severity fire in a vulnerable area is followed by high intensity erosive rainfall. In general, but particularly in these conditions, forest fires are one of the most important factors in increasing the risk of desertification in the Mediterranean.

Challenges and opportunities

Forest fires are a complex phenomenon, with enormous environmental, socioeconomic and tend to worsen due to the evolution of climate change.

The development of policies for prevention, suppression and restoration of areas affected by fires requires previous knowledge of the characteristics of the processes involved their impact on the environment and the evolution and response of the affected areas. The level of knowledge available has gradually improved but there are still many issues, circumstances and factors related to forest fires on which we have to provide facts and information. It is necessary to increase awareness about the phenomenon itself, in its environmental effects in the short and long term and in their social and economic costs. The detailed information of processes gives a favourable position to mitigate or at least to improve the management and recovery of affected areas.

Mitigation and control of the continuing threat posed by wildfires represent major challenges and opportunities for conceptual, technological and management aspects. The possibilities and options to improve the mitigation of wild fires are very broad. There is a general level or passive structural control based on policy approaches and designs adapted to forest biophysical Mediterranean that demand further development and implementation. The design of approaches based on forest multifunctionality characters have to consider not only the productive and ecological functions but also and primarily a forest structure that mitigates the risk and spread of fires by increasing structural preventive aspects.

The issue of surveillance, intervention and suppression is a key aspect that undoubtedly provides great opportunities for innovation and technological development in the perspective of continuous improvement and greater efficiency.

Once the fire occurred there is also an interesting field of innovative actions on recovery approaches. Restoration techniques, measures of soil and water conservation, reintroduction of species, and the use of organic amendments are some of the many specific aspects to be reinforced. Specially, bioengineering approaches in soil and water conservation and landscape

restoration offer new and interesting options for the development of a Mediterranean forest more diverse and stable.

In the general framework for combating climate change, combating forest fires and the development and enhancement of natural sinks for CO₂ capture and storage are complementary options. Besides the possibilities of technological innovation in this area there are also economic choices arising from a monetary valuation of environmental externalities of the forest, including its role in regulating greenhouse gases.

Modelling Water Balance and Erosion in AgroforestryThe Water Retention and Throughfall in Tree and Bush Canopies

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Keywords: water balance, erosion models, vegetation cover, water/soil conservation

The conservation of soil and water is a key priority for the proper management of watersheds and for the land use. Controlling runoff/infiltration and combating soil erosion are the two major aspects to take into account for the related management strategies. In areas of Mediterranean climates of southern Europe the mixed use soil is quite common and trees and shrubs are quite often associated with arable crops, under their canopy. The analysis and treatment of those vegetation covers have not been carefully considered in the scope of hydrology and the models used to quantify erosion rates disregard this aspect. We sought to understand the main behavior of those canopies for different precipitation rates, in terms of interception, retention and dripping. This was aimed to the development of a component, to be included in water balance and erosion models, to quantify the water retention and the crop cover factor, for land use systems with trees and shrubs together with agricultural crops; particularly, quantify rainfall abstractions and to include a subroutine for the cover factor C, in the revised universal soil loss equation (USLE / RUSLE). A rainfall simulator was used in the experimental work to measure the diameters of the drops, dripping from the leaves of species characteristic of the land use systems most common in southern Portugal, including: "sobreiro" or Cork oak (*Quercus suber* L.); "azinheira" or Holm oak (*Quercus ilex* L. ssp. *rotundifolia* Lam) and "carrasco" or Kermes Oak (*Quercus coccifera* L.). Also, the amount of water retained at the surface of the leaves, at the begin and at the end of the dripping, was measured. Different scenarios for the hydrological behavior of the cover canopy were established from the obtained values. The kinetic energy for different drop heights and cover densities were estimated and, consequently, values of the cover factor C usually applied in agricultural crops were adjusted.

Impact of wildfires on aboveground biomass in shrublands of Lagadas county in northern Greece

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Key words: unburned area, cover type, burned area, woody biomass, herbaceous biomass

Large forested areas are destroyed by wildfires in Greece each year. A significant part of these areas comprises rangelands that are degraded considerably events lead to low biodiversity, soil erosion, water runoff and low soil productivity. The present study was carried out in an area of 563.2 ha, located at Lagadas county, which was burnt in 2007. The dominant shrub species of the area are kermes oak (*Quercus coccifera*) and wild pear (*Pyrus spinosa*). In burned and unburned shrublands of three cover types, namely open (10-40%), medium (41-70%), and dense (71-100%), the aboveground biomass of both herbaceous and woody species was estimated at the end of the second growing season since the wildfire. It was found that the herbaceous biomass was increased considerably two years after the fire apparently due to the reduction of woody plants. Woody biomass however was lower in the burned than in the unburned area. Nevertheless, the total biomass was the same in burned and unburned areas because of the higher yield of herbaceous vegetation which balanced the reduction of the woody biomass. Also, medium shrublands produced significantly more herbaceous biomass than the open ones as the latter were exposed to heavier grazing by livestock.

Runoff and sediment transport after forest fire: Case study on the watershed of water reservoir "Zavoj" in Eastern Serbia

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Keywords : influence of forest fire, runoff, soil erosion, sediment transport.

Forest fires are important factor increasing the risk of land degradation. Forest fires has an important influence on biotic and abiotic properties of the soil in a watershed. Normally after forest fires increases in peak runoff rate and volume, and increases in sediment transport in a watershed (Robichaud, et al., 2000). Watershed of water reservoir " Zavoj" is emplacement on Stara planina Mt in Eastern Serbia, near to boundary with Bulgaria. This reservoir is very important for water supplying and energy production in this region. In summer in 2007 yr a part of watershed was fired as a consequence of high temperatures and drought. Fire was spread complex of mixture forest and forest planting in area of 294.3 ha. The aim of the work described in this paper is to determine influence of fire on runoff, soil erosion and sediment transport in the watershed, and to identify potential the best land management in the region of forest fires.

Studies of runoff, soil erosion and sediment transport before and after forest fire on watershed show that soil erosion and sediment transport after fire is extremely higher. Empirical models SWAT (Soil and Water Assessment Tool), and Gavrilovic method are used for calculations of hydrological parameters. These results are input for risk area mapping of land degradation after forest fire.

Soil conservation in the Czech Republic and implementation of GAEC 2 requirements

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Keywords: GIS, GAEC 2, Factor of the Canopy Cover

Evaluation of erosion processes and their consequences is an important content of the research activities carried out within the activities of the Research Institute for Soil and Water Conservation. Water erosion risk is currently a much discussed topic at the European level.

The GAEC requirements refers to a range of standards that relate to protection against soil erosion, maintenance of soil organic matter and structure, avoidance of the deterioration of habitats, and water management. This paper deals with implementation of GAEC 2 standard concerning soil erosion issue in the Czech Republic. The main objective of this standard is to protect the soil against water erosion and efforts to reduce the negative effects of erosion (flooding, clogging by the washed soil). This standard deals with the problem of soil erosion by establishing requirements for the main method of selected crops cultivation on the highly endangered soils.

According to EU legislation the Czech Republic set the rules to meet criteria of Good agricultural and environmental condition (GAEC). The limit criteria of GAEC are set upon the map of „The Maximum Admissible Value of the Conservation Effect Factor of the Canopy Cover (Cp)“ on blocks of arable land in the Czech Republic. The map is based on the Universal Soil Loss Equation (USLE) and was created in the Research Institute for Soil and Water Conservation as a part of the new research of Ministry of agriculture. This map has become a tool to protect agricultural land against water erosion. The map is primarily intended as a basis for the suitable way of farming on the soil blocks or parts of them. The output is raster map with 10m resolution which gives information about limit values of Canopy Cover Factor. On the map the soil is divided into categories and according to the Cp values the specific and appropriate organizational or agro-technical measures using specific methodologies can be identified (Janeček et al., 2007; Hůla et al., 2003). The aggrieved farmers should not exceed the limit factor Cp on the individual blocks of arable land. In case of exceeding this value it is necessary to implement the erosion control measures. The existence of this map is mandatory for conditions compliance assessment of GAEC 2. All the layers of the water erosion and the GAEC 2 definitions are public in the map project "Water and wind erosion of soils CR" at <http://ms.sowac-gis.cz>.

Another models using USLE with GIS tools to determine the most appropriate location for soil erosion control measures in the landscape, such as agro-technical erosion control measures (i.e. conversion of arable land to permanent grassland) and technical control measures (a ditch and a sediment trap) and their implementation have been modeled (See presentation of T. Dostál, Czech Technical University in Prague, CZ at the ESSC congress).

Wind erosion effect on soil properties in “protected” and “not protected” areas in GBAO region, Tajikistan.

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Keywords: soil, wind erosion, degradation, protected areas, sand accumulation.

Agriculture is widespread in GBAO (), eastern Tajikistan, where wind erosion of farmland is very common because of sandy soil and dry, windy weather. Here the cultivated lands mainly situated in the river bank where sandy soil are vulnerable to erosion. Because of the high level of poverty and fuel shortage, the population in the mountains areas use the forest belts (created to protect the cultivated land from wind erosion) for their own needs. During the last decades because of not regulate deforestation, most of the fertile lands affected by wind erosion. According to official data about 47 % of farmlands nowadays degraded by wind erosion. However, there is no any data about effects of wind erosion on soil properties, particularly the effect of accumulated sand on the agricultural soil environment in semi-arid areas of GBAO. Thus, it is important to analyze changes in the physical and chemical properties of agricultural soils due to long-term wind erosion and leeward sand accumulation, and to evaluate the relationships among different soil protective measures on soil properties and degradation processes. There was organized a research to evaluate differences between “protected” and “not protected” (where the wind belts were destroyed) areas.

The results of the research shown that soil organic C decreased significantly with an increase in the eroded depth, with decreases of 35.5% and 84.2%, respectively, in the lightly and severely eroded sites compared with the protected sites. Accumulated sand also resulted in a significant decrease in soil organic C, but the magnitude of decrease was significantly lower than that in the wind-eroded sites (P <0.05); organic C decreased by 11.8% and 18.5%, respectively, in the light-and severe sand accumulation sites, compared to the protected sites. Total N and total P contents decreased significantly, while total K tended to increase with an increase in wind erosion depth. Total N and total P decreased by 54.4% and 31.8% respectively, and total K increased by 10.5%, in the severely eroded sites compared to the protected sites.

Soil pH increased in not protected areas. The pH value in the severely eroded sites was significantly higher than that in the protected sites.

Soil water content was calculated as (wet weight —dry weight/wet weight) x 100%. Wind erosion and sand accumulation did not result in significant changes in average soil water content in the 0-5 or 5-10 cm soil layers at any of the sites, but average soil water decreased significantly in the 10-30 cm soil layer with an increase in wind erosion depth and accumulated sand thickness. Compared to the protected sites, soil water content decreased by 35.8% and 76.5% in the lightly and severely eroded sites, and by 1563% and 21.9%, respectively, in the light- and severe sand accumulation sites (10-30 cm depth).

The data indicate that in arid and semiarid areas, soil protection is one of the most important factors influencing the storage of soil C, nutrients and water in nutrient-poor sandy soils. In our study, soil organic C, nutrients and soil moisture decreased significantly with compare to protected lands. Thus soil protection must be considered one of the main factors influence on plant productivity in some areas.

Fire Effects on soil physical and chemical properties in Guilan province Iran

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Keywords: Fire, Soil properties, Water repellency

This study was conducted in burned and unburned forest area in Guilan province, the north of Iran. The objective of this study was to investigate the effect of the forest fire on physical and chemical soil properties one month after the fire. Pilimbra site from pinus taeda community were chosen and soil samples from three depths (0-3, 3-6 and 6-9 cm) under the forest floor were collected. Results of this study indicated that clay content significantly ($P<0.05$) decreased and EC values significantly increased on the first and second depths in the burned area. In addition, pH values and phosphorous content significantly increased on the first depth in the burned area. However, there was no difference in sand, silt and nitrogen contents, bulk density, porosity, MWD, CEC and base saturation values on any depths. These results indicated that fire severity plays an important role in determining the extent of nutrient enrichment following the fire. Moreover, the results of WDPT test showed that the unburned site had not water repellency, while the burn site showed this phenomenon in the first depth. It seems that denaturation of the organic matter due to combustion is probably the main reason for this status. All the findings revealed that the fire effects on soil chemical and physical properties were confined mainly to the top soil of the study area which had a low intensity fire type.

Identification And Proclamation Of The Erosion Areas On State And Regional Level

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Over more than a hundred years of activity, numerous methods were developed that are still in use. Namely, all past and present water-related laws of the Republic of Serbia contain provisions that prescribe mandatory erosion and torrent flood control, as well as institutional organization of control of these two inter-related phenomena. As in other countries, the competence and responsibilities with regard to the said efforts are shared by specialized state enterprises, agencies, and local bodies of self-governance. Measures of erosion control by appropriate land husbandry are implemented by local bodies of self-governance (municipalities) on their territories. Such measures are introduced for land surfaces that have been identified as *erosion zones*.

Erosion zones are proclaimed on the basis of provisions of the Law on water resources of the Republic of Serbia and an Erosion status report in which erosion zones of a municipal territory have been identified by applying the prescribed methodology.

Bodies of self-governance were given a special role in this regard. Municipalities are required to prepare program:

Proclamation of erosion zones. The said program form the basis of planning and evaluation with regard to erosion control. These plan need an expert foundation. In order to synthesize and standardize program quality, in 1998 the Ministry prescribed methodologie to be applied in the preparation of each of the said program. The methodologie are developed by the Institute for the Development of Water Resources "Jaroslav Černi".

Fire detection, fuel model estimation and fire propagation estimation/visualization for the protection of Cultural Heritage

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Keywords: fire detection, fire propagation estimation and visualization, fuel model estimation, vegetation classification

FIRESENSE (Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions) is a project co-funded by EU FP7 Environment that aims to develop a multi-sensor early warning system to remotely monitor areas of archaeological and cultural interest from the risk of fire and extreme weather conditions. It will combine different sensing technologies, i.e. wireless networks of temperature/humidity sensors, optical and infrared cameras, as well as local weather stations. Pilot deployments will be made in five cultural heritage sites in Greece, Turkey, Italy and Tunisia. Another goal is the estimation of the propagation direction and speed in order to help forest fire management. FIRESENSE will provide real-time information about the evolution of fire using wireless sensor network data and estimate the propagation of the fire based on the fuel model of the area and other important parameters such as wind speed, slope, and aspect of the ground surface. The fire propagation data are visualized on a user-friendly 3D-GIS environment. Some of the supported features are: a) Display of sensor locations and regions of interest in the cultural sites b) Interactive selection of some parameters (e.g. ignition point, humidity parameters) c) Automatic acquisition of weather data from onsite or nearby weather stations d) 2-D or 3-D visualization of fire propagation estimation output (ignition time and flame length). Commercial satellite images have reached a fairly high spatial resolution which allows more powerful textural analyses and more detailed description of soil surface. This improves the capacity to recognize and classify land uses, the amount and typology of vegetation and other potential sources of fuel for wildfires. It also reduced substantially the time and costs for updating vegetation and fuel distribution. Ground truth is also required especially for developing and testing of new image analysis algorithms. Measurements of the main fuel component are required and are usually destructive and costly, sometimes even unacceptable, especially if biodiversity or soil are threatened or in protected sites. Therefore, a sampling technique has been developed for single or groups of plants. Sub-volumes, which are characterized by the same type of fuel component and vegetation mix, are sampled over small known volumes. Volumetric mass densities are transformed into biomass and fuel components as mass per unit of surface. Very-High-resolution satellite images (QuickBird) are ortho-rectified with a detailed DTM of the study area and analyzed: recognition of lines of water flux convergence, pathways, usually unrecorded on official maps, vegetation patchiness, connectivity lines for fire to spread more easily, and connectivity lines for water fluxes during rainstorms will be among the results. Another approach that we use for vegetation classification is multi-band SVM classification approach. Each band characterizes/emphasizes a particular type of information such as textural, spatial, local and spectral information. The combination of these features improves significantly the accuracy of the results. We are currently investigating the registration between the ortho-rectified images and a ground truth map from the covered area in order to validate and improve the classification results. It is expected that the characterization

of these areas and the accumulation of temporal series of vegetation/fuel distribution will serve not just for fire prevention and management but also for soil conservation and soil erosion control.

POSTER PRESENTATIONS

Influence of previous disturbances in the resilience capacity of a Mediterranean forest soil

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Keywords: Runoff, forest soil, soil recovery, fire effects, rain characteristics

Along the history, human influence on Mediterranean ecosystems has been mainly translated, among others, in two main phenomena: changes on vegetation cover (mostly driven by land use changes) and forest fires. Their effects have been the increase of hydrological and erosion processes, deforestation, soils impoverishment, and the advance of desertification. This work studies the evolution in the hydrologic characteristics and the erosive response of a Mediterranean forest soil, through its response to changes in its use and the fire impact. This soil is recovering since year 1996 when its conditions were left to stabilize avoiding any impact on it. The study has been carried out in the Experimental Station of Porta-Coeli in a system of four erosion plots (40 x 8 m) of closed type, corresponding each treatment to a different history of changes. These treatments are: T1 (soil with natural Mediterranean forest vegetation but burnt in 1996), T2 (soil with a plantation of *Medicago arborea* as erosion control system), T3 (soil with a plantation of *Psoralea bituminosa* as erosion control system and partially burnt in 1996) and T4 (soil maintained without vegetation cover). After 1996 these soils were left unaltered to monitor their regeneration pattern. The hydrologic behaviour and erosive parameters have been studied in each rain event during period 2006-2009, together with its relationships with the climatic parameters. The great inter-annual climatic variability, with wide fluctuations in the distribution and characteristics of precipitations has been a determining factor in the hydrologic response of studied soil, in its different treatments. The recovery of the vegetation cover and the relative improvement in the soil characteristics since year 2000 has influenced a general improvement in the hydrologic behavior of the different treatments. This has been translated in low levels of runoff and, mainly, in reduced sediment delivery. However, independently of this improvement, the differences between treatments stay. A clear progress has been observed in the T2 and T3. Whereas the treatment that stayed without vegetation during 10 years (T4) is the one that shows the highest values in runoff generation and in soil loss, followed by the treatment that underwent the impact of the fire (T1). The intensity of rain (I₃₀) is the most important factor regarding runoff generation and sediment production in all the treatments. Only in case of T4 the factor of highest weight is the rain volume, even more than runoff.

The evaluation of desertification risk by a modified ESAs approach in an agro-pastoral area (Orosei, Italy)

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Keywords: Desertification, overgrazing, stocking rate, Environmental Sensitive Areas (ESA), Mediterranean areas, Land degradation.

Desertification processes affect much of the world's drylands, resulting in a significant loss of biological and economic productivity of the land. Preventing desertification requires suitable methodological approaches to identify prone areas and to assess its impacts, along with the cost of actions and the risks related to inaction. The intrinsic complexity and multiplicity of forms of desertification processes make it necessary to develop and to implement methodologies capable of handling considerable amounts of data in an integrated approach. This would allow evaluating the synergistic effects of climate and soil conditions, vegetation cover, land use changes and more in general land management practices in sensitive areas.

It is well known that in the Mediterranean environments, desertification processes are generally triggered by unsustainable land uses and changes, such as clearing of natural vegetation cover, overgrazing, inappropriate agricultural practices, overuse of the groundwater and salinization of the irrigated soils.

The environmental sensitive areas (ESA) methodology, developed in the frame of the MEDALUS III project, specifically targets desertification risk in the Mediterranean environments. Since the late 1990s it has been applied in several areas and at different scales, by a number of Mediterranean research groups and local governmental bodies. It has proven to be a flexible method to obtain a relative evaluation of land degradation risk, and suited to be adapted to the local conditions, considering that some key indicators related to land management can be operationally defined in order to match the local relevance of the management factors.

The present paper describes a case study implementation as well as an example of adaptation of the model. The selected study area is the Orosei Municipality area (Italy, central-eastern Sardinia). Here, due to the importance of livestock breeding and overgrazing in the local context, the capability of the method to take into account the impact of pastoral activities was enhanced. A careful review of local data sources was done to quantify the surfaces actually subjected to grazing. Previous applications were instead based on potential grazing areas according existing land use maps. The obtained results highlighted a considerably lower degree of the overall desertification risk. This is supported by the evidence collected in the field and can be considered as a significant improvement compared to previous applications carried out in the same area.

Investigation on some physical and chemical properties of soils in sloping areas of Lahijan Iran

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Keywords: Sloping area, parent matter, soil properties, tea

This investigation was done to study the effect of slope position and parent material on soil characteristics of tea gardens of Lahijan, Guilan province, Iran. Four profiles were dug in two positions along a slope: upper and lower. The parent material is granite and phyllite. The results showed that both slope and parent material had effect on soil properties, but parent material had main effects. Parent material affected sand and clay content, pH, CEC and total exchangeable bases. Thickness of the solum, surface horizons and properties such as organic carbon content, total N, clay and available P varied on different slopes. The study area was covered by tea plants that their roots absorb water and prevent rush of water from upper slope to lower slope, so growth of this plants on the slope areas were useful and protect soil and prevent severe soil erosion, however much rain in this area created few changes in soil profiles.

Grassland fire effect on soil organic carbon reservoirs in semiarid environment

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Keywords: carbon stock, grassland management, semi arid environment

The effect of fire on soil organic matter content is highly variable and depends on several factors including fire intensity, soil type and nature of burned material. Grassland in semiarid environment are often managed by shepherds with annual burning in order to enhance pasture recovery. The aim of this work was investigating the effect of fire as grassland management tool on soil organic carbon (SOC) reservoirs and on post-fire plant recovery. The study was conducted on Hyparrhenia hirta grassland and Ampelodesma mauritanicus grassland, located in the Province of Palermo, in the north of Sicily. Soil samples were collected at two depth (0-5 and 5-20 cm) before and after experimental fire and soil organic carbon was measured. During grazing fire soil surface temperature was monitored. Biomass of both grassland species was analyzed to determine dry weight and its chemical composition. Our major results showed that SOC varied significantly with land cover, while it is not affected in the short period by grassland fire. Ampelodesma grassland stored more organic carbon (60.5 ± 2 Mg ha⁻¹) compared to Hyparrhenia grassland (40.2 ± 1.5 Mg ha⁻¹), thanks lower content in biomass of labile carbon pool. No significant difference in SOC before and after fire may been caused by multiple factors. Firstly, soil temperature measured during fire was low due to poor litter layer, secondly in semiarid environment higher mineralization rate results in lower soil carbon labile pool, thirdly most SOC is stored in the finest soil fractions and thus such physical protected SOC pool is not affected by fire.

Influence of the research scale on runoff generation data in a Mediterranean catchment

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Keywords: Mediterranean catchment, hydrology, work scales, runoff

The implications of scale in the hydrologic and erosive processes is a much needed approach to understand the functioning of complex natural systems as the Mediterranean basins and a challenge. Different dominant processes exist from each scale that make that the measures taken at a determined scale are not, necessarily, valid on another. Thus, when it is changed from a small scale to a larger one, in time or space, the interpretation of the fundamental principles or their characteristic parameters must be changed. In some Mediterranean ecosystems, the production of runoff at catchment scale depends greatly on the spatial pattern of vegetation distribution. The vegetated areas act like "drains" or areas of overland flow infiltration in contrast to the zones without vegetation that act like runoff contributing areas. In this framework, the main objective of this work has been to determine the possible differences that could be appreciated in the output data of runoff when working at plot and catchment scale in an area of long history of fires. In this sense, the study has been focused in several significant rain episodes from the hydrologic behavior of the area, in the last years. Generally, appreciable differences in the generation of runoff regarding plot and catchment scales have been observed. The period of study (three years) is still insufficient to allow establishing tendencies or relations in the production of runoff in the two studied scales, and their possible interrelations. It becomes necessary, besides the analysis of a greater number of rain events and of the runoff produced, the study of the distribution patterns of the vegetation. With this information, it could be characterized more suitably those zones that work as runoff generating and those that act as "drain" ones, their relationships and influence in the registered variability.

Effects of forest belts on reduction of water erosion processes and mitigation of water deficit on sloping arable land

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Keywords: soil erosion, forest belts, Romania

The present study was conducted in a small representative watershed of about 300 ha in the Tutova Rolling Hills of Romania, which comprise a range of categories of soil conservation measures and refers to the influence of some forest belts on water and soil losses. In the area water erosion is predominantly while the wind erosion is insignificant. The role of forest belts in the reduction of water erosion was emphasized by estimating erosion and deposition rates over a long period of time by using the fallout radionuclides technique. The approach was based on the comparison of the measured ¹³⁷Cs inventories (kBq m^{-2}) along a representative transect through the basin with a reference value that represents the inventory at a site where neither erosion nor deposition was observed.

The study-site is an arable land protected against erosion mainly by using a contour strip-cropping system and two forest belts located in the middle and the bottom part of the right hillside. The maximum slope gradient is 12%, the soil is a moderately eroded Cambic Chernozem and, the most common crops are winter wheat, maize, peas, soybean sunflower and alfalfa.

It was pointed out that, in a period of approx. 50 years, the forest belts contributed to additional reduction of soil loss with values representing from 8 to 14% of the net erosion. Also, monitoring soil moisture dynamics over a period of 10 years along a cross-section through the entire basin, it was revealed the contribution of forestry belts in mitigating effects of drought in dry years. Thus, in the area protected by the forest belts, in years when the sum of rainfalls was lower by 20-30% than the multiannual average which is 492mm, the soil water reserve in the 0 to 100 cm layer was up to 14% for peas and up to 22% for winter wheat higher than those from surrounding unprotected areas.

A quality index for volcanic soils based on environmental soil forming factors

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Keywords: Soil quality index, Volcanic soils, Canary Islands, Soil-forming factors

The ultimate target of soil quality has often been to integrate relevant data into a quality index. Many soil quality index have no easy interpretation in an ecological or pedogenetic context. Some authors have proposed indexes that evaluate the biological quality of soils as compared with their theoretical, maximum natural potential, which is determined by environmental factors. In this work we propose an approach linked to these ecosystemic models focused on soil-forming factors. Some soil properties vary during succession processes, but have been shown to be very stable in conditions close to equilibrium in nearly mature ecosystems. On this basis, it should be possible to develop model capable to predict the potential of these properties under a given combination of soil-forming factors. The ratio between observed and predicted values might then be interpreted as a measurement of soil quality, as it quantifies how soil properties would differ from their theoretical values in absence of human disturbance. To do this, we analyzed soil properties from 150 soils located in ecosystems close to maturity, along the main habitats in the Canary Islands: coastal scublands, thermophylle forests, evergreen forests, Canarian pine forests and mountain scrublands, and chose the soil organic C (SOC) content as the dependent variable because of its tight relationship with ecological successive processes in all of these environments. In addition, we chose a set of environmental variables related to soil-forming factors as predictors: climate (temperature, rainfall, PET and elevation), topography (inclination of the slope), and soil parent material (porosity, chemical composition and age). SOC was related to these variables by means of a Multiple Linear Regression Analysis, so as to achieve the maximum predictive power. According to the results, a linear regression model with only six independent variables may account for 80% of variance related to SOC.

We applied our predictive equation to 511 soil samples undergoing different degrees of human disturbance. In all cases, the less altered ecosystems showed an observed vs predicted SOC ratio close to 1, with increasingly different values according to soil degradation status. Therefore, the relationships of this index with the degree of human disturbance and succession processes confirm the validity of an approach based on soil forming factors. However, the model should be improved by using non-linear regression methods and/or including new predictors related to soil forming conditions.

Contribution to the Cuban Program of Soil Conservation using RUSLE

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Keywords: soil erosion, RUSLE, risk assessment, Cuba

The watershed of the Cuyaguateje River is one of the regions in Cuba which is facing the most severe erosion problems. Being the largest watershed in western Cuba, it is of great national importance. It is situated in the Pinar del Río province, a province renowned for its tobacco cultivation. In 2001, a national soil conservation program (Programa Nacional de Conservación y Mejoramiento de Suelos, PNCMS) was established in Cuba to implement soil conservation practices. In this regard, erosion models can be useful tools to delineate erosion risk areas and evaluate alternative management systems. However, up to now, erosion models have not been applied in Cuba for erosion risk mapping. In this work, RUSLE model was applied. Erosivity R was calculated from long data series of 26 pluviometers and three pluviographs located in the watershed. Erodibility K was characterized for the main soil types from field rainfall simulations. The development of the main agricultural crops (tobacco, maize, sweet potato, cassava) was followed during the rain and the dry period to determine the crop management factor C. A georeferenced topographic map (1:25000) provided by the national agency for geographic data GeoCuba was used to map the topographic LS factor. The effect of management practices on soil loss was elaborated by scenario analysis using the RUSLE model and the land use map (1:10 000). Tobacco was selected for the scenarios due two main reasons: 1) the economical importance of tobacco not only to the province but also for the entire country and 2) the significant soil loss that takes place during soil preparation and before planting, a period in which the soils remain uncovered and which coincides with the most intensive rains. Different C values were considered based on combinations that were investigated during field experiments. From these results, recommendations were elaborated to the PNCMS.

Properties and management of acidic Greek soils

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Sixteen acidic soils were studied in the hilly and mountainous area of Elassona, Central Greece. The examined soils consist from coarse material originated mainly from the weathering of schist, gneiss, igneous rocks and in some cases from hard limestone. Sand content is increased and ranged between 48 and 78 % (average 69.6 %), whilst the average clay was 6.3 %. The value of pH ranged from 3.8 to 5.7 and sandy texture enhances the leaching of exchangeable cations. It is well known that soil acidity has a negative impact on fertility, biological activity and plant productivity. The rate of acidification is strongly depended on parent material heredity and excessive usage of nitrogen fertilizers. The average content of exchangeable cations was found to the following order: $\text{Ca}^{++} > \text{Mg}^{++} > \text{K}^+ > \text{Na}^+$. Cation Exchange Capacity (CEC) varied greatly and ranged between 6.9 and 81.8 cmol/kg. Furthermore, a close relation was found between CEC and soil organic carbon, indicating that CEC in these soils depends very much from the presence of soil organic matter. The presence of soil organic carbon was rather high in comparison to the respective content observed in the lowlands. The distribution of soil organic carbon also varied and the increased content can be attributed to factors related to topography, gentle slopes and climatic conditions. Total soil nitrogen ranged between 0.6 and 4.6 g/kg, and a close relation was found between soil nitrogen and organic carbon, indicating that nitrogen is bound to soil organic matter. Low content in available phosphorous (P) was found in most of the investigated soils and this may be attributed either to parent material heredity or to low P quantities which are used by farmers during the application of P fertilizers. However, increased P content was observed in soils rich in soil organic carbon. Iron (Fe) and zinc (Zn) were in general at sufficient levels, whilst average manganese (Mn) content was decreased. Copper (Cu) was lower than critical level in most of the studied samples. According to average content of micronutrients, the following decreased order was found, such as: $\text{Fe} > \text{Mn} > \text{Zn} > \text{Cu}$. Taking into account the soil and climatic conditions, trace elements in the study area are mainly inherited from soil parent materials, while inputs through anthropogenic activities are insignificant. The amelioration of the acidic soils is suggested to be combined with proper management, practices and measures, such as: application of lime material for correction of pH, rational use of inorganic nitrogen fertilizers, re establishment of indigenous vegetation and introduction of species and varieties with high tolerance to soil acidity. Moreover, a regional action plan should be drawn up against soil degradation caused either by natural processes or by human activities.

GIS Application For Characterising and Mapping Fire-Prone Forest Areas In The River Struma Basin, South-Western Bulgaria

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Keywords: Forest fire; Struma River Basin, Soil; Water; Bulgaria; GIS; Mapping

The forest fires are an ecological disaster, provoking important both abiotic and biotic changes. Therefore understanding the factors influencing the occurrence of fire and elucidating their dynamic behaviour are of great importance for taking effective fire-prevention measures and post-fire management practices.

During the last 20 years, a trend of an increasing number, frequency and intensity of forest fires, especially pronounced until year 2001 was observed in the territory of Bulgaria. In this study, an attempt to exploit the capabilities of GIS modelling techniques and to suggest an appropriate methodology for forest fire prone zone characterizing and mapping is done.

An analysis, of fire-affected forest areas in the Struma river basin located in the south-western part of Bulgaria, was performed. The studied cases include coniferous and deciduous forests. Grouping of the affected areas have been performed taking into account the environmental characteristics – exposure, relief, part of the slope, as well as some soil differences. The results obtained were used for mapping the areas most frequently influenced by forest fires. Based on these results, prediction of soil losses, which could affect the quality of surface waters might be performed.

Congress Thematic Session

3. Sustainable management of wetlands and drylands

ORAL PRESENTATIONS

Vegetative buffer strips and 'erosion dams' as sediment traps

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1. Introduction

Conventional systems or constructions for controlling erosion and reducing the amount of sediments, nutrients and pesticides leaving a field and entering and polluting the surface water and local river networks include **vegetative buffer strips** and **sediment barriers**, also called 'check dams' or 'erosion dams'.

2. Grass buffer strips

In Flanders, Belgium, there exists an 'Erosion Plan' and a 'Code for Good Farming Practice' with ways and means for controlling on-site and off-site erosion, with or without financial compensation for the farmer.

One of the off-site erosion control measures is putting in '**grass buffers trips**'. Buffer strips are not considered as on-site erosion control measures as such, unless they are placed within the field. When situated down slope of fields, they can collect runoff water and transported sediment with nutrients and other pollutants, such as pesticides, herbicides and insecticides.

Buffer strips have seeded, planted or spontaneous grass vegetation. Popular grasses used in Flanders are *Lolium multiflorum* Lam., *Lolium perenne* L., *Poa pratensis* subsp.*pratensis*, *Festuca rubra* subsp.*rubra*, *Arrhenatherum elatior* and *Dactylis glomerata*. The latter is seeded on loamy soils in mixture of, for example, 30% *Poa pratensis*, 20% *Lolium perenne*, 30% *Festuca rubra* and 20% *Dactylis glomerata*.

2.1. Efficiency of grass buffers trips.

A buffer strip favors the settling out of soil particles by restricting the flow of surface runoff and increasing the water infiltration.

Buffer strips are effective in reducing losses of nutrients and pesticides that attach to soil particles. Buffer strips with extensive and dynamic root systems prevent these substances from easily entering surface and subsurface waters.

Buffer strips are most effective as sedimentation and filtration areas when water flow is shallow and regular. Water usually seeks depressions, gullies, and ditches on its way to the watercourse. Field practice, such as tillage, may further concentrate water flow.

The efficiency of buffer strips depends on a number of factors, including its width, land slope, climatic conditions, quality of vegetative cover within the filter strip, use and soil type, but also on the amount of rainfall and on the amount of runoff.

Efficiency of buffers trips increases with width but at a certain width efficiency remains constant. There is however no general agreement on the standard optimum width of a buffer strip. A number of factors affect the width of the buffer strip, among which is the steepness of the adjacent slopes and the nutrient and sediment load of incoming runoff.

2.2. Fertilization of buffer strips

The buffer's vegetation growth depends on the nutrients transported by the runoff for its fertilization. A lack of runoff may in some cases result in nutrient deficiencies. Sometimes it may be necessary to fertilize the buffer in order to maintain the desired vegetative stand and limit the presence of invading weeds.

The soil and plants of the buffer have a limited capacity to absorb and cycle nutrients. Continual input of nutrients to the site could soon reach or exceed the system's capacity to absorb them. A saturated system could then become a source of pollution instead of a sink.

Under normal conditions, applied phosphorus is rapidly bound to soil particles and transported to the stream with eroded sediments. As the buffer area promotes the deposition of sediments, it will reduce the transfer of soil-bound phosphorus from the field to the water course.

2.3 Maintenance of buffer strips

Sediment that has built up in the buffer must be removed periodically in order to maintain its effectiveness. A buildup of a few cm is enough to block and redirect overland flow. This may lead to the concentration of the runoff at low points. Sediment removal will be of little value if preventative conservation practices are not adopted to prevent the recurrence of excessive buildup.

3. Sediment barriers

Sediment barriers or erosion dams can be made of hay bales or stuffed coco fibre rolls. Those dams can be placed at regular intervals in drainage ways or on slopes to reduce the velocity of the water flowing over and through them and remove sediment entrained in the water.

The southern part of Flanders is characterized by locally steep slopes with sandy loam to silt loam soils. As erosion can be high, grass waterways were installed to safely discharge the runoff water from the fields. However, a bank gully and ephemeral gullies were developed where the runoff water was leaving the grassed waterway. Therefore both up- and downstream of the grassed waterway either an erosion dams were installed either composed of several 3 m long coco fibre bars (0.4 m high and 0.4 m wide), or containing wood chips.

3.1. Efficiency of sediment barriers

The efficiency of a sediment barrier is determined by its ability to remove or filter the sediment from the water flowing through it and also by its ability to accumulate large volumes of sediments. Hence the efficiency relates on one hand to how well it traps sediment while allowing sediment free water to pass through, and on the other hand to the length of its functional life.

3.2. Some problems can be encountered.

- It is not easy to remove a sediment barrier once sediment is deposited on it.
- Dams making use of hay bales or stuffed fibre rolls (coco bales) sometimes permit water to flow under the dam structure which is sometimes called 'under cutting'.
- Under cutting can erode the soil under the dam and the water flowing under the dam can cause the dam to fail.
- Dams can be quickly buried under the accumulated sediment.

4. Conclusions

Grass buffer strips and erosion dams have been shown to significantly reduce the amount of nutrients and sediments entering a watercourse. They should not be viewed as an alternative to infiel conservation technologies, but rather as a complement. Neither should they be used as a primary sediment control technology. Soil conservation practices must be in place, uphill from the buffer strip or the sediment barrier, in order to minimize the amount of sediments reaching the buffer

The PRACTICE project: towards an integrated assessment of prevention and restoration actions to combat desertification.

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Keywords: integrated protocols; indicators; ecosystem good and services; participatory approach; knowledge exchange

Desertification is an important environmental and socio-economic problem that affects much of the world's drylands, resulting in a significant loss of biological and economic productivity.

Responding to desertification by improving the efficiency of land and resource management represents a crucial step towards social welfare in drylands. While science has made noticeable progress in aiding our understanding of the drivers and processes of desertification, the evaluation of the practices to combat desertification, the exchange of experience and knowledge, and the incorporation of social dimension in the solutions often remain limited, compromising the adoption of best practices in prevention and restoration efforts.

PRACTICE is an EC-FP7 global initiative that gathers scientists and stakeholders from among the most affected regions of the world to combine local and scientific knowledge to help address the desertification challenge.

To pursue this goal PRACTICE first aims to develop and apply integrated evaluation protocols to assess the effectiveness of prevention and restoration practices: the protocols integrate the multiple dimensions of land degradation based on the unifying conceptual framework provided by the analysis of the desertification impacts on ecosystem good and services and on human well-being, across different spatial scales (by integrating field and remote sensing approaches). The evaluation tools implemented by Practice are participatory. They integrate the human and biophysical dimensions of desertification, involving stakeholders at all levels, including farmers and ranchers, natural resource managers, scientists, and policy makers (local, national and international).

PRACTICE involves research teams and stakeholder platforms in 12 countries. Monitoring sites are distributed in the Mediterranean Europe (Greece, Italy, Spain, and Portugal), Africa (Morocco, Namibia, South Africa), Middle East (Israel), China, and South, Central and North America (Chile, Mexico, and USA). The project seeks to create an international network of long-term monitoring sites aimed at supporting future synthetic analysis, improving the accessibility and use of long-term data, and facilitating the exchange of knowledge of successful practices worldwide.

An Optimized Methodology to Estimate the UsleRusle R Parameter in the Portuguese Madeira Island and in the Southern Mediterranean

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Keywords: Erosion models, Erosion risk, Precipitation, Rainfall erosivity, Revised Universal Soil Loss Equation.

In 20 February 2010 very intense precipitation occurred in the island of Madeira, in the region of Funchal creating intense runoff and debris flows, with huge devastation and losses of lives, becoming one of the catastrophes hitting the island. The rainfall event was considered with a return period in the order of 100 years. To analyze the magnitude of the event it was decided to apply the USLE/RUSLE methodology to evaluate the amount of distributed erosion.

It is well known that at local or regional level, one of the best indicators to access the potential erosion risks is the rainfall/runoff erosivity parameter (R) of the above mentioned model. However, there was not enough data available to compute the R value, and other parameters, such as the Modified Fournier Index, were not considered adequate to make detailed assessments and to be used alternatively.

For the Funchal meteorological station precipitation data with 10 minute discrimination was available only for the last 10 years. The data with that resolution enable the calculation of the erosivity event by event, and on a daily and monthly basis. Correlations were established to extend the estimation of erosivity for other periods and to access values for other locations and for larger periods.

This methodology enabled the calculation of large term average erosivity in several meteorological stations in the Madeira Island and to access the return period of the event of 20 February. Also, it was possible to verify the validity of the methodology to be applied in the Mediterranean regions of Portugal, because a comparison was made with the computed data and the estimations obtained by a previously developed methodology for the Algarve region, which considers monthly rainfall and the number of days with more than 10 mm of rainfall.

Using SOIL CARBON MANAGER- a soil organic carbon simulation model- to evaluate various soil-crop-climate scenarios for the long-term change of organic carbon in the Anthemounta basin of Greece.

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Keywords: soil carbon, simulation, sustainable practices, management zones

A major research project (LIFE07 ENV/GR/000278-Soil Sustainability-SO.S.) aiming in soil resource conservation and related to the European Soils Directive, is carried in the Anthemounta basin, in Greece. Extensive soil sampling in ca. 6,000 ha with a dense grid system of 250 m X 250 m was conducted and partial data and information is presented in this paper. Management zones of soil organic carbon (SOC) were established, using crop species and soil type criteria. The objective of this paper is to evaluate the long-term change in SOC in the above area within each of the established SOC zones, as affected by production management activities and various weather scenarios considering trends in the climate change, using SOIL CARBON MANAGER, a simulation model. This model predicts SOC changes under winter rainfall farming systems, for a range of soil types and climatic conditions. The simulations outlined important trends in changes along a variety of production practices and management and crops and foraging, and suggested integrated production schemes to optimize and sustain levels of soil carbon in long term.

Effect of eleven years liquid cattle manure application on soil fertility

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Keywords: liquid cattle manure, soil fertility, soil organic C, soil organic N

Application of liquid cattle (*Bos taurus*) manure to soil can improve soil chemical properties and increase crop yields and plant nutrient concentration and uptake. In addition, a possible improvement of soil physical properties cannot be excluded. However, long-term application of liquid cattle manure could increase soil salinity and NO₃-N content at unacceptable levels. The objectives of this study were to investigate the impact of 11-yrs soil application of liquid cattle manure on organic C, total (TOC) and dissolved (DOC), electrical conductivity (EC) and soil available macro- and micronutrients, in comparison to the recommended inorganic fertilization. Composite surface soil samples were collected from the plots of an experimental field of the University Farm of Aristotle University of Thessaloniki, the spring of 2009. The field had been used in a fertilization experiment with winter wheat (*Triticum aestivum*), 1996-2000, initially, remained uncultivated the year 2001, and then used in a similar fertilization experiment with corn (*Zea mays*), 2002-2008. The size (6 x 10 m) and the number of experimental plots were the same in both experiments and the experimental design was randomized blocks, with 4 fertilization treatments, replicated 6 times. The treatments, which were practiced on the same plots every year were: i) soil incorporation of liquid dairy cattle manure, before seeding, at a rate equivalent to the recommended N-P inorganic fertilization (based on manure's total N and P content) for each crop; ii) application of the recommended inorganic N-P fertilization, for each crop, before seeding; iii) identical to ii, but with split N application; iv) no fertilization (control). The recommended N-P inorganic fertilization was 120 kg N ha⁻¹ yr⁻¹ and 26 kg P ha⁻¹ yr⁻¹ for wheat and 260 kg N ha⁻¹ yr⁻¹ and 57 kg P ha⁻¹ yr⁻¹ for corn. The liquid cattle manure was applied at rates of 40 and 80 Mg ha⁻¹ yr⁻¹ (wet weight basis), for wheat and corn, respectively. Surface soil samples were collected the spring of 2009 and analyzed for pH (in a 1:2 soil to water ration), EC_{se} (electrical conductivity in the saturation extract), TOC (wet digestion method), DOC (extracted with water), total N (Kjeldahl method) and available NO₃-N (extracted with KCl), P (extracted with NaHCO₃), K (extracted with CH₃COONH₄), Cu, Zn, Fe, Mn (extracted with DTPA), B (extracted with hot water). For each parameter determined, analysis of variance (ANOVA) (treatments x blocks) was conducted and the LSD test was used for mean comparisons. The results showed that soil pH and EC_{se} were not affected by the organic or inorganic fertilization. In all cases, EC_{se} was lower than 0.7 mS cm⁻¹. After liquid cattle manure application to soil for 11 years, TOC, DOC and Kjeldahl-N were significantly increased compared to control or inorganic fertilization treatments, whereas C/N ratio remained unchanged. The same (as for the organic C and N) was evident for the available NO₃-N, P, K, Zn, Mn and B. In all cases, the residual NO₃-N was lower than 17 mg kg⁻¹. In conclusion, long-term soil application of liquid dairy cattle manure, at rates equivalent to the recommended N and P fertilization for the crops, can increase soil organic C and N and improve soil fertility, with respect to certain macro-

and micronutrients, without increasing soil salinity and soil available NO₃-N at unacceptable levels.

An alternative simplified solution for a two dimensional flow subsurface water harvesting system

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Keywords: rain water harvesting, subsurface water collecting system, water harvesting in arid zone

This study addresses the problem of increasing water shortage in rural dispersed/nomad communities in arid and semiarid areas, where no advanced technologies of water supply are available and solutions have to be implemented on a small scale of the individual family/tribe, using cheap simple means. It suggests a partial solution, which can be implemented in sandy areas where water infiltrates rapidly. It consists of a gallery of subsurface collecting units connected in parallel to a concealed water pipe leading the water to a designated source point for livestock, human consumption, or watering point for wild life.

The objective is to derive an approximate simplified solution for two dimensional saturated and unsaturated flow domains in the elementary collecting subunit, which will be scientifically sound enough for feasibility check of the suggested water harvesting system and design of its optimal configuration. It takes into account the hydraulic properties of the soil bed, the local climate conditions, the rainstorm characteristics, and/or other possible water input from occasional floodwater.

The suggested approximate solution is tested versus accurate numerical solutions of the flow equations, as well as some preliminary results of experimental water collecting units.

Socio economic aspects of land degradation in the drier zones of India

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Keywords: agriculture, economy, India, population, land degradation, land management, adaptation

Sustainable land management is a challenging issue in developing countries like India with a fast rising population and weak economy, and with an inefficient administrative mechanism to implement effective protection measures. Controlling the land degradation is important in achieving food security, sustainable forestry, and agricultural and rural developments. Indian economy is largely agriculture dependent and life of more than half of the population, especially the rural poor is some way related to it. Most of the land area in the country shows evidence of degradation, thus affecting the productive resource base of the economy. Out of the total geographical area of 329 million hectares, 175 million hectares are considered degraded. Arid and semi arid agricultural area comprise a large share of this. Soil erosion by wind and water causes landslides and floods in hill areas, threatening the existence of tribal communities. Intensive agriculture and unscientific irrigation leads to water logging and soil salination and alkanization in farms. Waste outflow from urban centres and domestic areas, salinity intrusion due to groundwater overdraft in coastal zones, overgrazing, deforestation, industrial development etc. result in widespread degradation of rich soil. In the arid western zone of India, wind erosion increases desertification, whereas in the plains, erosion due to floods and eutrophication due to agricultural runoff are evident. The agricultural revolution made India self-sufficient in food, but resulted in losing fertility of rich farming lands and contaminated the soil and water with fertilizers and pesticides. Sand quarrying, and landfilling of wetlands and paddy fields for industrial and residential purposes add to the already shrinking agricultural area. Large anomalies in climate worsen the situation. Demands for food in India will be tremendous in near future, as the population is expected to stabilise only by the year 2050 at 1.5 Billion, 50% more the present level. Feeding such a large population is a real challenge and efficient land management has a key role to do in it. Agriculture being the livelihood of millions, any setback in it will have far reaching consequences in the socio-economic conditions in all sectors of India. India already faces issues like migration that leads to conflict over resource allocation and rural unemployment leading to social unrest. Unfortunately, the administrative and legal measures for land resources protection in India fail because of various social, political and economic reasons. Present paper is a comprehensive assessment of the issues associated with land degradation and sustainable land management in the drier zones of India. Suggestions for better management and adaptation strategy have been provided, considering the social, economic, political and environmental conditions.

Optimum land use pattern in Pereschiv catchment from Eastern Romania

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Keywords: land use, land evaluation, land suitability

The spindle-shaped Pereschiv catchment is located in the Tutova Rolling Hills, Southern Moldavian Plateau, and covers 23,267ha, among which only 12.2% forested. Clayey-sandy Miocene-Pliocene strata with a gentle dipping of 7-8 m/km NW-SE have outcropped from under the loess-like deposits as a result of erosion. Slopes within the plateau are mantled by Chernozems and forest soils. In addition, the azonal soils controlled by erosion exceed 22% of the total area. The native vegetative cover was dramatically modified over the last two centuries in favor of the agricultural terrains, mainly cropland. The improper human activity such as the up and down hill farming and inadequate road network resulted in a significant development of surface erosion and gullyling. The total erosion values computed for the entire basin exceed 410,763 tones/year, which result in a mean erosion rate of about 17.65 tha-1yr-1, of which 44% is due to surface erosion and 56% to gully erosion. The main objectives of the study were to identify, by using GIS techniques, an optimum (rational) land use pattern for this extremely degraded area, based on the soil pattern and geomorphologic realities, but also taking into account the needs of local communities. In the first phase a complete pedological and geomorphological characterization of the study area was conducted. The soil maps accompanied by an attribute database and the geomorphological maps were drawn at a scale of 1/10,000. Based on aerial photo imagery achieved at 1/5,000 scale, edition 2005, and using some field survey data, were inventoried the current land use and also the main areas affected by those soil forming (salinization, compaction etc.) and geomorphological processes (surface erosion, gully erosion, landslides etc.) that have a significant role in land degradation. Then a series of maps relating to land natural favorability (according to the ICPA Methodology, 1987) for the most important crops in this area (corn, sunflower, wheat, peas and beans, grape vine, cherry, pasture) were drawn in digital format. Finally, based on current land use pattern, by integrating the layers describing the main features of the studied area and taking into account the evaluation marks obtained of each culture, we tried to automatically create an optimum land use map with a 2x2m pixel resolution for the entire catchment. The resulting map takes into account the natural conditions so that the land planning investments should be minimal. The results show that over half of Pereschiv catchment area the current land uses does not match the maximum favorability given by the natural conditions. Thus the arable land area is too extended and it should decrease by about 53% from the existing 12,000 ha (54.3 % of the total area), up to only 6,000 ha (28.7%). Instead, the forested area, which occupies only 2,800 ha (12.2%) at the present moment, should grow more than three times and cover over 8,600 ha (37.1 %).

After choosing the most appropriate uses it is necessary for the land use to be in full agreement with the main erosion prevention and control methods.

Conservation Agriculture experiences on irrigated areas in Uzbekistan

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Keywords: no-tillage, soil conservation, permanent bed, furrow irrigation, crop residue

Uzbekistan is one of main producer and exporter of cotton in the world. Agricultural production system is heavily influenced on soil and water degradation of the country. Land degradation is a serious economic, social, and environmental problem in Uzbekistan and the rest of Central Asia. It directly affects the livelihood of the rural population by reducing land productivity, and by causing agricultural production losses estimated at \$2 billion a year for the region. Soil conservation technologies as a part of sustainable crop production system can improve the situation in the region. Cotton (*Gossypium hirsutum* L.) and winter wheat (*Triticum aestivum* L.) is dominant crop in irrigated land of Uzbekistan. In irrigated areas farmers mainly use furrow irrigation system with intensive tillage operations starting with deep plough, chiseling, leveling, up 6-7 times cultivations and reshaping furrows. Cotton and wheat mainly used in crop rotation. One of the main characteristics of irrigation is use of furrows with 60 and 90 cm spacing. Several conservation agricultural technologies were studied as the appropriate solutions for irrigation areas. Experiments was conducted with common use by farmers irrigation system with 90 cm inter row spacing. Effect of no-tillage, permanent bed parameters under different soil types on soil parameters in different regions of Uzbekistan were studied from 1996. Conventional technology (CT) practice which include plowing or deep chiseling with cultivation and furrow opening field operations was taken as a control treatment. Treatments made with and without crop residue (CR) cover treatments. Soil texture is different from farm to farm. Soil texture of study areas include several soil types as sand, loamy sand, sandy loam, loam, sandy clay loam, silt loam, silt clay loam, clay loam. Three dominating soil types loam, sandy loam and sand in study area were chosen in addition to the technology treatments. Results show improvement of soil quality parameters on soil conservation treatments compare with control. Results show that loam texture of the soil more appropriate for implementation of CA in irrigated areas for cotton production.

Modeling the erosion risk potential of bench terraces

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Keywords: terraces, soil erosion, Yangtze, Three Gorges Dam, China

The Three-Gorges Dam is currently one of the largest in the world. Consequently, high land-use dynamic with resettlements, construction of infrastructure, and new land reclamation for smallholder agriculture and cash crops characterize this area. Soil loss is one of the major threats and its control an enormous challenge. Even existing erosion control measures like dry-stone walling bench terraces have to be adapted to this new situation in order to keep their effectiveness. Typical features along the Yangtze river are steep slopes artificially fractured by terraces. A preliminary erosion survey has shown a strong connection of the frequency and intensity of erosion and the quality of terrace-maintenance. Therefore, a conceptual Terrace-Condition-Erosion model (TerraCE) was developed in order to assess to what extent soil erosion depends on the quality of terraces. Central aspects are the distance to the inundated area, to the road network, and to the settlements. First results of TerraCE indicate that with increasing distance from the highly dynamic inundated area and the main roads the better is the quality of terrace-maintenance with less wall disorders and less soil erosion potential. It is concluded that the construction of infrastructure and the artificially fluctuating water level at the dam lead to a degradation of terraces within close distances to the river and the main road network. Terraced farmland that is more remote to the main transportation routes seems to be less influenced by the high land-use dynamic. By combining the model results with DEM-analysis and remote sensing data a high-resolution soil erosion risk model will be computed using spatial regression approaches. It aims to assess the soil erosion as a function of natural factors and anthropogenic impacts in an increasingly complex system. Especially against the background of global change and the increasing demand for water and energy the study aims at enhancing the understanding of the ecological consequences of large dam projects.

Ecological and economic effects and assessment of risk and uncertainty of sustainable soil management

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Keywords: soil loss, economic effects, sustainability, risk, uncertainty

The existing structure of agricultural production in the hilly region of the wider Belgrade area indicates that erosion processes in this region have narrowed and also decelerated the yield increase rate which would be possible on natural and economic conditions. In this paper the establishment is discussed of the production model, taking into account the conservation of land resources, the needs of the population and profitability in the case of the hilly watershed of Baricka Reka. In this sense, agricultural, fruit and forest productions are anticipated from the aspect of sustainable soil management - SSM (model I).

The assessment of the long term effects of the planned model I and its improvements by model II (with the honey as chief product and propolis, wax and flower powder as co-products) and model III (with royal jelly without co-products) is presented through the ecological effects by decreasing in soil loss and economic efficiency (through the benefit cost analysis). The long term effects of the planned model I as well as of the models II and III have been performed in terms of the internal rate of return (IRR), pay back period (PBP), benefit cost ratio (B/C) and net present value (NPV). Assessment of risk and uncertainty has been performed by sensitivity analysis of IRR and PBP. Soil losses have been estimated according to USLE equation for the present way of soil use, as well as for the proposed model - based upon the sustainable soil management (SSM) principles.

POSTER PRESENTATIONS

Incidence of Pharmaceuticals in a Mediterranean Wetland Ecosystem

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Keywords: Pharmaceuticals, Mediterranean wetlands, agricultural soils, emerging contaminants

Contaminants resulting of the human pressure, such as pharmaceuticals, personal care products or drugs of abuse are an emerging problem that should be tackled to meet the Water Framework Directive of the European Union (WFD, 2000). The Valencia Community is a study case where the scarcity of this resource put in danger its quality. An insufficient water volume makes the dilution and drainage of the contaminants difficult (Ginebreda et al., 2010). This circumstance is particularly critical in the quiet films of water, lagoons and wetlands that cover the Valencia littoral. In the present work, the spatial distribution of 19 pharmaceuticals between water, soil and sediment of L'Albufera Natural Park have been studied. This park is one of the most important wetland in Europe, included in the RAMSAR agreement, being a key point for migratory birds.

The presence of pharmaceuticals in soils (5 contaminated samples) was more sporadic than in water (100 % of samples contain pharmaceuticals) or sediment (90 % of the samples), probably because they are not in permanent contact with water.

A positive correlation between samples of water, soil and sediment was observed, so that the sampling point with more contaminated soil presents also the most contaminated water and sediment. Higher levels and frequency of pharmaceuticals appears in the north area of the lagoon, which is justified by a larger concentration of population. The simultaneous determination of seventeen pharmaceuticals by solid Phase Extraction (SPE) in the case of water samples and Pressurized Liquid Extraction (PLE) and SPE for soils and sediments, and LC-MS/MS afforded high sensitivity (MQLs in the low ng g⁻¹) and achieves unequivocal identification of these compounds.

The results from the screening of water, soil and sediment of several locations within the L'Albufera Natural Park are of concern because they show a ubiquitous contamination of this protected area by pharmaceuticals. As a consequence, much more should be known about the determination, evolution and potential for chronic effects of pharmaceuticals in the aquatic and soil systems, particularly, in those of so fragile equilibrium as the Mediterranean wetland ecosystems.

Research on macronutrient losses by runoff to various crops in Tarina Vale experimental polygon, Perieni

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Keywords: macronutrient, erosion, nutrient losses

The paper presents the experimental results obtained, in 2009 year, on standard plots for runoff and erosion control, located in the Tarina Vale subcatchment. The experimental polygon is located at 232 m altitude on a 12-14 % slope of land with moderately eroded cambic chernozem soil. The measurements were carried out regarding humus, nitrogen, phosphorus and potash losses, in 6 standard plots (each plot having an area of 100 m²), cultivated with different crops in rotation: winter wheat-maize-bean-soybean sp., the control being maintained as bare fallow.

The obtained results are follows: N losses are between 0,058 and 12,606 kg/ha; P₂O₅ losses are maximum value 0,352 kg/ha; K₂O losses are between 0,022 and 1,350 kg/ha; humus losses are between 0,510 and 176,5 kg/ha.

Depth distribution of mineralised nitrogen in organic and inorganic soils in the area of Philippoi, Greece

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Keywords: nitrogen, mineralisation, soil, organic,inorganic

The main objective of this study was the investigation of main factors which affect mineralization of soil organic nitrogen in both organic and inorganic soils in the area of Philippoi. Moreover, the distribution of mineralised nitrogen in the soil horizons in two profiles was also studied. Two soil profiles were described in the Philippoi peatland (Northern Greece) and samples were taken from each soil horizon or layer. The surface horizon consists mainly of well-humified organic materials in the organic soil, whilst the inorganic consists from organic material mixed with mineral soil particles. Incubation experiments showed that nitrogen mineralization was higher in both profiles during the initial weeks of incubation and this was decreased substantially later in the experiments. It was observed that mineralization values were affected significantly by the temperature change of incubation, due to increased microorganism activity at higher temperature. The quantity of mineralized nitrogen at a constant temperature 35 °C was greater in comparison to values obtained at incubated samples at 25 °C. Furthermore, nitrification values of surface soils were found much higher than ammonification. The amount of mineralized nitrogen was higher in the organic soil and mineralization values can be attributed mainly to the origin and degree of decomposition, although the history of land use and management (such as type of crop, irrigation method, fertilization and quality of irrigation water) affect strongly this process. Differences in the quantity of net nitrogen mineralization in the organic soil were observed among the studied soil horizons due to the kind and content of organic matter which is independent to depth of organic layer. A declining trend with soil depth in the mineralized nitrogen was recorded in the inorganic soil. It can be argued that the fluctuation of temperature affects organic soils much more than the inorganic due to the intense activity of soil microorganisms. The values of constant k among soil horizons also varied and these were increased with the rising of temperature. Values of mineralization constant k depend from the origin of organic matter and the degree of decomposition of organic material, taking into consideration the similar conditions of temperature and moisture during the aerobic incubation. However, the estimation of nitrogen demands in various crops which is based on potentially mineralized values (N_0) requires additional research and further detailed analysis regarding the fluctuation of climatic conditions is needed.

Variation of Properties in Surface Soils in Almyros area

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Keywords: GIS, DGPS, remote sensing, soil, geostatistics

Economic developments, integration of markets and the exacerbation of competition in agricultural sector during the last years have led to the need for drastic reduction of cost in the process of agricultural production. At the same time, the problems of environment that continuously grow, with fast rates have made the careful management of the application of material input in agriculture imperative. The objective of this work was the creation of digital thematic maps using GIS and remote sensing techniques. For the achievement of this objective, various sources of data were used, such as analog topographic maps, satellite images, geological maps and also GIS and Remote Sensing software. Soil samples were taken from Almyros (Greece) area. This was the first stage of the study. It is mentioned that the region of the study has acreage in 13,636 ha and is located in the plain of Almyros. There were taken 135 soil samples in total. The samples were analyzed for the texture, the pH, CaCO₃ as well as the availability of trace elements Cd, Fe, Zn, Cu, Mn, and Pb. The collection and input of the data was the third stage of the work with which primary digital data was created. This was used in the following stages for the production of new thematic levels of information via analysis methods that are provided by the GIS. A special soil database was then created. Geostatistical analysis methods and processes of analysis of satellite images were applied for the creation of thematic information that concerned mainly the soil properties and secondly the morphological characteristics of the soil as well as the classification of land use which was executed in an early stage. In the plain of Almyros there are very acid but also alkaline soils. The last ones are also more extensive. The content of organic matter is low with the exception of the region of the Sourpi bay where boggy land (estuary) exists. The content in CaCO₃ fluctuates from 0 in the region of Euxeinopolis to 40% in the region of Alias. Almost all of the soils of the plain of Almyros are characterized as sandy clay loam while in the region of Aidinon clay soils exist. The concentrations of available Cu are medium to high. Highest concentrations are found in the region of Korfakion where there are horticultural crops. The plain of Almyros is characterized by medium to low concentrations of available Fe with the exception of the region of the Sourpi bay where high concentrations of iron were found. This phenomenon is owed more or less to the liquid fuels depots and to the other industrial installations that exist in the region. It is likely that the same installations are also responsible for the high concentrations of available Zn in the region. The concentrations of available Mn are mainly medium to low. Exception to this rule constitutes the soils of the region of Euxeinoupolis where the pH is acid.

The concentrations of available Pb are fluctuated from 0,02 to 3,46 mg / kg dry ground. Increased concentrations exist in the region of the Sourpi bay as well as around the settlement of Horostasi. The plain of Almyros is characterized by medium to high concentrations of available Zn. Very high amount of available Zn we found in the region of Korfakion as well as in the area of Sourpi bay.

The Geological simulation of water Shortage from Jifara Plain Basin

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Libya is among the countries suffering from surface water shortage Libyan land occupies (1.700.000km) of which 95% is arid. In this study attention is paid Jifara plain basin which consists from complicated geological formations with extreme slopes. The examined area was exposed to cleave movement resulted in two fractures, the first fractures heading north-east toward Tunisia borders as far as Jabal Abu-kirsh , 100 to 200 meters , the second fracture is heading west and called , the greater Azizia elevate , such movement led to fold and slop towards the sea forming three rock units :

- Mountain front sequence, to the west (mainly sand lime sediments).
- Mountain front sequence extending from eastern to western Tunisian borders (soils originated by limestone) which is extended up to 700 meters above sea level.
- Hadba surface sequences include scattered formations in most edges and centre of the area (rocks, dry area). It is believed that rocks moved to its present place by the erosion factors.

The basin is covered by lime and sand material where water accumulations reaches 2.4×10^6 km³. Also the presence of poor water reservoirs scattered in the centre of the basin contributed to the lowering of the north part of the basin. Most parts of this basin have been flooded by sea water during the Miocene and Oligocene. The formation of rock hollows contain large quantities of water most of which are accumulated in the sea. It was also observed a large water basin branching from Jifara plain, with poor underground reservoirs, where water flows from the southern to the lower northern part. The study of water paths indicated that it originates from sea to land and vice versa, and is expected to exploit appreciable quantities of fresh water from sea in future. Another formation of sediments is considered that has contributed to the basin features during the Holocene period containing water. The most important sediments are Quaser El-haj that consists of lime and grain rocks where reservoirs of Al-Azizia Abushaibs and Abu-ghailan are located and water is being pumped mainly from the Miocene layer. Formation which contains Ber El-Ghanam and kikla reservoirs that are covered by lime sediments, water is also pumped in the south area of the Jifara plain. Saline sediments are scattered to south and west part of the basin and Oligocene has led to soil salinization. Preliminary results are in favour of our expectations to find traces of water flow from Jifara plain, towards sea, in order to mitigate the water scarcity in this dry district. The 3D three dimension surveys and mathematical models can assist us to investigate and solve problems related to geological structure, to take measures for rational water management and exploitation and to follow proper practices for wise use of this valuable natural resource.

Crop rotation for maintenance soil quality for sugarcane growth

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Keywords: Oxisol, soybean, sunnhemp, millet, aggregate stability index, mean weight-diameter

In Brazil, sugarcane growth period takes about 4 to 6 year in average. Nevertheless, the crop is harvested annually. Before a new sugarcane growth period, farms usually grow a different crop (usually soybean) for only one growing season, during the interval between two sugarcane growth periods, aiming to improve soil quality. The objective of this work was to evaluate soil quality of an *Oxisol* after it has been submitted to two soybean growing season, growing different crops, sunnhemp (*Crotalaria juncea* L.) and millet (*Pennisetum galucum*), between them, during the interval between two sugarcane growth periods. The treatments were:

sugarcane/soybean/sunnhemp/soybean/sugarcane,

sugarcane/soybean/millet/soybean/sugarcane

and sugarcane/soybean/fallow/soybean/sugarcane.

The experiment took place in a farm located at Jaboticabal County, São Paulo State, Brazil (21°14'05" S, 48°17'09" W). The statistical design was a randomized block with three treatments and five replications. Soil samples were taken from 0-0.10, 0.10-0.20, 0.20-0.40 and 0.40-0.60 m depths, in three times: before the first soybean growing season (October/2008), before the second soybean growing season (October/2009), and after the second soybean growing season and before planting the new sugarcane growth period (February/2010). Aggregate stability index (ASI) was obtained in each soil sample. The mean weight-diameter (MWD) was obtained at soil samples from 0-0.10 and 0.10-0.20 m depths. In October/2008, ASI values were 73%, 68%, 62% and 54%, at 0-0.10, 0.10-0.20, 0.20-0.40 and 0.40-0.60 m depths, respectively. In February/2010, ASI values were significantly higher for all depths (76%, 74%, 66% and 65%) when compared to those ASI values obtained in October/2008. Sunnhemp or millet grown between the two soybean growing seasons did not affect the MWD at the 0-0.10 m depth. After fallow the MWD values decreased from 3.0 to 1.9 mm at 0-0.10 m depth. In February/2010, MWD values (2.5 mm) were significantly higher when compared to those obtained in October/2008 at 0.10-0.20 m depth (2.2 mm). The results indicate that soil must be planted between two soybean growing seasons, during the interval between two sugarcane growth periods, in order to maintain the soil quality for the new sugarcane growth period.

Changes in soil organic carbon and climate change. Application of the RothC model to agro-silvo-pastoral Mediterranean land use systems

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Keywords: C sequestration, CO₂ emissions, climate change, emission scenarios, RothC model

The effects of climate change on soil organic carbon (SOC) turnover have been evaluated in land use systems under different levels of agricultural intensification. In the study-area agriculture is mainly extensive and markedly agro-silvo-pastoral, and is typical of north-eastern Sardinia (Italy) and similar areas of the Mediterranean basin.

Due to the complexity of the soil-plant-atmosphere system, the study of SOC dynamics is best approached through the use of simulation models combined with local data. To simulate the soil organic carbon turnover we used the Roth-C model, which considers the following main factors: climate, clay content, water regime, crop management and plant cover, and can be used to predict changes in SOC under the different management and climatic conditions that may occur in the future. The study-area is characterised by the same soil type and the same potential native vegetation (*Quercus suber* L.). The following land uses have been considered: vineyards (tilled/no-tilled), established in the 90s; hay crop (oats, Italian ryegrass and annual clovers or vetch) and sparse cork oaks; pasture covered with spontaneous herbaceous vegetation and sparse cork oaks; semi-natural systems (scrublands, Mediterranean maquis and *Helichrysum* meadows), represented by former vineyards set-aside about 30 years ago; and a forest (*Quercus suber* L.).

Climate change scenarios have been generated from the baseline climate with two Global Climate Models (GCMs): GISS of the Goddard Institute of Space Studies (USA), and HadCM3 of the Hadley Centre Met Office (UK), under two emission scenarios (SRES, A2 and B2) among those indicated from the Intergovernmental Panel on Climate Change (IPCC).

Land uses at low cropping intensity such as the extensive silvo-pastoral systems showed, as could be expected, a better efficiency in terms of soil carbon storage and atmospheric CO₂ fixation, in the order hay crop > pasture > *Q. suber* L. forest > semi-natural systems (former vineyards), with a net distinction in comparison with the vineyards.

Changes in land use with respect to the potential native vegetation affected the carbon balance significantly, e.g. 0.2-0.3 t C ha⁻¹ yr⁻¹ decrease in the vineyards, and this should be taken into account when planning measures for mitigation and adaptation to climate change.

Humus content and acidity of dominant soil types in the Pannonian agroregion of Croatia

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Keywords: soil, humus, acidity, agricultural land, Croatia

As a conditionally renewable natural resource, soil has a crucial and irreplaceable impact on the sustainable development of world economy, particularly sustainable agriculture, and on the environmental protection. The main objective of soil management is its protection from all forms of damage, especially from soil degradation. Particularly unfavorable degradation processes in Croatia are dehumification and soil acidification. In order to protect the soil from further dehumification and acidification, this paper presents the state humus content and acidity of the three dominant soil types found on agricultural land in the eastern, central, western and northwestern Croatian agricultural sub-regions. Climatic conditions of these sub-regions are characterized by equal values of average annual air temperature and a significant reduction in average annual rainfall from west to east - precipitation is highest in the northern sub-region (1014 mm) and smallest in the eastern sub-region (687 mm). Humus content in all three soil types in all sub-regions is very low (less than 3%) and increases from east to west, which correlates with the increase of precipitation. Highest humus content was found in Pseudogley soil type, and lowest in Luvisol. Average pH values (M KCl) of the plough horizon variate in Eutric Cambisol from 5,97 to 4,64, in Luvisol from 4,80 to 4,30, and in Pseudogley from 4,60 to 4,16 (the lowest values were determined in the northwestern sub-region, and the highest in the eastern sub-region). In all soils there was a pH increase with depth, as a consequence of parent material properties and debasification of surface soil horizons.

Degradation of agricultural peat soils in Estonia

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Keywords: agricultural peat soils, organic carbon loss, land use

In Estonia according to the land use register of Agricultural Registers and Information Board the soils with peat layer (Histosols and Histic Gleysols) occupy 110 823 ha of agricultural land which comprises 9.2% of all agricultural land in register. Preferably the peat soils are used as long-term or natural grasslands but still remarkable share is used as arable land and is therefore endangered by the bigger risk of degradation. For agricultural use the peat soils are usually drained quite heavily, especially the arable land and therefore under intensive cultivation the mineralization of organic matter can be relatively intensive and fast. According to the studies made in long term trials in Estonia the agricultural use of peat soils lead to twofold organic matter loss in arable field compared to permanent grassland. The goal of the work was to analyse decrease of soil organic carbon content in agricultural peat soils. The intensive mineralization of organic matter in peat soils can lead to the change of soil type which should be upgraded also in soil map. According to the methodology the agriculturally used peat soils which have soil analysis for content of organic carbon (determined by Dumas method with NIRS in years 2004-10) were identified in digital soil map (1: 10 000). In the precise analyse the soil samples were taken into account where the sampling area was dominated by Histosols or Histic Gleysols. The indicator threshold of organic material was set as 20% of Corg content in soil. Altogether 1134 composite soil samples from different agricultural land parcels were analysed for Corg in peat soils having mainly Histosols (74%) in the investigated dataset. The analysis indicated that the majority (93%) of Histic Gleysols in agricultural use have lost their peat layer during last 20-30 years and 52% of Histosols have been significantly influenced by decomposition and humification processes. The analysis of land use did not show the significant influence of land use on peat mineralization intensity mainly due to lack of historical land use records. The slight difference appeared comparing the contemporary land use where out of analysed peat soils 65% arable land and 54% permanent and semi-natural grasslands had reduced Corg content. The inventory of agricultural peat soils would allow calculate the exact stocks of organic matter and together with land use records evaluate yearly carbon losses predicting the changes in soil properties. The investigation gives also the opportunity to work out conservation measures for those areas to limit the intensive cultivation of peat soils.

Cluster and geostatistical analysis in the chemical and granulometric characteristics of an Oxisol Brazil

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Keywords: soil management, principal component, spatial dependence, Brazil

Aiming to analyze the spatial variability dependency of chemical and granulometric soil on the crops in a Oxisol, we used cluster and geostatistics analysis. Soil samples from depths of 0-0.2 m and 0.4-0.6 m were subjected to hierarchical cluster analysis which allowed the identification of five groups, and confirmed by the analysis non-hierarchical k-means. Groups 3 and 1 (about 3% slope) located in the areas of orange and sugarcane, group 2 near the zone of permanent protection area (PPA) with the planting of orange (about 2% slope) and groups 4 and 5 located on a slope of 2% with sugarcane. The principal component analysis reduced the variables in seven components (PC1, PC2, PC3, PC4, PC5, PC6, PC7), retaining a variability of 80.5% of the original data and geostatistic analyzed the spatial distribution of each component. The PC1 (28.7% of variability) showed a greater influence of the granulometric variables at both depths, especially in contrast to fine sand with clay in the topsoil and coarse sand in the subsurface, with a range of 752 m with moderate spatial dependence, observed in the areas cane lower slopes. In PC2 (17.2%) superficial chemical variables were more discriminating power, with the H + AL contrast with pH, Ca, Mg and soil base saturation (%), with a range of 451 m and moderate spatial dependence, present in the areas of orange. In the PC3 (13.7%), subsurface chemical variables, Ca, Mg, base saturation (%), pH and P showed a larger influence, with a range of 207 m and high spatial dependence, as observed in areas of orange and concentrated points in sugarcane. In PC4 (7.4%), the variable showed contrast medium sand with very fine sand subsurface, with a range of 618 m and high spatial dependence, present in the sugarcane area with lower slopes. In PC5 (5.2%) P and K at both depths and organic matter showed the greatest influence, with contrast with the subsurface P, with a range of 495 m and moderate spatial dependence, present in the area of orange on a gentle slope near the APP. In PC6 (4.7%) the silt at both depths in contrast to the P surface layer was more influential, with a range of 571 m and moderate spatial dependence, observed in the sugarcane area of lower slope. In PC7 (3.6%) both depths of silt along with organic matter subsurface showed greater influence locally in the area of sugarcane, with a range of 200 m and moderate spatial dependence. The results show that the soil has a clay subsurface layer more influential at the top of the ground with signs of accumulation of fine sand in the surface layer. The silt occurs in most sugarcane areas showing potential for surface sealing of soil. In areas of orange, there was the more acid soil, but with less nutritional deficiency due to chemical management. In sugarcane areas where the soil there was less homogeneous due to more intense management, with points of chemical deficiency. The integrated use of cluster and geostatistics analysis provides an efficient exploratory data analysis, with subsidies for land-use planning and soil management.

Study of ammonium nitrogen adsorption by natural materials

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Keywords: adsorption, ammonium nitrogen, goethite, bentonite, zeolite

In this work the adsorption of ammonium nitrogen by goethite, bentonite, zeolite, and zeolite - goethite systems was studied for using them as soil improvements in contaminated soils. For this purpose were prepared samples with the above natural materials and with different concentrations of ammonium nitrogen. Langmuir, Freundlich and Temkin models were used to evaluate the experimental data. According to the results the maximum adsorption was 166.6, 33.3, 20.0, 20.0, 12.5 and 3.33 mg N-NH₄⁺ / g goethite (G), zeolite-goethite (ZGR), zeolite-goethite (ZGY), zeolite – bentonite in ration 1:3 (Z-B), zeolite (Z) and bentonite (B) respectively. Finally, the fitting of models in the experimental data showed that Langmuir follows the B>Z-B>G>ZGY>ZGR>Z order, Freundlich Z-B>G>Z>ZGY> B>ZGR>Z and Temkin G>Z-B>ZGY>Z>ZGR>B. Finally the isotherms constants gave us the opportunity to determinate the proper amount of the above natural materials to improve contaminated soils from ammonium nitrogen.

Evaluation of pH uniformity and moisture content between lots of sfagno peat imported from Canada

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Keywords: Keywords: peat moss, quality, stability, standardization, Brazil

Geologically, the peat is considered a recent formation, with a maximum of 10,000 years. Peatlands, peat extraction areas, are about four feet deep and are sustained by groundwater. Peat is used in several areas: agriculture, energy, environment, fine chemistry and medicine. In agriculture is used for the inputs production. In the energy area is used for direct burning or for generating fuel gas, turning into electricity or heat. Peat can also be used to filter waste and can still absorb oil in environmental accidents. It is an excellent material in the recovery of degraded soil, mainly mining, and reduce water contamination. In fine chemicals, peat can be used to produce activated carbon, sugars and alcohol, besides being a source of organic acids. Peat increases baths in European spas and can still turn a dietary supplement. In Brazil, the peat is used mainly for agricultural use, applied in natural form or formulated with other organic or inorganic materials giving rise to substrates. The aim of this study was to evaluate the uniformity of pH and moisture content lots of sfagno peat imported from Canada in 2010. This study was conducted in the laboratory at the Department of Natural Resources, Soil Science Area, FCA/UNESP - Univ Estadual Paulista, in Botucatu, São Paulo State - Brazil. The experimental design was randomized blocks with 23 treatments, three blocks and three replications. The pH determination was performed using the method of extraction 1:2 (v/v) substrate and deionized water, and readings with a pHmeter. The uniformity was determined after the peat sfagno was placed in rings with a volume of 90.478 cm³. The rings were placed in an oven with forced air circulation at temperature of 65 ° C until constant weight. The results were statistically analyzed using the Tukey test. There were no significant differences in pH values observed between lots of peat sfagno, with values ranging between 3.58 to 3.98. However, there were significant differences in water content between lots, with a range between 46.58% and 53.50%, and average of 15%. This may occur due to the season that peat is extracted, extraction depth and/or exposure time of containers under the sun during the import process, which were waiting the import authorization in ports, ships and trucks. The lots evaluated showed pH uniformity and good quality for agricultural purposes.

Viability of the replacement of Brazilian peat by composted sewage sludge for agricultural use

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Keywords: sustainability, porosity, water retention, solid particles, Brazil

Peat is a fossil product, naturally formed thousands of years ago by deposition of plant debris and minerals in the bottom of ponds and marshlands. In Brazil, the largest reserves are located in the coastal plains of the states of Santa Catarina and Rio Grande do Sul. However, 90% of all the peat in the world are located in the northern hemisphere in cold climates. The largest producer is Russia, followed by Finland and Ireland. The final disposal of sewage sludge has been characterized today as a more relevant urban environmental problem and the amount is proving daily in the world. Sewage sludge is derived from biological treatment of sewage treatment stations, predominantly domestic sewage on the industry. After extraction sawdust and mud crushed sugarcane is added to the sewage sludge in the proportion of 1:1:1. Then, the mixture passes through the composting process in a storage yard for proper sterilization. The levels of heavy metals and pathogens have remained within acceptable levels. For centuries man has been extracting peat for agricultural use in an unsustainable way and attacking the environment. The objective of this work is to assess whether the sewage sludge composting has physical attributes similar to the peat to eventual replacement for agricultural use in order that the sewage sludge composting comes from inexhaustible sources. This study was conducted in the laboratory at the Department of Natural Resources, Soil Science Area, FCA/UNESP - Univ Estadual Paulista, in Botucatu, São Paulo State - Brazil. Brazilian peat and sewage sledge compost (SSC) were physically characterized in the laboratory. The experimental design was randomized blocks with two treatments, five blocks and three replicates. The characteristics evaluated were: total porosity, solid particles, air space, available water, buffering water and remaining water. The materials were placed in rings with a volume of 90.478 cm³, saturated and left for 24 hours. After which the rings were placed on the tension table of 0.1, 0.5 and 1.0 kPa, remaining for 48 hours in each tension and measuring the weight at each time interval. Upon reaching the constant weight rings were dried in an oven with forced air circulation at temperature of 65 ° C. The results were statistically analyzed using the Tukey test. There were no statistical differences between the peat and the SSC for the following parameters: porosity (74.8% to peat and 72.7% to SSC), solid particles (25.2% to peat and 27.3% to SSC) and air space (11.2% to peat and 15.1% to SSC). Statistical differences were observed for the following parameters: available water (13.6% to peat and 7.5% to SSC), buffering water (7.1% to peat and 20% to SSC) and remaining water (42.8% to peat and 30% to SSC). The results showed that the sewage sludge compost can replace the peat for agricultural use, with a proper irrigation management, since the SSC can provide a smaller volume of water to plants.

Variations of Soil Organic Carbon Content in Rangelands of Southwest Spain

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Keywords: soil organic carbon, rangelands, land degradation, grazing

Many rangelands of the world's drylands 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. In the southwest of the Iberian Peninsula rangelands cover vast extensions with semiarid to subhumid climate. They are composed of grasslands with a varying degree of tree cover, ranging from treeless to 100 individuals per hectare. In some areas, shrubs form a third component of the vegetation. The land is grazed by different animal species (sheep, pigs, cattle, goats). The dominant soil degradation phenomena include water erosion and physical and biological degradation. The present paper deals with soil organic carbon (SOC) content investigated in farms exhibiting different environmental conditions in the Spanish region of Extremadura where rangelands cover more than 2 million hectares. The main aim of the research is to detect relationships between soil organic matter content and range management. The study was carried out in the framework of two consecutive projects, with the first one including 54 farms with varying lithology and the second one a selection of 10 farms dominated by schist. 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 region. The dominant soil types are Cambisols and Leptosols, being less frequent Luvisols and Acrisols. Soil analysis included the determination of standard chemical properties (Na, Ca, Mg, K, P, N, pH cation exchange capacity), as well as SOC content, grain size composition, bulk density, aggregate stability and water retention capacity. Furthermore, the present state of degradation and degradation risk was evaluated using parameters such as erosion features, soil depth, depth of the A horizon, soil surface cover (vegetation, litter, outcrops, stone cover, surface crusts), and information related with land use and management (livestock species and density, grazing practices, pasture improvement, etc.). Soil samples were collected from 0-5 cm and 5-10 cm depth, as well as for each soil horizon in 45 soil profiles. A total of 577 soil samples were analyzed. In ten farms soil surface cover was determined along transects in September 2009, May and September 2010 and pasture production and quality is determined using exclosure cages. The results show high variability of SOC. Significant differences of SOC were encountered with respect to rock type, with highest values in soils developed on alluvial sediments, followed by schist. Granites and Tertiary sediments register lower values. SOC decreases exponentially with depth, concentrating in a very shallow upper soil layer (2.22 % in 0-5 cm and 1.18 in 5-10 cm). Vegetation cover type is only significantly related with SOC of the upper 5 centimetres of soil, being higher in soils below the canopy of trees and shrubs, as compared to the open spaces covered with forbs and grasses. No relationship could be found with livestock density (LD, equivalent cattle units/ha), although this does not mean that grazing intensity does not effect SOC content. On one hand significant relations exist between LD and soil surface cover and depth of the Ah-horizon, and on

the other hand SOC is significantly related with the percentage of herbaceous cover at the end of the summer. The results indicate that the relation between the amount of organic matter in soils and grazing intensity is not linear. It is necessary to investigate in depth the effect of grazing animals on soil organic matter in these type of ecosystem in order to be able to give advice for rangeland management and planning.

Influence of puddling intensity and organic amendments on soil water availability status under System of Rice Intensification

V. Sharma

Keywords: System of Rice Intensification, Puddling intensity, organic amendments, soil water availability status

Experiment was conducted for two Kharif and two intervening Rabi seasons, beginning with Kharif 2006 at WMRC research farm of SKUAST Jammu, to analyze the influence of puddling intensities and organic amendments on soil water availability status. Soil moisture status in rice rhizosphere as a consequence of incident rainfall and applied differential irrigation in C1,C2 (Conventional transplanting of 25-day old seedlings, two per hill, at spacing of 20cm x 15cm, with inorganic fertilizers of N:P2O5:K2O= 30:20:15 and 3 t ha⁻¹ FYM respectively, with 7cm depth of irrigations at 8-day frequency) and S1, S2 (SRI transplanting of 10-day old seedlings, one per hill, 25cm x 25cm spacing, with 3 t ha⁻¹ of FYM and wheat Bhusa respectively, with 5cm irrigation at 8 day frequency or less) monitored at 3 week intervals throughout rice growth seasons of Kharif 2006 and 2007 revealed that irrespective of differential inputs of water, the soil water content in the preponderant rice rhizosphere has remained at >50% of plant available range, throughout the crop period. There has not been any influence of either puddling levels or organic addition on this uniform moisture status. Similarly, soil water status monitored in Rabi season (2006-07, 2007-08) revealed that soil water status was again in upper half of the plant available moisture range throughout the crop season in all treatment plots.

Congress Thematic Session

4. Soil and water management under global climatic change scenarios

ORAL PRESENTATIONS

Icelandic Soil Conservation in the European Context: Laws, policies and approaches.

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Abstract. Land degradation and desertification continue to be a threat to the future of human civilization in addition to being large contributors to the risks of climate change. Iceland has a long history of desertification and land degradation since its settlement by humans about 1,100 years ago. Organized battle against destruction of woodlands and soil erosion in Iceland began with a law that was set in 1907, establishing the Soil Conservation Service of Iceland (SCSI). Here we describe the century long history of combating desertification in Iceland and discuss how the experience gained can be useful for other European countries. The key to success of reaching people is through involvement and education using participatory approaches to soil conservation. These soil conservation practices could also be the way forward for future European soil protection.

The global context of land degradation

We humans are facing unprecedented environmental changes in the 21st century. The magnitude of our impact on the Earth's environment and the related consequences and risks for our societies is beginning to dawn upon us. The double challenge from human activity and feedbacks from nature itself has led the world to face a mounting crisis. The increased pressure on natural resources from growing populations has fostered ecologically unsustainable agriculture leading to soil degradation, affecting water resources, biodiversity and resulting in climate change. Land degradation has been ranked among the world's greatest environmental challenges today by the Millennium Ecosystem Assessment and is hampering efforts to achieve the Millennium Development Goals in all eco-regions of the world. Vegetation and soil is being lost at an alarming rate in many parts of the world, leading to a wide range of environmental and socio-economic challenges. The weakening of the vegetative cover can lead to a chain of ecosystem disturbances, further reducing the resilience of the ecosystems towards greater degradation. If prolonged, this can lead to desertification in a wide range of moisture regimes. Successful soil conservation and sustainability are therefore important concepts to master for future generations.

The environmental history of Iceland

Iceland has gone through this cycle of ecosystem disturbances frequently since its settlement by humans about 1100 years ago. Coupled with climatic fluctuations and volcanic eruptions, the pressure on the land exceeded its resilience, resulting in the ecosystem deterioration that Iceland faces today (Ágústsdóttir 2004; Arnalds, 1987, 2005, 2011; Arnalds and Runólfsson 2009, Runólfsson and Ágústsdóttir 2011).

Iceland is located just beneath the Arctic Circle, an island in the North Atlantic Ocean. The climate is maritime, with cool summers and mild winters, and a short growing season. Average monthly temperature varies from -3 to +3 °C in January and from +8 to +15 °C in July, with annual precipitation ranging from 400 to 4000 mm on average (Ministry for the Environment (2006)).

Iceland was settled by Scandinavian Vikings around 874 AD. The vegetation in Iceland had evolved without large herbivores and was highly vulnerable to new stresses associated with imported livestock. The new settlement prospered in the first few centuries (The Saga period),

enjoying a mild climate warmer than today. The woodlands were cut for fuel and timber, or burned to provide space needed for agriculture and grazing. The woodland cover was reduced and grazing pressure increased as human population increased (Kristinsson, 1995). For 1000 years Iceland was predominantly a subsistence agricultural society. The sensitive volcanic soils gradually lost their shelter and became more vulnerable to the forces of nature. Climate deteriorated, with colder temperature between the twelfth and nineteenth century occurring in several steps, with the most severe conditions occurring during the eighteenth and nineteenth centuries (Axford et al., 2007). The climate change coincided with the peak of the ecosystem destruction in Iceland which may have been reached in the 19th century, when new export markets led to an increase in sheep production without regard for the carrying capacity of the country. Repeated disastrous events occurred in the last decades of the 19th century and numerous farms were destroyed by sandstorms and soil erosion (Olgeirsson, 2007).

Vast areas became denuded with a total loss of vegetation and soils. About 95% of the original woodlands and half of the vegetative cover may have been lost since the settlement. Much of the remaining vegetation is severely degraded, biological diversity has been reduced, land fertility diminished and hydrology altered. Thorsteinsson (1986) estimates that the carrying capacity for livestock grazing is now only about 20% of what it may have been at the time of settlement. A national survey of soil erosion in Iceland completed in 1997 revealed severe soil erosion in 40% of Iceland (Arnalds, 2001). The composition of remaining vegetation varies, but is severely affected by long term over-grazing.

Overview of soil conservation in Iceland

These catastrophic events were threatening the future of agriculture in many districts and triggered preventative measures. In response to the immediate need, the Act on Forestry and Protection against Soil Erosion was passed by the Icelandic Parliament in 1907. This marked the beginning of organized battle against the rampant loss of vegetation and soil erosion that was destroying land quality across the country. By this law North Europe's only designated, and possibly the world's oldest, Soil Conservation Service of Iceland (SCSI), was established in 1907. The existence of several communities and some small towns today owe their existence to the reclamation work. Historically, the most common practices for reclaiming severely degraded areas include fencing them off to provide protection from grazing, and fertilization with or without seeding of various species. In some areas extensive barriers of stones and timber were constructed with manual labour. In the 1940s and 1950s, machinery and the use of mineral fertilizer made large scale revegetation and range improvement possible (Ágústsdóttir 2004).

These projects had a high success rate, despite limited financial and human resources for most of this time. However, their scope was always limited and often the focus was to alleviate the symptoms of the problems rather than dealing with the underlying causes, such as improper grazing management. On a national scale, not enough was being achieved in mitigating the extensive ecosystem degradation. Traditionally, governmental efforts (personnel and machinery) halted localized, catastrophic soil erosion, with little local involvement. Consequently, for a long time, soil conservation was regarded as a governmental responsibility, but not an ethical obligation of the land user. The farming community with its limited financial resources and poor perception of the degradation problems did neither conceive itself as part of the problem, let alone a part of the solution.

The history of soil conservation in Iceland reveals both failures and success stories. The failure is a story of top-down approaches, the lack of incentives to care for the land, and similarly a lack of disincentives to reduce unsustainable use. Governmental subsidies are important drivers for agriculture in Iceland. In the seventies when sheep production was at maximum the government was paying at both ends, for both livestock production that caused damage and for soil conservation to repair the damage caused by overgrazing (Arnalds, 2005, 2011). The lack of environmental measures linked to agricultural subsidies resulted in inadequate achievements in soil conservation on a national scale. This continued until 2000 when a policy change developed towards environmental protection through quality in land management in an agreement

between sheep farmers and government. This change was initiated by farmers brought about by public pressure. The pressure was possibly reflecting increased awareness of the society to environmental protection, and also a national soil erosion assessment programme, which demonstrated the degraded condition of Icelandic rangelands (Arnalds, et al., 2001, Arnalds and Barkarson, 2003). The linking land use and economic incentives can be regarded as a milestone towards sustainable land use in Iceland.

The Icelandic experience illustrates success through the increased involvement in soil conservation and local responsibility of farmers and other landowners. Icelandic agriculture is primarily based on sheep farming and dairy production, a pasture- and rangeland based livestock production. A part of the sheep farming has historically relied on grazing of communal highland grazing areas and the farming community therefore owns or has grazing rights to most of Iceland. Without their participation and commitment in soil conservation, sustainable use and restoration of land quality at national scales are unattainable.

Participatory approaches in soil conservation have since 1990 gained increased importance, where land-user and public involvement are the key ingredients towards adoption and successful implementation of conservation approaches (Arnalds, 2005). Holistic ecosystem management for multiple uses, with integrated approaches for land husbandry can provide a path towards sustainable land use and good land health.

Programs with voluntary incentives to adopt sound conservation practices have been evolving. The most extensive is the "Farmers reclaim the land", that started in 1990, aiming to assist landowners to reach their reclamation goals (Arnalds 2011). Also it increases their conservation awareness and makes them the true custodians of the land. The projects bottom-up nature has made it easy to reach the land users on their own terms.

The task of protecting and restoring Iceland's ecosystems is still enormous. Still, improvements are needed for appropriate incentives for soil conservation and revision of weak laws for rangeland protection. The history of land degradation in Iceland demonstrates how a cycle of unsustainable land use and struggle for survival, can reduce land quality and feed the loop of desertification in a self-sustainable farm-based culture. The main underlying causes are the same as in many other parts of the world: clearing of land for agriculture, overgrazing and removal of trees and shrubs that together gradually weaken the soil structure and diminish the ecosystems resilience to change and hamper regeneration after disturbances.

International outreach

Iceland has already started to share their experience through The United Nations University - Land Restoration Training Programme a post-graduate training programme on Sustainable Land Management and Restoration of Degraded Land in Iceland. Efforts to fight land degradation problems are often hampered by lack of knowledge, capacity and social motivation in the affected areas. The experience of a century of soil conservation work in Iceland, in a society that has undergone rapid change from a poor rural agricultural community towards a high-technological society, gives others in similar situations an opportunity to learn.

Collaboration agreement with JRC, signed in 2008 has also resulting in interchange of information and scientific collaboration between researchers in Europe and SCSI. Worldwide university collaboration and exchange of ideas, builds up capacity to remedy land degradation. Iceland is currently in the process of joining the EU and can deliver a substantial added value to the European Community through its experience in participatory land conservation programs and services. Given the current difficulties that the proposed EU Thematic Strategy for Soil Protection is experiencing, particularly for its legally binding component, there is a need for a fresh start in European soil protection strategies. Redesigning the EU approach to soil protection on principles of stakeholder participation and bottom-up approaches involving the local farming community could prove to be the best way forward also for other EU countries, as it has been the case for Iceland. Introducing participatory soil conservation practices in a reformed CAP could be the way forward for future EU soil protection.

Devastating effect of water use in an arid agricultural land: Karapınar case, central Anatolia

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High production increases in field crops in arid lands are only possible by irrigation. Large irrigation projects in arid lands were realized by employing river sources in Turkey, Iran, Mexico, India and Egypt. The recharge rate of rivers provide sufficient water supply unless precipitation is homogenous. However, irrigation based on ground water sources require an utmost care due to critical recharging rate as many arid parts of the world ground water level is decreasing by excess exploitation as the case in Karapınar (Central Anatolia). The site is under risk of desertification process since the 1960s due to overgrazing and excess machinery use on sandy soils. In late 1960s, the erosion control project was launched and in late 1980s the desertification was halted. And in 1990s irrigation became a common land management and ground water wells were used for irrigation of cereals and sugar beet. Today 3000 legal and more than 6000 illegal wells are used for irrigation. State Hydraulic Works reported that ground water level is decreasing since 1989, from around 28 m to the present 130m. However, since 2008, 10 sink holes with 20 to 50 m in diameter and 10 to 45m depth have developed in the study site. The development of sink holes is correlated to the overall decrease of ground water levels in Karapınar. Thus, irrigation in Karapınar has a different adverse effect on environment in addition to well-known salinization, nutrient leaching, and soil structure destruction.

The study reviews the water level change in last three decades in relation to crop pattern, land use management changes along with distribution of sink holes in Karapınar. The Karapınar area in Central Anatolia is taken as a case study for a critical review of ground water based irrigations in arid lands.

Assessing the impacts of wastewater reuse for irrigation using soil quality index

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Keywords: soil quality index, soil quality evaluation, soil functions, wastewater reuse

Wastewater reuse for irrigation is a common practice for preventing overexploitation and degradation of water resources, especially in semi-arid climates such as the Mediterranean region. Consequently, impacts of such practices on soil resources are unavoidable, depending on the level of wastewater treatment that may lead to soil quality degradation. The most appropriate approach to assess these impacts is detecting changes in soil quality in response to applied water qualities. A variety of methods is currently used to measure and evaluate soil quality for assessing sustainability of agricultural practices. In this study, three different water qualities were applied in an experimental field for six years. These were: a) fresh water (Tf), b) wastewater that received a secondary biological treatment and disinfection of the outflow (Tp) and c) wastewater that received a secondary treatment in a series of lagoons without disinfection of the outflow (Tl). At the end of the six years period soil samples were taken and analyzed for measuring a set of soil indicators. Soil indicators that showed a significant difference among water qualities applied were infiltration rate, water filled pore space, pH, electrical conductivity, sodium absorption ratio and soil respiration. A linear method was used for normalizing soil indicators' values and a weighed additive Soil Quality Index (SQI) was adopted for calculating final score for each treatment (a value between 0 and 1). The method detected soil quality changes among the three different water qualities applied and found that soil quality was affected by wastewater reuse. Soil Quality Index values for wastewater reuse (treatments Tp and Tl) were smaller than the value for freshwater (treatment Tf). Caution has to be exercised when applying wastewater for irrigation and site specific adaptive soil management has to be taken into consideration to avoid soil degradation.

The Potential of Forage Production in Alley Cropping and Pro Cropping in Turkey and Its Role on Erosion Control

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Keywords: erosion, forage, alley cropping, pro-cropping

The erosion has threatened more than 85 % of soils of Turkey due to inappropriate conditions such as topographic and climate as well as anthropogenic factors. It is occurred by rain storms much amount sediment and nutrient losses over arable lands where have highly steeps. The most effective way of diminution of soil losses and is to be cover soil surface by plants during whole season as possible as. There are about 1.6 million ha of irrigated and rainfed orchard and 1.8 million ha of irrigated crops area for growing forage by alley cropping or pro-cropping in Karadeniz, Marmara, Aegean, Mediterranean and South East Anatolian regions. According to results of researches, demonstrations, inquire and field observations, it is obtained fodder in irrigated and rainfed areas about 10-15 ton/ha and 2-3 ton/ha of yield, respectively. According to data, it is possible to obtain about 20 million ton of fodder in these regions. So it will prevent soil losses by erosion while it will be supported fodder which is major input for livestock.

The effect of land management practices on soil erosion and land desertification in an olive grove

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Keywords: olive groves, erosion, runoff, land management practices, Greece

The effect of land management practices on soil erosion and land degradation in olive grove has been assessed by conducting experimental measurements for a period of two years (2008-2010). The olive grove is located in a hilly sloping area with soil formed on marl deposits, vulnerable to desertification due to surface water runoff and tillage operations. The experimental design included three treatments with two replicas (in experimental plots 3m x 5m) corresponding to the following land management practices prevailing in olive groves of the area: (a) no tillage – no herbicides application (cover crop: Oxalis sp.), (b) no tillage – herbicides application, and (c) ploughing the soil in a depth of 20 cm perpendicular to the contour lines. The following measurements were conducted: surface water runoff every five minutes using dipping buckets, sediment loss sampled automatically, soil temperature at 10 cm soil depth, soil moisture content at depths 20 and 50 cm using time domain reflectometers (TDR), amount of rainfall, air temperature, wind speed, relative humidity, net solar radiation. All data were recorded in a data logger every three minutes and averaged every one hour. Tillage erosion caused by the used implements was estimated using existing empirical relations derived by the TERON research project. Desertification risk was assessed using the DESERLINKS research project methodology.

The obtained data have shown that the no tillage – no herbicides application land management practice compared to the other techniques derived nil sediment loss ($0.001\text{-}0.025 \text{ t ha}^{-1}\text{year}^{-1}$), lowest water runoff ($0.4\text{-}8.8 \text{ mm year}^{-1}$), highest amount of water conserved into the soil, lowest soil temperature, highest biodiversity, lower desertification risk, lowest olive oil cost production. The tillage land management practice showed the highest sediment loss ($0.044\text{-}0.25 \text{ t ha}^{-1}\text{year}^{-1}$) and surface water runoff ($7.9\text{-}44.7 \text{ mm year}^{-1}$), the highest desertification risk, intermediate amount of rain water conserved into the soil, and 3.7 mm soil loss per year due to ploughing. The herbicides application showed lowest amount of water conserved into the soil and intermediate values of water runoff ($6.7\text{-}16.1 \text{ mm year}^{-1}$) and sediment loss ($0.040\text{-}0.11 \text{ t ha}^{-1}\text{year}^{-1}$).

Release of sediment and phosphorus from fish ponds during their draining as important potential pollution source

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Keywords: ponds draining, phosphorus remobilization, sediment transport

The process of eutrophication is very serious problem of recent fresh waters and phosphorus is most often its main reason. There are intensive discussions about phosphorus sources in European water sources held, but for sure, point and non point phosphorus sources can be distinguished. While point pollution sources are well defined, non-point pollution sources are mainly connected with agriculture and other land management practices and activities. Soil erosion and sediment transport has been identified as the most important source. There exist number of methods to determine soil loss and sediment transport from agricultural land and this process is relatively well described. But following step is transport of sediment trough hydrographical network is far not than well known. Especially weak point is the process of sediment trap, retention and potential re suspension within small water reservoirs within the catchment. Even less information there is about transport of various forms of phosphorus and especially about the processes of phosphorus transformation within mentioned small water reservoirs. There has been traditionally assumed, that small water reservoirs, specifically fish ponds are retention elements, with high trapping capacity related to both of sediment and phosphorus. But there are very few data to document his problem. Two fish ponds built in cascade, with total catchment area ca 60 km² and intensively agriculturally used landscape were selected as experimental ones. First soil erosion and transport processes has been documented in the field and calculated for entire catchment, using USLE and GIS methods. Sediment transport from the catchment to both reservoirs has been assessed using traditional method of SDR. Calculated sediment volume within both reservoirs has then been verified by field measurement during winter period, when both reservoirs are empty. Field measurement approved good agreement with simulated data. Experimental campaign has then been realized during fall 2010 with the goal, to approve potential sediment trap or sediment and phosphorus release during process of fish pond draining. Due to manipulation at the outlet devices of the ponds, part of sediment has been resuspended together with phosphorus, which entered ponds together with the sediment, or which has been introduced into ponds with feed for fish. Outputs of the measurement done are temporal distribution of discharges, suspended solids, conductivity and total phosphorus during all process of pond draining. Results show important role of manipulation mainly during last parts of draining of sediment resuspension and document, that fish ponds can be important source of pollution within the catchments. Nevertheless, this effect can be significantly limited by proper management. In conclusions of the paper, the effect of various types of ponds and their management and their potential to either trap or release sediment and nutrients in relation to fish management are discussed.

Effect of conservation agriculture on soil CO₂ flux in semi-arid Morocco

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Keywords: no tillage, CO₂ flux, seasonal variability, semi-arid, vertisol

Tillage practices and climate influence the release of green house gases but information is lacking on CO₂ flux and its seasonal variability in Mediterranean basin. Soils in this region are characterized generally by low organic matter and moisture with the widespread use of intensive tillage. Soil plowing is a principal cause of decreasing soil organic matter and increasing soil CO₂ emission. In this study, we assess the short effect of conservation tillage (NT) on soil CO₂ flux compared to reduced (RT) and conventional tillage (CT). Measurements were done during before and after tillage events (from 0 h till 96h after tillage) under wheat and lens crop. The study was conducted in Mediterranean Vertisols in semi arid Morocco. Soil temperature, moisture and soil strength were also measured to study their effect on soil CO₂ Magnitude. Immediately after wheat tillage, CT showed the highest CO₂ flux (about 5 g/m²/h) compared to NT (<1 g/m²/h). In contrast, after lens tillage, CO₂ flux values were 2 g CO₂ m⁻² h⁻¹ (CT) and lower than 0,5 g CO₂m⁻² h⁻¹ in NT plot. Soil strength measurements were significantly correlated to soil CO₂ emission than soil temperature and moisture. The intensity of rainfall events occurred during the wheat and lens cropping season explained the seasonal CO₂ flux trends. The findings suggest to promote conservative practices which can be found for reduce CO₂ losses in such semi-arid conditions.

Soil and water assessment tool (SWAT) model and application

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Keywords: SWAT, developmental history, modeling, flow analysis, water quality.

The Soil and Water Assessment Tool (SWAT) model is a continuation of nearly 30 years of modeling efforts conducted by the USDA Agricultural Research Service (ARS). SWAT has gained international acceptance as a robust interdisciplinary watershed modeling tool as evidenced by international SWAT conferences, hundreds of SWAT related papers presented at numerous other scientific meetings, and dozens of articles published in peer reviewed journals. The model has also been adopted as part of the U.S. Environmental Protection Agency (USEPA) Better Assessment Science Integrating Point and Non point Sources (BASINS) software package and is being used by many U.S. federal and state agencies, including the USDA within the Conservation Effects Assessment Project (CEAP). At present, over 250 peer reviewed published articles have been identified that report SWAT applications, reviews of SWAT components, or other research that includes SWAT. Many of these peer reviewed articles are summarized here according to relevant application categories such as stream flow calibration and related hydrologic analyses, climate change impacts on hydrology, pollutant load assessments, comparisons with other models, and sensitivity analyses and calibration techniques. Strengths and weaknesses of the model are presented, and recommended research needs for SWAT are also provided.

Climate-change- need of measures to control erosion in winter wheat areas

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Keywords: soil erosion, winter wheat, measures, climate change, soil tillage, Norway

Much of the focus related to climate change and agriculture latest years has been on how agriculture can reduce emissions of greenhouse gases. Less effort has been on effects of climate change on effects on production systems, environmental effects and adaptation measures. In Norway, one expected positive effect of climate change is an increase in the length of growing season with 1- 3 months. This can give possibilities for higher yields, extended cultivating area for specific crops, and possibilities for growing new crops. Many farmers see new possibilities in growing winter wheat into other areas than today. Winter wheat normally gives a higher yield than spring cereals and is therefore economically beneficially to farmers. In Norway, climate change is expected to increase precipitation, especially outside the growing season, during the autumn and winter period. More frequent freezing/thawing cycles and snow melting periods combined with increased rainfall is expected. This can increase the risk of runoff and erosion and has put new focus on whether winter wheat should be recommended, or if specific restrictions are needed to reduce erosion and nutrient losses.

This paper present results from a plot study (2002- 2010) established to study the effects of erosion from winter wheat and use of different soil tillage methods: direct drilling, autumn harrowing, autumn ploughing compared with spring tillage for spring cereals. Two study sites, each site with 4 plots (8m *22m) with 2 replicates were established. A monitoring station by end of the plots collected surface runoff and was equipped for water sampling of suspended solids, phosphorus and nitrogen. Sampling was event based after precipitation events or during snowmelt. The Hellerud site had clay soil influenced by land levelling and a higher erosion risk than the Øsaker site with silty clay loam, but lesser influenced by land levelling. Weather conditions varied between years resulting in very different runoff and erosion conditions. Some years there were few runoff events during the autumn period and consequently the soil losses were small. Other years e.g. intensive rainfall (105 mm) occurred shortly after tillage and sowing. Concentrations of suspended solids in runoff from plots varied from 5 mg/l with direct drilling, 1110 mg/l with autumn harrowing and 5820 mg/l with autumn ploughing for the Øsaker site. The same event for the Hellerud site gave concentrations from 235 mg/l for direct drilling, 824 mg/l for autumn harrowing and 1900 mg/l for autumn ploughing to winter wheat. Autumn harrowing reduced soil loss with 66% (silt loam) and 79% (clay) compared to traditionally ploughed winter cereals. Direct drilling or no-till reduced soil loss with 88%. Erosion was even higher from autumn tilled winter wheat than for autumn tilled spring cereals. These results have led to changes in the regulations and environmental support system in the "Regional Environmental Programmes" although many farmers are not willing to reduce autumn tillage.

Seasonal variations of aquifer intrinsic vulnerability in an intensively cultivated vulnerable basin of Greece

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Keywords: hydrology, GIS, DRASTIC, multi-criteria analysis

Viotikos Kifissos, central Greece is a key agricultural production area of the country where intensive agriculture is being practiced for several decades. Due to the geological structure of the wider area and sporadic elevated groundwater nitrate concentrations documented in the past, the basin was declared as vulnerable to nitrates pollution of agricultural origin, according to Directive 91/676/EC. The downstream part of the basin was selected as a pilot area, in the context of the "EcoPest" LIFE+ research project that is co-funded by the E.C. This project aims in the strategic planning for the adaption and application of the principles for the sustainable use of pesticides in a vulnerable ecosystem. Due to the lack of systematic datasets and knowledge to assess groundwater susceptibility to pollution and in order to facilitate understanding the controlling pollution mechanisms, DRASTIC model was compiled. To support this exercise, relevant temporal and spatial data series were retrieved from existing archives, and further datasets of missing parameters for setting up DRASTIC were compiled following extensive field work campaigns. GIS technology was used in order to construct a database, produce DRASTIC's factors as layers and apply to each one of them a specific weighting factor, so that the regional vulnerability maps could be produced, with the aid of multi-criteria analysis. Originally, the compiled model that was based on mean annual data values for each of the time variant factors, suggests a highly vulnerable region. In actual terms, however, this approach may mask the effects of seasonal variations in related hydrological parameters thus leading to potentially misinterpreted or under (or over) evaluated vulnerabilities and consequently pollution risks over specific periods within the hydrological year. To examine this possibility, DRASTIC was also compiled for each season. The resulting vulnerability maps of the compiled model helped in studying the seasonal changes of intrinsic vulnerability within the pilot area. In that way, it became feasible to observe spatial and temporal changes of intrinsic vulnerability related to seasonal changes in climatic conditions. Indeed, considerable variations are observed between the overall mean and the seasonal vulnerabilities, both in terms of actual values and spatial distribution. The results suggest that the parts of the basin, which are characterized as highly vulnerable, cover the greatest extent of the aforementioned area during the wet period, while, during drier seasons, the highly vulnerable parts of the pilot area become reduced in extent. Finally, this observation served in pinpointing during which periods of the year the measures for the protection of the aquifer should be more intensive and strict. In view of the projected climate changes DRASTIC may serve as a valuable tool to perform an initial analysis of the expected changes in the vulnerability regime of the system, that will in turn affect the integrity of groundwater quality. Such an analysis would contribute in shaping up the appropriate adaptive measures in time.

Influence of lithology on groundwater quality and projected impact due to climate change. The case of wider Kopaida basin-central Greece

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Keywords: geochemistry, groundwater quality, climate change, ophiolites, redox sensitive metals

Lithology and physicochemical conditions are amongst the major factors affecting regional geochemistry and consequently groundwater quality. The area examined in this work forms part of the wider Kopaida basin-central Greece, which is an intensively cultivated region. Water sampling from the alluvial aquifer and the vadose zone was carried out in 7 campaigns during 2009 and 2010. Results of the conducted hydrochemical analyses document Fe, Mn and Ni concentrations that exceed by far the E.C. drinking water standards, especially during spring and summer, are attributed to the geological structure of the wider region. Ophiolitic blocks from the Jurassic tectono-metamorphic complex, bauxitic and lateritic formations crop out around the basin. These rocks supply the alluvial basin with their weathering products, thus affecting the soil composition that also exhibits elevated concentrations in heavy metals, as reported in earlier research works and documented by findings of the LIFE + EcoPest project, in the framework of which the current work has been elaborated. Geostatistical analysis was applied in the broader area in order to delineate the zones exhibiting the most elevated concentrations, thus identifying the most probable rock sources. Based on the results of this analysis, the ophiolitic blocks at the northern part of the basin may be identified as the main source of Mn and Ni, whilst the existence of Fe may be attributed to the lateritic outcrops at the southeastern part of the region. Kopaida basin is a former lake and the anoxic conditions that prevail due to the rich organic content of the deposited sediments, result to increased solubility of Fe and Mn in groundwater. In such conditions Fe and Mn act as oxidants and Ni becomes soluble usually attached to the Mn complexes. Seasonal variations on the concentration values of aforementioned heavy metals are largely related to the seasonal temperature variation that impacts on the redox potential. During the cold months low temperatures reduce the influence of organic matter resulting in redox values sustained at higher levels and therefore in low concentrations of the considered metals. During the warm months the effect of the organic matter increases and the dissolved oxygen decreases resulting in low Eh and high Fe, Mn and Ni concentrations. Global and regional climate change scenarios project a temperature increase of about 4-5 °C for the next 100 years in the Mediterranean region and particularly in Greece. Under these conditions the concentration of these heavy metals in groundwater will increase, thus further impairing groundwater quality at the studied region. However, more research supported by laboratory and numerical simulations is required to quantify the anticipated effects on groundwater quality in response to the projected climate changes. Despite the fact that due to the origin of the heavy metal concentrations the studied groundwater bodies may not be characterized as being at critical or bad state, poor groundwater quality remains an issue that is bound to affect the socio-economic stability, welfare and development of the region; As such, it calls for the appropriate adaptation measures to be designed and implemented.

Leachate monitoring network design in the vadose zone at Viotikos Kifissos basin, central Greece

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Keywords: vadose zone, agricultural lecheates, groundwater pollution, monitoring networks

Intensive agriculture is often acknowledged as one of the main sources of groundwater quality deterioration. Due to climate changes net recharge is exhibiting an overall decrease trend. Consequently, groundwater resources are being reduced and groundwater quality deterioration phenomena intensify, since pollutants are being diluted to progressively reducing volumes of water. The role of the vadose zone in deep percolation of pollutants is of paramount importance, especially in highly vulnerable hydrogeological systems. Hence, monitoring of agricultural lecheates becomes essential in assessing groundwater pollution, developing an understanding of the importance of influencing factors and ultimately in setting-up and deploying mitigation measures. Methods developed so far for lecheate monitoring at the vadose zone are based on devices that recover time and space discretised samples, i.e. provide water samples from a specific point at a specific time. Despite the usefulness of those methods, collected samples may fail to provide the footprint of agricultural practices that have taken place over critical periods of cultivation. Therefore, the impact of application of plant protection products and/or fertilisers to groundwater pollution may be missed, or miss-evaluated. LIFE + EcoPest project is co-funded by the E.C. and focuses on the development, application and demonstration of an economically viable Strategic Plan for the sustainable use of pesticides and fertilisers. Viotikos Kifissos basin-central Greece, is a highly vulnerable hydrogeological system and serves as the pilot area of EcoPest. In the framework of this project, a simple yet efficient sampling device has been developed that allows collection of time-averaged lecheate samples that may be considered representative of the cultivated field where they are installed. Lechate collection is performed underneath the core root zone development depth of the main cultivars in the pilot area of the project. Collected samples are analysed for a comprehensive suite of parameters, and the results of the performed analyses provide mean concentration levels of lecheates, that can be conceived as the overall footprint of the performed agricultural practices during the sample collection period. Fourteen sets of the vadose zone sampling devices are installed in fields cultivated by the dominant cultivations of the region. Four sampling campaigns are conducted annually to coincide with key periods: a) prior to sowing and any other agricultural works, b) post-sowing, pre-germination plant protection treatment and before the first fertilization application, c) after completion of plant protection treatments and fertilization application and d) after the end of the harvesting period. Due to the immediacy of the sampling device to the soil surface, the response of the system, as recorded in the collected samples, is relatively rapid thus enabling correlation of the lecheates to specific agricultural interventions for plant protection and/or fertilisation. Implementation of the specific monitoring system provided an insight of the background concentrations of the lecheates and their temporal variation that is related to the agricultural activities practiced. It further assisted greatly to the design and efficiency assessment of measures implemented in the

fields aiming at reducing the agricultural inputs and subsequently reducing groundwater pollution potential linked to cultivation activities.

Effect of wastewater sediments on some soil properties under energy grasses

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Keywords: air and water permeability, density, *Phalaris arundinacea*, *Dactylis glomerata*, *Bromus inermis*, waste water sediments

Due to the energy problems in the World, more attention is paid to the biomass as potential energy resource instead of fossil fuels. Next to xylem plants the grasses are in the interest of research. Growing of grasses is giving quick results and there is enough suitable agricultural or fallow land available. As the biomass is not used for human food or animal feed, it is possible to use alternative fertilizers as wastewater sediments. Due to the high expenses of the composting of sediments, it is pressure to use the raw sediments without composting. But it may result degradation of soil properties. The field experiment to study the suitability of some grassland cultures as energy plants have been established on the experimental station of Eesti Maaülikool (EMÜ), the Estonian Agricultural University in Rõhu in year 2007. Soil of the experiment area is sandy loam Haplic Luvisol (siltic) by WRB (2006). The plant species investigated in the experiment were *Phalaris arundinacea*, *Bromus inermis* and *Dactylis glomerata* at different fertilizers and fertilization rates. Samples to measure soil properties were taken from the plots without any fertilizers use and from the plot where fresh wastewater sediments were used in rate 1.3 kg m⁻². In the first year the sediments were added to the soil, next years on the soil. Soil samples were collected in September each year from two depths: 0–5 cm and 20–25 cm. From chemical parameters, adding of waste water sediments increased significantly the amount of available phosphorus in soil up to two times especially in 20–30 cm deep in soil. Sediments decreased in most cases soil pH measured in KCl, but had no significant impact on Corg, N and K content in soil during two years. The results revealed the higher bulk density, lower air and water permeability in the soil of treatments where wastewater sediments were used compared to unfertilized treatments. However, highest soil bulk density was measured under *Phalaris arundinacea* and lowest under *Bromus inermis*. At the same time water and air permeability was better under those species compared to *Dactylis glomerata*. Higher soil density but better functions under *Bromus inermis* and *Phalaris arundinacea* were probably caused by their root properties. *Bromus inermis* had highest root volume, mass and diameter, *Dactylis glomerata* had thinnest roots and *Phalaris arundinacea* lowest root volume in investigated depths compared to other species. Wastewater sediments increased also root volume, mass and average diameter of all investigated species. Even the fresh wastewater sediments decreased soil air and water permeability, it had no negative effect on investigated species growth. Also the amount of sediments added to the soil was not as big to decrease the permeability under plant growth limiting value.

Spatial Soil Temperature and Moisture Monitoring

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Keywords: Soil temperature, soil moisture, GDD, Transylvanian Plain

The Transylvanian Plain, Romania is an important region for agronomic productivity. However, limited soils data and adoption of best management practices hinder land productivity. Soil temperatures of the Transylvanian Plain were evaluated using a set of twenty datalogging stations positioned throughout the plain. Soil temperatures were monitored at the surface and at 10, 30, and 50 cm depths, and soil moisture was monitored at 10 cm. Preliminary results indicate that most soils of the Transylvanian Plain will have a mesic temperature regime. However, differences in seasonal warming and cooling trends across the plain were noted. These have important implications for planting recommendations. Growing degree days (GDDs) are preferred over maturity ratings, because they can account for temperature anomalies. The crop being considered for this study was corn. The base temperature (BT) was set at 10°C, and the upper threshold was 30°C. Two methods were used to calculate GDDs; 1) minimum and maximum daily temperatures, and 2) 24 h of averaged temperature data. Growing degree days were run from 110-199 day of year (DOY) to represent approximate planting date to tasseling. The DOY that 694 accumulated growing degree days (AGDDs) was reached at each site was then analyzed to identify differences across the TP. Three sites failed to reach 694 AGDDs by DOY 199, and were excluded from comparisons to other results. Averaged values were used to create spline interpolation maps with ArcMap 9.2 (ESRI, Redlands, CA, USA). The southeastern portion of the TP was found to tassel a month earlier assuming a planting date of 109 DOY. Four DeKalb® corn hybrids were then selected based on GDDs to tasseling, drydown, drought tolerance, and insect resistance. With a better understanding of the GDD trends across the TP, more effective planting and harvesting could be accomplished by Romanian farmers to maximize agronomic production.

Evaluation of Soil and Water Conservation Practices in Vineyards of Catalonia (NE Spain)

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Keywords: vineyards, moisture regime, wine quality, land transformation, climate change

In Catalonia (NE Spain), traditionally the vineyards for wine and cava production (mainly under dry land conditions) have been one of the main crops, especially in sloping lands. The semiarid Mediterranean climate conditions, including sunshine hours, temperature and especially rainfall amount and distribution, together with the soils and land management, have been the main responsible for the high quality of the wines produced in the wine producing regions of Catalonia. In the last 15-20 years, there have been introduced some land transformation practices like levelling and terracing, together with the use of new vine varieties and plantation patterns, some times with complementary irrigation and cover crops, mainly with the purpose of reducing hand labour and to increase production, and also to "improve soil and water conservation". Those practices may have drastic influences in the soil hydrology and on the hydrology of the watersheds. Field research and monitoring for several years in three of the wine producing regions of Catalonia have permitted the identification and quantification of the effects of the different changes in land management on the soil moisture regime during the different growing cycles of the vine, and to deduce the derived influences on soil and water conservation affecting the quantity and quality of crop production. The results show that in most of the cases the land transformation and the new land management practices have increased the risks of droughts and of soil erosion (surface or mass erosion depending on the region), and also the spatial and temporal variability of production- both in quantity and in quality- among the years. The effects of using soil cover crops and complementary irrigation to solve these problems may be positive or not, according to the particular soil, land, climate conditions and water availability, in each region. It is concluded that before adopting and applying extensively land transformations and strong changes in land management practices in vineyards for wine production in Catalonia, it would be necessary to preview, with appropriate field evaluations and modelling, the effects of them on soil and water conservation, and specially on the soil moisture regime during the critical periods of the vine development affecting quantity and quality of production. One of the main factors to be considered in those evaluations is the climate variability, including the previewed future climate changes in the Mediterranean region.

Evaluation of different statistical approaches for predicting soil organic carbon stock

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Keywords: soil organic carbon, bulk density, mixed model, linear regression, soil monitoring

Soil organic carbon (SOC) determines ecosystem functions and SOC stocks are an important store of global terrestrial carbon. Therefore the spatial pattern of SOC stocks and its appropriate management is important at various scales. Due to the commitments outlined in international agreements, national estimates of SOC stocks have to be determined and reported. Mathematical modelling has been frequently used in estimating SOC stock. However, given the importance of soil carbon model, the precision and reliability of parameter estimation and prediction quality are highly relevant. The aim of this study is to compare different statistical approaches for estimating and predicting SOC stock in Estonian arable soils in the humus horizon. More specifically, the scope was to find out if better results are achievable by using a combined SOC stock prediction model or by integrating separate SOC concentration and Db models in the SOC stock calculation. We used Tartu County in south-east Estonia as a pilot study area to evaluate the developed models and to present results embedded into the Estonian large scale soil map (1:10,000). Three different statistical methods were compared: the median-based approach, linear regression and mixed model analysis. Additionally soil bulk density (Db) and SOC concentration were modelled using linear regression and mixed model. The median estimates of SOC content and Db were calculated for each unique soil type – texture combinations. SOC concentration was modelled using linear regression (soil type, texture or clay content, pH as input variables) and a mixed model (clay content, soil type, depth of humus horizon, pH as fixed effects and site, year, transect, plot as random effects). Same approach was applied on Db prediction where a mixed model (mean square error=0.009) was constructed from multiple variables (SOC content, sampling depth, moisture content, texture, soil type, thickness of humus horizon as fixed effects and site, transect, plot, year, and the site-year interaction as random effects). Constructed Db and SOC models are not compatible for predicting values for peat soils, which have median values depending on the degree of peat decomposition. For modelling Db and SOC content by means of the three approaches described above, we used a dataset compiled from soil samples collected from 1983–1994 under the framework of national monitoring of arable soils. The dataset consists of 90 different sites all over Estonia holding 17,294 unique Db and 8,707 unique SOC content values. SOC stocks were calculated (also the coarse soil fraction was subtracted from the total soil volume) using different approaches and integrated to Estonian large scale soil map. Bottom-up SOC stock estimation and prediction using different methods is showing large variations in prediction quality. While easily applicable soil carbon models are highly desirable their accuracy might be not sufficient. Using more sophisticated approaches rapidly increases the amount of input data required. However, the estimation and prediction of SOC stock in regional scale should be done using all the parameters available and analyzed with appropriate methods.

Fuzzy analysis of infiltration problem using Parlange model

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Keywords: fuzzy logic, infiltration, Parlange model

A major problem in the simulation of water resources is the uncertainty of the various parameters. Fuzzy analysis is a powerful tool for dealing with such problems involving uncertain data. In most unsaturated bodies systems, the exact values of saturated hydraulic conductivity as well as sorptivity are often not known. A methodology for the infiltration problem with vague values of the above soil parameters is introduced in this paper, and an application example is presented. Infiltration is the physical phenomenon during which water crosses soil surface and is stored in the soil profile. Infiltration rate depends on many elements such as the initial condition of the soil surface, the structure and the mechanical behavior of the soil. Soil homogeneity affects infiltration as well as soil pore dimensions affect infiltration. Infiltrability is greater in soils with big pores than in synectic soils. Water temperature and the initial soil moisture have an affect on infiltration too. The infiltration is a very important physical phenomenon for irrigation as well in hydrology since the amount of irrigation water and the amount of runoff water depend on it. Complete knowledge of the mechanics of water infiltration into the soil leads to assessment of irrigation water supply and to the ability to enrich the underground water horizon. Different formulas have been proposed, expressing the law of infiltration. They are based on either the analysis or on the empiricism of researchers working on this subject and deriving various equations which describe the phenomenon of infiltration. It is very useful in hydrology to characterize the phenomenon of infiltration by a small number of parameters. It is for that reason that Parlange model was chosen to describe the phenomenon. It comprises two parameters (sorptivity and hydraulic conductivity at saturation), and have an implicit form. In infiltration flow problem the exact value of various coefficients (saturated hydraulic conductivity, sorptivity, etc.) of the soil is often not exactly known. The classical approach in dealing with this type of uncertainty was till now the use of a probabilistic approach. However this method is difficult to apply in real world problems. The probabilistic characteristics of the input data are rarely known. For these reasons some authors propose the use of fuzzy arithmetic to deal with uncertainties, occurring in infiltration problem and introduce the membership function which denotes that a certain value of a given parameter is likely to occur and not the degree of certainty. A fuzzy analysis approach of water resources problems, involves usually the consideration of several α -level cuts in the analytical expression of the infiltration. In that paper we use the experimental data and we assume that data concerning saturated hydraulic conductivity and sorptivity are uncertain and a membership function for them is introduced. The existing analytical solution is solved for different α -level cuts and the results are presented as membership

functions of cumulative infiltration at different times. The Fuzzy logic model seems to have the ability to reproduce the infiltration values quite well using two parameters as fuzzy numbers.

Water augmentation techniques for plantations on sloped drylands an experimental evaluation

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Keywords: water harvesting, tree productivity, soil moisture, Chile, Eucalyptus, Pinus, water conservation

Increasing crop and forest productivity in drylands is a major challenge to make these regions more sustainable in response to an increasing world population. Water augmentation for plant growth is key to achieve that objective. This was explored at two locations in semi-arid central Chile by comparing the effect of different soil treatments on soil water availability during the dry season: microterraces (M), infiltration trenches (IT) and rototilling (R). Watermark soil moisture sensors were installed at two depths (0.3 and 0.6 m) and monitored daily during the dry season to measure water potentials for each treatment, and were converted to soil moisture contents using a soil water retention curve. The sensors installed in the M-plot measured higher water contents during the dry season when compared with the control plot without treatments. Similarly, the R-plot showed increased water storage closer to the surface. The IT-plot showed a clear decreasing trend in moisture content with increasing distance from the IT. Survival rates of *Eucalyptus globulus* Labill were improved by each of the soil treatments, but *Pinus radiata* D. Don was less affected. Tree dry weights of *Eucalyptus* followed available water contents rather well, with highest productivities observed at the M- and R-plots, and showing higher values closer to the IT. The soil treatments improved productivities significantly for *Pinus* trees, but differences among them proved not significant.

POSTER PRESENTATIONS

Nitrogen in successive sugarcane ratoons derived from residual straw mineralization

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Keywords: sugarcane, nitrogen, ¹⁵N, sugarcane straw, biofuel

The Brazilian production of ethanol from sugarcane inserts the country in a prominent position on the worldwide biofuels production. Nowadays, there are new technologies to obtain the ethanol, named ethanol of second generation, using sugarcane bagasse and/or crop residues as raw material. The sugarcane crop residues are called sugarcane straw or sugarcane trash, and are composed of green and dry leaves, and small pieces of stalks, which remains on the soil surface after green mechanical harvest. However, under soil conservation point of view, the maintenance of sugarcane trash improve some attributes of the soil, as physical quality and some chemical soil features, like as increase in CEC, toxic elements and micronutrients complexation, and availability of nutrients for crop, being the nitrogen the most affected, especially due to the impact of sugarcane trash on immobilization-mineralization turnover mediated by soil microorganisms. In this context, this study aimed to evaluate the N utilization from residual straw (trash-N) by three consecutive sugarcane ratoon crops during the seasons: 2007, 2008, and 2009. For this purpose, three experiments were carried out in sugarcane commercial fields in São Paulo State – Brazil. The trials were performed on following types of soils: Arenic Kandiudults (AK), Rhodic Eutrudox (RE) and Typic Eutrudox (TE). The study started after the plant cane was harvested (unburnt mechanical harvest), and was developed until the fourth cut of sugarcane (third ratoon crop). The experiment was carried out in randomized blocks with four replicates. Each plot had 12 rows of sugarcane plants, with 15 m long and 1.5 m between rows. Within each mean plot were installed microplot (2 m length and 1.5 m width) where sugarcane residual straw from the mechanical harvest was replaced by another with N labelled-¹⁵N. The rates of trash-N and ¹⁵N abundances were 41, 41 and 51 kg ha⁻¹ with 1.01, 0.83, and 1.00 atom % ¹⁵N, respectively, for AK, RE and TE trials. The shoot of sugarcane ratoons plants in the center of microplot were harvested and the dry material were analyzed for total-N and ¹⁵N abundance (atom %). In the 1st ratoon the highest trash-N uptake was observed in the TE experiment (4.3 kg ha⁻¹ trash-N), followed by AK and RE trials (3.8 and 3.7 kg ha⁻¹ Trash-N). For the 2nd ratoon it was found an increase

in trash-N uptake in the AK experiment (4.3 kg ha^{-1}), whereas in the RE trial the trash-N uptake was 0.8 kg ha^{-1} , with a decrease in the latter for the first ratoon. In the 3rd ratoon the trash-N uptake were 3.0 and 2.1 kg ha^{-1} for RE and AK respectively. After three consecutive ratoon crops the total trash-N uptake by sugarcane were 7.5 kg ha^{-1} (18.4%) for RE, and 10.2 kg ha^{-1} (24.9%) for AK. The results indicated that the N from crop residues generated by mechanical harvesting of unburnt sugarcane can represent, throughout consecutive crop seasons, important N source to grow up sugarcane, to improve the N recycling in the soil sugarcane system, mitigating the environmental impacts of nitrogen fertilization.

Quality Drinking water in Moldova

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Keywords: water resources, water quality, health, sources

The quality of the water and accessibility of the fresh water sources are the two global problems, which the mankind tries to solve nowadays. In the country side of Budjac the majority of the people use the ground water from the wells. The ground water is not very deep, it is at the depth of 1,0-15 m. The quality of the water depends as on the natural conditions as on the economic activity. The quality of the drinking water of Cirsovo village in Comrat district was investigated. We explored the organoleptical characteristics, the chemical structure and the microflora character. Twenty -eight wells were researched: 13 wells in the lowland of the village and 13 wells in the highland of the village and also 5 artesian wells, which are used by the great part of the population of the village. According to the organoleptical data the majority of the models correspond to the State Standard Specification except some wells in the lowland of the village, the colour indicator data of which 9 degrees exceeded, and some wells in the highland of the village where some models didn't correspond to the State Standard Specification according to such points as turbidity and coloration.

The water from the artesian well of the grain store does not correspond to the requirements of the State Standard Specification on the organoleptical data, such as smell and smack. According to the sanitary and chemical data the water from the artesian wells does not correspond to the state standard specification on ammonia content and the general rigidity. In some tests of water, e.g. in the artesian well of the grain store the ammonia concentration 9 times exceeds PDK and is 4,73 mg/dm³.

According to the bacteriological indicators the E.Coli data were taken. Mostly the water in the wells corresponded the requirements of the State Standard Specification on the bacteriological indicators. In the models of the water from Olympiskay Street E.Coli was found.

The analyses allowed to expose the problems in the village on the problems of the drinking water, evaluate the wells conditions:

- The specialists of the sanitary and chemical laboratory should make the analyses of the drinking water in the wells more often.
- The Mayor staff should make control of the conditions of the wells.
- The population should organize the sanitary cleaning of the territory near the wells.
- The sanitary and epidemiological office should use the passport system of the wells.

The effect of overgrazing on soil erosion and land desertification in grazing land

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Keywords: grazing land, erosion, runoff, land management practices, Greece

Overgrazing is considered as the main cause of soil erosion, land degradation and desertification in hilly Mediterranean areas used as pastures. In order to assess the effect of overgrazing on land degradation, measurements of soil erosion and water conservation were conducted in a hilly sloping area (slope gradient 22%) with a moderate deep soil (45-65 cm depth), severely eroded and formed on plough parent material used as pasture for centuries. The following two treatments: (a) sustainable grazing, and (b) overgrazing were studied in four experimental plots (2m x 5m) for a period of two years (2008-2010). The following measurements were conducted: surface water runoff every five minutes using dipping buckets, sediment loss sampled automatically, soil temperature at 10 cm soil depth, soil moisture content at 20 cm depth using time domain reflectometers (TDR), amount of rainfall, air temperature, wind speed, relative humidity, and net solar radiation. All data were recorded in a data logger every three minutes and averaged every one hour. Furthermore, plant cover, resistance to soil penetration and shear strength was measured periodically. Desertification risk was assessed using the DESERLINKS research project methodology.

The obtained results showed that under sustainable grazing surface water runoff was 7.4-28.0 mm year⁻¹, compared to 18.7-43.7 mm year⁻¹ overgrazing, while sediment loss was 0.033-0.14 t ha⁻¹year⁻¹, and 0.14-0.35 t ha⁻¹year⁻¹, respectively. Under overgrazing conditions, organic matter content was by 35% lower and the average soil temperature 1.9 °C higher compared to sustainable grazing. Soil moisture content was mainly higher in the overgrazing soil due to lower plant cover but soil water stored into the soil was lower compared to the soil under sustainable grazing. Mean values of soil penetration and shear strength were higher under overgrazing conditions. Finally, desertification risk was assessed as high in both cases but the desertification indices for sustainable grazing was lower indicating lower vulnerability to desertification if sustainable grazing is conducted.

An alternative of surface water storage at Skryje locality

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Keywords: Skryje village, river basin plan, the accumulation of surface water

The aim of this paper is to propose an alternative possibility for an accumulation of surface water (dam) at Skryje locality and to compare it with the original variant derived from the 70s. New variant corresponds to the location and parameters required to prevent flooding at Skryje the village and residents not be forced to move out. The requirement was to satisfy its purpose and to fulfill its intended need (to improve the flow and to protect the Svatka valley, Bobrůvka (Loučka) and Svatka Flood). Evaluation of the current state of site and its vicinity was performed by maps, photos, custom ground survey and information provided by Povodí Moravy. Photographs were taken. Then the proposal was created as alternative versions of accumulation of surface water (dam) Skryje including the necessary calculations and drawings. Map data were provided by the Czech Surveying, Mapping and Cadastre Authority and subsequently processed by ArcGIS program. S-JTSK EastNorth Bushman was selected as an coordinate system. Finally, the two versions were compared. The study was done as a climate change is becoming more serious issue in recent years and such a problem is closely related to permanent loss of drinking water and the looming shortage in the world, including the Czech Republic. For these reasons the feasibility study of the dam in this area is not completely rejected. The Czech Republic is increasingly loosing subsurface resources, which are mainly less stocked during the summer months. Therefore it was therefore recommended to build the water basin at the selected locality in the future.

Overwinter processes influence on soil aggregate disruption

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Keywords: freeze-thawing, freeze-drying, wind erosion

Heavy clay soils that are normally resistant to wind erosion, from the study site situated in the foothills of the Bílé Karpaty Mountains, Czech Republic, were a subject of physical soil analysis. The objective of the analysis was to determine the influence of overwinter processes on disruption of soil aggregates and thus reason of vulnerability to soil loss by wind. Two overwinter processes were observed – freezing and thawing, and freeze-drying of the soil. Both processes indicated the increasing of erodible fraction in dependence on water content of analysed soils. The most water soil contained the most vulnerable to wind erosion was, because of faster disruption of the soil aggregates. Linear dependence of the erodible fraction content change on the number of freeze/thaw as well as freeze/dry cycles resulted from statistical analysis. Correlation coefficients ranged from 0,9249 to 0,9599 (for freeze/thaw process) and from 0,9311 to 0,9899 (for freeze/dry process). The average percentage decrease in nonerodible fraction content among individual freeze/thaw and freeze/dry cycles was linear with correlation coefficients ranging from 0,8185 to 0,9457 (for freeze-thawing), and from 0,3277 to 0,9876 (for freeze-drying). The laboratory analysis showed the influence of overwinter processes and soil humidity on disruption of soil aggregates. Exposed frozen clay soils that freeze-dries during the winter in the foothills of Bílé Karpaty Mountains, leaves soils highly erodible in late winter and early spring.

Soil carbon accumulation after agricultural abandonment. A Mediterranean case study

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Keywords: carbon stock, agriculture abandonment, mediterranean climate

In the last decades, in Europe large agricultural areas have been abandoned. In absence of disturbance factors, renaturation of these areas is rapid due to secondary succession of vegetation communities. In the Mediterranean region, in the last years have been conducted studies on soil carbon accumulation after agricultural abandonment. Soil has to be regarded as the most considerable carbon (C) sink on a global level. CO₂ emission compensation is guaranteed also by C uptake by plants and by organic matter accumulation in soils. The present study analyzes organic carbon stock in some soils of Southern Italy, in the Madonie Mountains in Sicily, where large areas are subject to secondary successions because they have been abandoned by agriculture during the last 50 years. For the hilly and mountainous parts of the Madonie Mts., which are as a whole characterized by a Mediterranean climate, our aim was to: 1) quantify soil organic C accumulation after abandonment and 2) evaluate soil organic C variation as a function of bioclimate. The study areas selected ranged from 188 m to 1350 m a.s.l., and are representative of three distinct bioclimates (*sensu* Rivas-Martinez): thermomediterranean, mesomediterranean and supramediterranean. For each bioclimate several study plots representing three successional stages were chosen: pasture, mantle and forest. In the thermomediterranean belt we studied only pastures and mantles, due to forest absence. In each plot two soil samples were collected at 0-10 cm and 10-30 cm depth. Results of the soil sample analysis showed an increase of soil organic C stock from thermomediterranean to supramediterranean soils, for both soil depths. In the thermomediterranean belt, no significant difference was found between the succession stages pasture and mantle. Also in the mesomediterranean belt, where total organic C stocks were higher than in the thermomediterranean belt, there were no significant differences between pasture and mantle plots, but forests showed significantly higher stocks than the younger succession stages. In the even cooler bioclimate, i.e. the supramediterranean one, we found the highest organic C stocks, but also here we found no significant differences between the succession stages. This study confirms one of the general principles of soil organic C accumulation for our study area: soils in cooler and more humid conditions represent higher potentials as carbon sinks compared to soils in warmer and drier conditions. Moreover, we can conclude that bioclimate is a more important factor for C accumulation than abandonment age or succession stage. With decreasing altitude, the differences between forests over mantle and pasture communities increase. Bioclimate plays a major role for the differences between succession stages above all at 0-10 cm soil depth. These kind of evaluation studies on soil C dynamics after agricultural abandonment assume an increasing importance, also after the Accords of Marrakech. In fact, according to FAO data, Italy is one of the countries where land cover change is mainly characterized by the increase of wooded lands.

Soil tillage conservation and its effect

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Keywords: Minimum tillage, soil functions, carbon sequestration, climate change

The energetic function of the soil expressed through the potential energy accumulated through humus, the biogeochemical function (the circuit of the nutrient elements) are significantly influenced by its hydrophysical function and especially by the state of the bedding-consolidation, soil capacity of retaining an optimal quantity of water, and then its gradual disponibility for plant consumption. The understanding of soil functions and management including nutrient production, stocking, filtering and transforming minerals, water, organic matter, gas circuit and furnishing breeding material, all make the basis of human activity, Earth's past, present and especially future. The minimum tillage soil systems – paraplow, chisel or rotary grape – are polyvalent alternatives for basic preparation, germination bed preparation and sowing, for fields and crops with moderate loose requirements being optimized technologies for: soil natural fertility activation and rationalization, reduction of erosion, increasing the accumulation capacity for water and realization of sowing in the optimal period. By continuously applying for 10 years the minimum tillage system in a crop rotation: corn – soy-bean – wheat – potato / rape, an improvement in physical, hydro-physical and biological properties of soil was observed, together with the rebuilt of structure and increase of water permeability of soil. Our results clearly demonstrate the complex effects of the minimum tillage systems what determine an increasing process of the humus content with 0.8-22.1% and an increasing of the hydro stabile aggregates content with 1.3-13.6%, on 0-30 cm depth towards the conventional system. The minimum tillage systems ensure an adequate aerial-hydrical regime for the biological activity intensity and for the nutrients solubility equilibrium. The vegetal material remaining at the soil surface or superficially incorporated has its contribution to intensifying the biological activity, being an important resource of organic matter. The minimum tillage systems rebuild the soil structure, improving the global drainage of soil which allows a rapid infiltration of water in soil. The result is a more productive soil, better protected against wind and water erosion and needing less fuel for preparing the germination bed. Presently it is necessary a change concerning the concept of conservation practices and a new approach regarding the control of erosion. The real conservation of soil must be expanded beyond the traditional understanding of soil erosion. The real soil conservation is represented by carbon management. We need to focus to another level concerning conservation by focusing on of soil quality. Carbon management is necessary for a complex of matters including soil, water management, field productivity, biological fuel and climatic change.

Relationship of the two main methods for estimating fertilizer N recovery efficiency in wheat

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Keywords: Calculating N fertilizer Efficiency, bread wheat, difference method, isotope dilution method, linear regression model

Two main methods are used to calculate fertilizer N recovery efficiency plant i.e., the difference and the isotope dilution method which under certain circumstances give comparable results. In 3-year experiments spring bread wheat genotypes (*Triticum aestivum L.*) were grown under field and lysimeter conditions. Data set collected were arranged in several data sub-sets such as genotypes, location of study (lysimeter or field experiments) and experimental years, in order to: i) apply the linear regression model proposed by a previous study in which the two main methods of calculating N fertilizer recovery efficiency (the difference and the isotope dilution method) were linearly correlated, ii) evaluate and apply the correct model of linear regression and iii) discuss the results for the conditions of the present experiments (field experiments or lysimeter experiments). In most of the cases (20 of 24) the methods were significantly correlated. For both test systems (location of study), 66% of the total variation of the non-isotopic recovery efficiency was explained by the linear function of the isotope dilution method. The results showed that the complete linear regression model ($a = \alpha \cdot i + \beta$) could be simplified to the form ($a = \alpha \cdot i$), since the intercept (β) was in almost all cases (except one) zero. Coefficient of determination (R^2) of the simplified model decreased especially in the lysimeters by 30% probably due to the "priming effect" in one of the experimental years and the more homogeneous soil conditions. Under field conditions the difference method did not over-estimated fertilizer recovery efficiency. Under the present experimental conditions and the considerable uncertainty complexity in the interpretations introduces by the phenomena "priming effect" for the difference method and the "mineralization-immobilization turnover-MIT" for the isotopic method, it is concluded that the two methods gave comparable results. Further study employing similar lysimeter facilities in the plant-water-soil system, under the semiarid Greek conditions is needed. Despite the expected differences on the absolute fertilizer recovery efficiency values due to climate differentiation, the present methodological approach could prove to be environmentally and economically beneficial provided a known relationship between the two existing methods.

Assessment of the vulnerability of soil to degradation and assessment of the soil ecological function in model area

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Keywords: Forms of soil degradation, soil environmental functions, data base systems, GIS elaboration

Possibility of the use the basic soil characteristics data for assessment of the potentials of soil environmental functions as well as the potentials of soil vulnerability to different forms of degradation is illustrated in tables and cartograms. Importance of wide and rich soil database system both numerical and graphical and possibilities of its exploitation is emphasized.

The values of the soil vulnerability potentials to degradation and similarly the values of the environmental soil function can be determined from common soil characteristics which are parts of data base system. Good and rich data base system containing all accessible data its right exploitation are generally necessary for this work. Some data can be the problem. For given work they must have direct or indirect relation to the specific form of the soil degradation and / or soil function, or they can be reckoned for it. They must issue from more or less stable soil characteristics which are not variable in space and time or must be transformed for this purpose (Doran – Parkin 1996, Karlen 1994, 1997, Bujnovsky – Jurani 1999). Some soil characteristics can be measured directly (infiltration). Significance of basic soil characteristics for assessment of the individual environmental soil functions as well as for forms of soil degradation is different. Table of the significance is in results of this paper. Following soil ecological function is assessed for model area: potential of water retention function potential of infiltration rate potential of transport function. Similarly the soil vulnerability to different forms of soil degradation is assessed for: potential vulnerability to water erosion potential vulnerability to acidification potential vulnerability to the loss of soil structure and compaction. All above mentioned assessments are carried out for model area about 8 000 hectares, for the broad group of soils in flat to hilly region. Annual rainfalls are about 580 mm, annual temperature 7,5 – 8,5°C. Soils of different taxonomic classification have extensive range of basic characteristics. Some parameters were measured (infiltration). All basic data as well as digitized soil map of the area are obtained from the results of Complex Soil Survey. Soil survey has the high density of described and analyzed profile pits: one profile pit at 12 hectares in average. Data of soil analysis are modified and in some cases transformed, grouped and categorized. Final results are presented and visualized as the cartograms with the use of GIS methods. Results are in the tables and in the cartograms: Table of significance the basic soil characteristics for assessment. Cartograms of soil vulnerability potentials to different forms of degradation (erosion, acidification, compaction). Cartograms of potentials of environmental soil functions (water retention capacity, infiltration rate, transport) for model area. Except the directly measured soil characteristics (infiltration, field water capacity, soil retention) the texture composition of soils is the most important characteristic. Soil texture influences directly or indirectly all other soil parameters and potential of functions (inclusive the production potential). In different ways it influences also potentials of soil vulnerability to degradation.

This paper illustrates possibility of the use the basic soil characteristic data for assessment of soil environmental function potentials and potentials of vulnerability to different forms of soil degradation. It also emphasizes the importance of broad and rich soil data base systems both numerical and graphical and possibilities for exploitation and cartography demonstration of results.

Impact of climate uncertainties on maize irrigation and productivity in Plovdiv region

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Keywords: Bulgaria, maize, irrigation scheduling, climate uncertainties, precipitation decrease impacts.

Tsalapitsa experimental field (Plovdiv region) experiences a warmest and driest climate in Bulgaria. In addition the soil there has a small water holding capacity (total available water TAW=116 mm m⁻¹). In previous studies WINISAREG model (Pereira et al., 2003), an irrigation scheduling simulation tool for computing the soil water balance and evaluating the respective impacts on crop yields, was validated using independent data sets relative to long term experiment with late maize hybrid (H708).

The objective of this study is to assess the impact of climate uncertainties on rainfed and irrigated maize at Tsalapitsa using the validated WINISAREG model under present and scenario built weather conditions.

Results from model simulations relative to the present climate conditions (1985-2008) show that:

- Net irrigation requirements NIRs range from 50-90 mm in wet seasons having probability of exceedance PI >95% to 200-280 mm in average demand seasons (40%<PI<75%) and reach 380-390 mm in very dry years (PI<5%);
- Considering the trend of NIRs, a raise by only 1 mm year⁻¹ on the average is found;
- Yields of rainfed maize are highly variable (Cv=64%). Thus half of the years are associated with economical losses.
- Considering the trend of yields of non-irrigated maize, an average decrease by 80 kg ha⁻¹ year⁻¹ is found for the period under study.

In the case of precipitation decrease in 2006-2030 it is concluded that for the average demand year:

- Adaptation consists of application of additional irrigation events.
- Future precipitation decrease would lead to 57% less yield for the non-irrigated maize.

Coping with possible rainfall decrease in Plovdiv region requires:

- Increasing the area of irrigated fields;
- Adopting water saving and environment oriented practices of improved irrigation uniformity and efficiency.

Long term monitoring of runoff and erosion in a badlands microcatchment

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Keywords: runoff, erosion, climate change, badlands

Badlands systems are known for their high erosion rates and their important off-site environmental impacts. Information on how badlands systems respond to climate change is scarce, and changes in the rainfall regime may strongly alter runoff and erosion rates and their impacts. Future climate scenarios point to a reduction in rainfall within the Mediterranean and some authors, given the dependency of badland inter-rill erosion on rainfall amount, predict a decrease in this type of erosion. However, at catchment scale, with different erosion and deposition processes acting at the same time, the dependency of erosion on rainfall amount can disappear in many systems. Moreover, the reduction in rainfall will also affect vegetation cover and potentially increase the sources of runoff and sediments. To adequately manage arid and semiarid badlands and predict the impacts of altered hydroclimatic regimes, the first step is to know the response of these systems under strong inter-annual variability of rainfall, as in SE Spain. This work analyses the influence of rainfall variability on runoff generation and sediment yield at microcatchment scale since 1991, during a long term monitoring program in a semiarid badlands environment (Tabernas Desert, SE Spain). Runoff was measured in a H-flume gauging station at the outlet of the microcatchment, equipped with a capacitive sensor to measure the depth of water every 20 seconds and a system of automatic pumps samples water with both suspended and dissolved sediments at different water depths. Larger particles are measured in sediment collectors at the flume outlet. Annual rainfall varied from $112 \text{ mm} \cdot \text{y}^{-1}$ to $417 \text{ mm} \cdot \text{y}^{-1}$ with an average of $216 \text{ mm} \cdot \text{y}^{-1}$ for the period. Less than 20% of rainfalls generated runoff, and a high variability in runoff rate was observed during the period, varying between 0.2 and $16 \text{ mm} \cdot \text{y}^{-1}$ with an average annual runoff rate of $4.8 \text{ mm} \cdot \text{y}^{-1}$. Measured runoff represented, in average for the period, only 2% of the total amount of rainfall with a maximum of 6.3% in 2001-02. Sediment yields ranged between 0.15 and $10.6 \text{ t} \cdot \text{ha}^{-1} \cdot \text{y}^{-1}$ highlighting that these badlands, contrary to appearances, are not eroding rapidly. Our results show the effects of changes in rainfall patterns on runoff generation and sediment yields, and although the relationship between annual runoff rate and annual rainfall amount was significant ($p < 0.05$), it absorbed only 46% of variance demonstrating that runoff generation was driven by the portion of rainfall that occurred at a high rate rather than its overall amount. Contrary to observations by other authors, annual erosion at microcatchment scale is not correlated with cumulative rainfall and a reduction in erosion rates in this system cannot be assured as a consequence of the reduction in annual rainfall predicted by future climate scenarios. Our results show a stronger dependence of both runoff and erosion on extreme rainfalls whose future trends remain uncertain. Studies analysing the influence of rainfall variability on runoff and erosion at the long term can provide insight into the influence of climate change in these systems.

The influence of nitrogen chemical sources from foliar fertilizers on the penetration, uptake and accumulation of the ¹⁵N in inflorescences of sunflower plants

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Keywords: ¹⁵N, foliar fertilizers, hydrolyzed of collagens

In order to quantify the influence of nitrogen chemical sources from complex foliar fertilizers (CFF), the concentration of their diluted solutions and the presence of the organic substance (hydrolyzed of collagens) on ¹⁵N absorption through the plant teguments and his translocation in sunflower vegetative organs (tops). The diluted CFF solution have been applied only on a part of these leaves while the N determination have been done only in the plant organs untouched with CFF solution. The isotopic determinations, of ¹⁵N, have been done only in the plant organs untouched by CFF solution. The data obtained, in a green house experiments, have revealed that N absorption through plant teguments was significantly higher in the presence of urea as N source. The duble quantity of collagen hydrolozed, from complex foliar fertilizers, have determined a high level of ¹⁵N accumulation in the plant tops. Also, the concentrations of of the CFF solution have influenced the absorption and distribution of N in the inflorescences of the plant test. The fertilizing composition for foliar application having a pronounced environmentally protective effect, are recommended, especially for crop growing in the areas with restrictions to usual soil fertilisation.

Parametrisation and validation of the Czech water balance model by the Austrian lysimetric data

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Keywords: Evapotranspiration, soil water content, weighing lysimeter

AVISO model was used to process and display a spatial data of the hydrological cycle. Measured data of soil water content were used for model calibration and validation. Weighing lysimeters have been selected as another appropriate opportunity to measure water balance parameters. Due to the lack of lysimeters in the Czech Republic, data from the Austrian site were used for model validation on a regional scale. It was possible, because of the geographical vicinity and the similar climatic conditions of the research areas in Austria (Marchfeld) and the Czech Republic. Calculated and measured evapotranspiration data was compared. Subsequently the model soil parameters were adapted to the lysimeter characteristics in order to get the soil water content on a daily basis. The results showed slight differences between simulated and measured water balance.

Phosphorus retention in the forest podzols

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Keywords: Phosphorus retention, forest soils, podzols,

Excessive phosphorus loss from soils leads to eutrophication of surface waters and is a growing concern in many parts of the world. Transport of P with water in soils depends primarily on P retention by soil components. Phosphorus retention by acid soil materials such as Podzols primarily results from P sorption by Al and Fe. The objective of this paper was to show the effects of different forms of Fe and Al on phosphorus sorption in forested podzols. To study the retention of P by Podzols four sandy, well drained pedons in northern Michigan (MI, USA) (44° 54' N lat., 85° 04' W long.) were described and sampled. The soils were located in a sugar maple (*Acer saccharum*) Marshall forest and classified as Haplic Podzols (sandy, mixed, frigid *Typic Haplorthods*). The soil material was air dried and passed through a 2 mm sieve. In all samples pH, Alexch, organic carbon content were determined. Soil pH was determined using a 1: 2.5 soil - water ratio and a 1 : 2.5 1M KCl ratio, total C was determined by the Wakley Black method, exchangeable aluminium were extracted by 1M KCL and determined by AAS; extractable P was measured in Bray P1 extract, the total content of Al, Fe were determined by ICP after dissolution in HF. Iron (Fe_d and Fe_o) and aluminium (Al_d and Al_o) were determined by DCP.

Iron and aluminium distribution. Al and Fe contents were greatest in the Bhs and Bs horizons and least in the E horizons. Citrate-dithionite extracted the most Fe and pyrophosphate the least. Oxalate tended to extract the most Al and pyrophosphate the least. This is not surprising as oxalate chelates more Al than citrate. Most of the Al and Fe were organic bound with crystalline Al and Fe was the least. In Bhs and Bs horizons oxalate extracted significantly more Al and Fe than pyrophosphate indicating a significant amount of inorganic amorphous materials were present. In non Bhs or Bs horizons oxalate and pyrophosphate extracted similar amounts of Al and Fe indicating little or no inorganic Al and Fe were present.

Phosphorus retention. P retention was greatest in the Bhs and Bs horizons (24.0 %) and least in the A horizons (4.0 %). Higher linear correlation coefficients were obtained when relating P retention with Al than with Fe extracted by the different extractants from all horizons. P retention was more highly correlated to organic bound - Alp ($r = 0.94$) and Fe ($r = 0.76$) than to non-organic amorphous Al ($r = 0.85$) and Fe ($r = 0.67$) determined by the difference between oxalate and pyrophosphate extractable Al and Fe. P retention was more highly correlated to organic bound Al plus Fe ($r = 0.91$) than to non-organic amorphous Al plus Fe ($r = 0.86$). P retention was not correlated to crystalline Al ($r = 0.00$) and Fe ($r = -0.02$) and negatively correlated to crystalline Al plus Fe ($r = -0.51$). The high content of extractable iron and aluminium related to the sorption of phosphorus suggests, that especially B horizons (Bhs, Bs) would act as sinks for phosphorus moving from overlying horizons.

Building resilience against drought and soil erosion: long term impact of conservation agriculture in northern Ethiopia

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Keywords: Conservation agriculture, Terwah, permanent bed, crop residue, wheat, tef

Conservation Agriculture (CA) can be a possible technique for building resilience against drought by increasing in situ moisture conservation, and thus reducing runoff and soil erosion, and increasing crop yield. Hence, a long-term tillage experiment has been carried out (2005 to 2010) on a Vertisol to quantify changes in soil moisture, runoff, soil loss and crop yield due to Conservation Agriculture (CA) in a rainfed field in Adigudem, northern Ethiopia. The experimental layout was implemented in a randomized complete block design with 3 replications on permanent plots of 5 m by 19 m. The tillage treatments were (1) conventional tillage (CT), where the soil is ploughed three times per year to create a fine seedbed and with the crop straw being completely harvested without leaving crop residues on the surface, (2) terwah (TER), a traditional in situ water conservation method especially used in tef where broad seedbeds are created using the marasha ard plough by making furrows on the contour at regular intervals of ca. 1.5 m, but which is in the context of this study also tested for crops other than tef, and (3) a newly developed tillage system we called derdero+ (DER+), which is based on another traditional in situ water conservation technique derdero, where at the last tillage operation, the farmers broadcast the seeds over the surface and then prepare beds and furrows along the contour using the marasha, moving the soil and seeds to an upper position on the beds. It protects the crops from waterlogging, while excess water drains towards the furrows where it can slowly infiltrate. The 'plus' in derdero+ stands for the improvements made, including the introduction of permanent beds with standing stubble (>30%), where furrows are prepared on the contour at intervals of ca. 0.6 m. At sowing, seeds are broadcasted over the land and the furrows reshaped, moving the soil to the beds and covering the seeds. Data on soil loss, runoff and grain yield were collected since 2005, and on soil moisture from 2009 on. The crops in rotation were wheat, barley and teff. Glyphosate was sprayed starting from the third year (2007) at 2 L/ha before planting to control pre-emergent weed in DER+ and TER. Crop stands were evaluated with local farmers and NDVI was measured on the spot at several phenological stages, using green seeker.

Significantly different ($p < 0.05$) mean soil losses of 4, 13 and 17 t/ha/y were recorded for DER+, TER and CT, respectively. Similarly, the mean runoff was 430, 683 and 866 m³/ha/y from treatments with DER+, TER and CT, respectively. The farmers' evaluation of crop performance in 3-yrs (2008-2010) showed a significantly higher score for DER+

(7/9) and least for CT (4/9). Mean runoff coefficients (%) in 6-yrs were 13, 20 and 26 in DER+, TER and CT, respectively. The mean runoff coefficients of 2-yrs of teff were higher than the 3-yrs of wheat. Correlation coefficients were significantly strong between crop yield, farmers' evaluation and NDVI measurements in 2008, 2009 and 2010. NDVI records in wheat (2009) and tef (2010) were found significantly highest in PB throughout the growing season. Although improvements in crop yield were observed, a period of at least three years of cropping was required before they became significant. Overall, the permanent raised bed and reduced tillage systems significantly reduced sediment loss and runoff, and increased crop yield. It is suggested that these tillage techniques, using the local plough without modifications, be implemented widely.

Soil thematic maps of the arable land of Greece as an instrument for policy implementation

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Keywords: soil, fertility, thematic map, arable land, policy

Agricultural development and implementation of agro environmental policy requires a large number of data and proper knowledge to suggest reliable measures to policy makers. This contribution provides information of selected soil properties and their usage for various purposes. Moreover, maps provide data that is indicative for land degradation, soil fertility, limiting soil factors for crops' adaptation and can become a useful tool of policy implementation for rural development and mitigation of land degradation. Maps concerning pH, clay content and Cation Exchange Capacity (CEC) in the arable land of Greece have been prepared using ArcGis 9.2 with extension geostatistical analyst, MS Excel, and CORINE (2001). The compiled maps contain 1.704 surface samples for soil pH, 1.867 for clay content and 968 for CEC, representing 39.084,5 km², almost the whole arable land of Greece. The selected properties were grouped into classes according to limitations factors and attention has been paid on soil fertility, crop adaptation and land degradation. These maps were drawn up by the Institute for Soil Mapping and Classification (National Agricultural Research Foundation) and are based on data collected for decades by the Soil Science Institutes of Greece. The above examined properties are characterized by spatial variability, which denotes soil heredity and human activities. The values of pH of the soils ranged from 3.8 to 9.2 and soil acidity classes for each region are presented in the respective map. It can be argued that some areas have been influenced by the secondary enrichment of carbonates due to transportation from the adjacent hills which contain lime material. The degree of soil acidity can be attributed to origin from acidic parent material or can be explained by the leaching of a part of exchangeable bases due to precipitation, especially to the western or to the northern part of Greece. Clay content also varied greatly, due to soil genesis factors and man induced activities such as levelling, clearing and tillage. Cation Exchange Capacity (CEC) ranged between 3.1 and 114.0 cmol kg and increased values were recorded in samples selected from organic soils or from those which are rich in clay content. Analyzing the importance of maps the authors stressed to the following uses: mitigation of land degradation (fertilization practices, irrigation methods, expected yields), rural development (mainly land use planning, crops adaptation) and agroenvironmental measures (set aside of unsuitable soils, application of proper rotation schemes, land abandonment, extensification of agriculture). It is obvious that these maps are useful for policy makers although a denser network in the future is suggested for increased accuracy.

Artificial neural networks simulation of ground water level in a flood spreading system

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Keywords: ground water, numerical models, artificial neural network, regression models, flood spreading, aquifer parameters

Flood spreading system is one of the most important methods for soil and water conservation in capable areas. It is effectely on vegetation, soil and ground water. An artificial neural network is a data driven modeling method for universal function approximations. This makes them useful in modeling problems in which the relation between dependent and independent variables is poorly understood. In this paper, the ability of Radial basis function and regression models compared by the ground water level simulation by some aquifer parameters in 21 flood events. Independent variable was maximum daily runoff, soil infiltration, rain and ground water level before occurred flood .Dependent variables was ground water level three month continuously after flood spreading. We compare three ANN's and regression models. Results showed a significant difference between simulation data set by two methods (ANN, Regression) with performance evaluation amount of determination factor and mean square of error for ANN's models. Therefore for simulate aquifer parameters; Ann's is useful technique for estimation effect of flood spreading on ground water level.

Geomorphic modelling suspended sediment yield of river system by radial neural network

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Keywords: artificial neural network, flow, geomorphology, modeling, radial basis function, regression, sediment yield

A river system contains interacting flow and sediment transport process. In applied fluvial geomorphology of study form and process of a complex system of river landscape, it is important that discovering discharges and sediment yield and making models for investigation interacting flow and sediment transport correctly. In this study two artificial neural network models, one geomorphology based (GANN) and another non-geomorphology based (NGANN) for predicting sediment transport in Heidary river system is developed by interacting flow and sediment yield with geomorphologic parameters effects. Also we have been tried to compare results of them with two regression models, one simple sediment rating curve by power relation(SRC) and another A multivariate adaptive regression spline model by using geomorphologic parameters (Mars).It was detected that radial basis function performed well both GANN and NGANN. Results showed the GANN estimated better with highest coefficient of determination(R square) of 0.912 and root mean square of error (RMSE) of 1.312 in compression to NGANN with 0.888 for R square and 1.897 for RMSE. Performance value of regression models were weaker than ANN models with R square of 0.733 and RMSE of 2.556 for SRC model And R square of 0.789 and RMSE of 1.997 for MARS model. Therefore it was revealed not only ANN models but also regression models have performance value when combine with geomorphologic parameters.

Discrimination of soil water content in semiarid vegetation in a multilayer evapotranspiration model

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Keywords: soil water content, *Anthyllis cytisoides*, evapotranspiration, soil evaporation, modelling

In arid and semi-arid areas, evapotranspiration (ET), together with precipitation, is the key component of the water balance. Therefore, the accurate estimation of ET is of great importance in the water management of these areas. This paper analyses the importance of the soil water content (θ) in a multi-layer evapotranspiration model (ETM) developed for a sparse stand of vegetation, considering three evaporating sources, plant (P) transpiration, and bare soil (BS) and soil under plant (S) evaporation. ETM calculates the total evapotranspiration of the stand as well as the contribution of each source. Analysis of the importance of θ focuses on the effect on ETM estimates of the depth and position (bare soil and soil under plant) at which θ is measured. θ was measured at three different depths (0.02 m, 0.05 m and 0.15 m), and then averaged for the whole soil profile (0 - 0.15 m). These θ data were then used in ETM parametric equations for BS and S surface resistances (rsbs and rss respectively) and leaf conductance of P (gsl). Evapotranspiration estimates were compared to Eddy Covariance system measurements and transpiration estimates were compared to sap flow measurements. Results show that θ affects mainly BS estimation, and therefore, θ must be measured as close to the surface as possible. Estimation of S and P contributions depends more on correct determination of D0 than on where θ is measured.

Hydrophysical properties of some soils from Arges hydrographic Basin

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Keywords: soil water retention curve, soil physical quality index - S, soil hidrophysical properties

Soil water retention and movement is determined by the action of various common forces, but they cannot be summed. To quantify these forces a generalized energetic index was established, named as soil water potential, and it represents the energy which water has it into the soil. The soil water potential is differentiated according to the nature of the forces acting upon the water: gravitational, matric, osmotic, hydrostatic. In unsaturated soils, the water movement is determined by the matric potential, namely by the pressure applied on the particle surfaces and into the capillary pores. The force with which the water is retained by the soil particles represents the suction force or just suction. The relationship between the water content corresponding to a certain water matric potential or suction (pF) is important in studies concerning the hidrophysical properties of a soil. In the literature this relationship is defined as soil water retention curve, water characteristic etc. and estimates the storage capacity of the soil for water at different values of matric potential or different levels of soil suction. This work presents the soil water retention curves determined on three soil types from hydrographic basin of Arges River: P1 - Luvisol vertic-stagnic, P2 - Eutricambisol tipic and P3 - Preluvosol vertic-stagnic. Undisturbed soil cylinders were sampled on the genetic horizon depths characteristic for each soil type. The soil water retention curves were measured in the laboratory using standard equipment for retention measurements supplied by the Dutch Eijkelkamp company. The principle of the method is based on the determination of the soil water content corresponding to a certain level of water suction applied. By applying the Solver Microsoft Office Excel program the measured values of the water content from soil water retention curves were used to estimate the parameters of the van Genuchten equation which were later used to estimate the soil water retention curves and the main hidrophysical indices: field capacity (CC), wilting point (CO) and plant available water (CU). The obtained results have illustrated the evident similitude between the estimated soil water retention curves from the van Genuchten equation and the measured soil water retention curves in the laboratory. Then the S index for agricultural soil physical quality was estimated using also the parameters of the van Genuchten equation. The S index is defined, in terms of the van Genuchten parameters, as the slope of the water retention curve in its inflection point. The estimated values of S have showed that soils with more equilibrate medium texture (soil profiles P1 and P2) have higher values of the S index for estimation of the soil physical quality as compared with the clayey heavy textured soil (soil profile P3). Consequently, the soils Luvisol vertic-stagnic (P1) and Eutricambisol tipic (P2) have a higher soil physical quality than the soil Preluvosol vertic-stagnic (P3). The good physical condition of the medium textured soils (soil profiles P1 and P2) as quantified by S index is associated with an increase of the water storage capacity of the investigated soils. Moreover, the shape of the soil water retention curves of the soil Preluvosol vertic-stagnic (P3) illustrates that this soil presents the degradation processes of its physical condition.

Capacity building and public awareness raising on Nitrates Directive in the countries aspiring to EU accession

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The governments of the EU Member States have agreed to potentially enlarge the Union with seven South East European countries (Croatia, the Former Yugoslav Republic of Macedonia, Albania, Bosnia and Herzegovina, Montenegro, Serbia, Kosovo under UN Security Council Resolution 1244) and Turkey. However, these countries will be granted a full member status only when all political, legislative and administrative requirements for membership are fulfilled. Transposition, implementation and enforcement of the EU Nitrates Directive (91/676/EC) are one of these requirements.

Many policy makers, farmers and consumers from the EU accession countries perceive Nitrates Directive as a very demanding piece of legislation with little relevance for their countries. Moreover, there is a widespread belief that Nitrate Directive can potentially limit the competitiveness of the agricultural sector in their respective countries. Limited or partial information and misconception about Nitrate Directive in these countries provokes fear, notably by farmers. In most countries aspiring to EU membership, there are no other driving forces besides the EU accession, driving the Governments to adopt Nitrate Directive. Pressure exerted from health, consumer or environmental protection NGOs hardly exists. Training and education on Nitrate Directive is poorly covered and addressed by the curricula at higher education organisations, as well as by NGO training programmes. Consequently experts from these countries do not have much opportunity to get acquainted with Nitrates Directive. The problem persists when these people become governmental officials, extension officers, etc., and are supposed to make policy decisions and administer Nitrates Directive – or advise farmers and manage farms according to EU Nitrates Directive requirements.

In order to remedy this problem, several international projects, financed by the Global Environmental Facilities fund (administered by the World Bank or the UN Development Programme), the European Commission, and the EU Member State Governments (notably the Netherlands) have been initiated recently. The experience from these projects show that transfer of information: capacity building and public awareness raising programmes – play a vital role in understanding the rationale behind Nitrate Directive and in accepting the farming practices it requires. Participatory trainings, demonstration of nutrient management planning software, on-farm water quality testing with mobile kits, experiments using piezometers/lysimeters and field trials involving various cover crops, buffer strips, etc.; accompanied with Web pages, demonstration videos, posters, leaflets, etc., have been shown to be powerful tools to demonstrate the link between water quality and (adverse) agricultural practices. The evaluation of ecosystem services and environmental costs generated by fertiliser industry and farming is newly emerging concept that particularly seems to be promising tool for awareness raising on Nitrates Directive. Emerging assessments from the accession countries suggest that hidden costs (public investments and environmental costs) associated with elevated content of nitrates in water can be substantial. Making policy makers and the public at large, to be

aware of these costs and of potential savings on them by practising water friendly farming methods (e.g. organic or pastoral farming) can foster adoption of EU Nitrates Directive in EU candidate counties and beyond.

Congress Thematic Session

5. Conservation and Management of Soil Biodiversity

ORAL PRESENTATIONS

Value of Soil Biodiversity: European policies and raising awareness.

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The necessity for a coherent approach to soil protection has become more recognised within the European Commission over recent years. This recognition led to the protection of soil being introduced as one of the thematic strategies to be developed within the Commission's 6th Environment Action Programme due to soils being recognized as "a fundamental environmental compartment performing vital ecological, social and economic services". The soil biota is responsible for performing many of these services and there is increasing evidence that it is increasingly under threat and in some cases already in decline. However, there is still a considerable lack of knowledge regarding the belowground biota when compared to aboveground ecosystems. Due to this lack of knowledge regarding the interactions between soil biodiversity and ecosystem services it is not yet possible to predict with confidence the impacts of declining soil biodiversity.

Soil biodiversity is a relatively new field of research and while quantification of current levels of soil biodiversity and its functioning is difficult, it is vital to allow the assessment of future impacts of anthropogenic activities or climate change. Due to intensive exploitation of soil combined with the soil threats (as laid out in the Soil Thematic Strategy) and the possible impact of climate change, there is an increasing risk of harmful impacts on the soil biota possibly leading to a decline in biodiversity and concurrent reduction in the ecosystem services provided by the soil biota.

Soil biodiversity and the ecosystem services that it provides is a relatively new area of study, despite the economic value of soil ecosystem services being valued in the range of \$1.5 trillion annual, and as such data are often lacking. To counter this, one of the main goals with regard to soil biodiversity at the JRC, is raising awareness of issues surrounding soil biodiversity aimed at everyone from the public, through to academics and including policy makers. A large step in this direction was the production of the European Atlas of Soil Biodiversity, produced in conjunction with experts from Europe and around the world. This atlas is being distributed to as wide an audience as possible, with the aim of shining some light on this understudied area. An overview of some of the key points and statistics of the atlas will be discussed.

Much of life below ground is microbial, and an estimated 90 – 99% of the microbes have not yet been cultured in the laboratory, meaning much of it is still unknown. Even for larger organisms many species still remain to be discovered and their roles within the soil system fully elucidated. Currently, no baseline exists with regard to levels of soil biodiversity at anything beyond a local level in a very limited number of instances. Therefore, quantifying threats to soil biodiversity remains problematic. For such reasons, policy steps need to be undertaken to protect soil biodiversity. As a first step to overcoming this issue, the JRC has produced the first map of pressures on soil biodiversity at the European scale, covering 24 of the EU member states. This map highlights where the soil biota is likely to face relatively high pressures due to numerous anthropogenic and biological factors, ranging from soil organic carbon depletion through to invasive species.

Soil biodiversity, owing to its scale and its complex nature and interactions with the production of various ecosystem services, is somewhat poorly understood and hard to measure and quantify. From an economic point of view, the loss of biodiversity as a resource is generally considered to be undervalued due firstly to its full value not being integrated in decision making, and secondly due to the lack of markets for many of the services it provides. This is the reason that it has not been given the same level of attention as other natural resources and why soil resources have been, and continue to be degraded so extensively throughout the world.

A further complication which arises when attempting to value ecosystem services is that there is an inherent mismatch between the private and social costs, and benefits, of biodiversity conservation. For example, conservation of soil biodiversity generally benefits society as a whole through the provision of ecosystem services. Many of these ecosystem services, such as nutrient cycling, function on a much larger scale than that at which efforts of conservation generally occur, such as at farm or natural park scale.

Economic Evaluation of Soil Biodiversity

As there are currently no, or very few, mechanisms to support the conservation of biodiversity or a given ecosystem service, it is frequently more beneficial for a resource user to overexploit and run down the resource (i.e. to maximize profit through yields even if that leads to a loss of biodiversity). Therefore, private economic choices, in this case maximizing yields, do not necessarily mirror and respond to additional societal values, in this case conserving biodiversity, as the consequences of the choices and their associated costs are not solely met by those demanding the services. For example, a farmer may make more money by maximizing yields but society as a whole faces the costs of reduced ecosystem services. However, biodiversity loss can also be the result of ill-judged incentives provided to resource users by well-intended but ill-conceived government policies and regulations. Notable examples of policy failures that have led to environmental degradation and associated loss of ecosystem services are those financial incentives, subsidies and pricing schemes that cause deforestation, depletion of water resources and degradation of agricultural lands.

Environmental economists have long been trying to measure the economic value of biodiversity and non-marketed ecosystem services such as water regulation and erosion reduction. Such efforts stem from the belief that if it is not possible to demonstrate the value of biodiversity to those who control its fate, people will be unwilling to incur the 'opportunity costs' of its conservation. In this case opportunity cost is defined as the lost opportunity to use the conserved habitats or soil organisms for any purpose other than conservation i.e. agriculture, industrial development etc. Therefore, the goal of economic valuation of biodiversity is to attribute a value for its many ecosystem services and in doing so to inform and guide decision making into increasing the efficiency of resource allocation among uses with different objectives.

It can be argued, however, that demonstrating the true economic value is a necessary, but not a sufficient, condition of ensuring the sustainable use of biodiversity. It is also necessary to develop ways for policy makers to use these values and for resource users to capture this value. Various economic instruments have already been applied in numerous cases, such as income from ecotourism, payments to avoid deforestation for carbon sequestration purposes, conservation easements, debt-for-nature swaps, etc. Regardless of which instruments are used, what matters is that any action taken forms part of a well-informed decision framework. Measuring economic value is not an end in itself; rather, the aim of valuing natural capital and ecosystem services is to facilitate decision making, thus resulting in better actions relating to the use of land, water, and other natural resources.

Applications of Soil Biodiversity

The economical aspect of soil biodiversity can be assessed by taking into account some of its applications. While soil organisms are directly involved in, or are facilitators of many biological processes, soil organisms are also highly sensitive to several stressors and are, therefore, widely used as indicators to assess the quality of the soil. Several soil meso and macrofauna groups (e.g. Collembola, earthworms, acari) have been used as biodiversity indicators for assessing changes in belowground biodiversity in several monitoring programmes. The development of operational biodiversity indicators and the implementation of biodiversity monitoring programmes has been a priority at the EU level in recent times. So far, several bioindication programmes have been developed and implemented in different European countries, using changes in soil fauna communities as indicators for monitoring soil.

Soil Biodiversity under Threat

There is increasing concern regarding the possible decline of soil biodiversity, even though there is only limited data available showing this owing to a paucity of investigations in this area. It is well known, and widely reported, that the planet is currently losing biodiversity, with the current rate of species extinction being several orders of magnitude higher than it would be in absence of human activities, but few specific data are available for soil organisms. Current levels of soil biodiversity in most areas are still unknown and quantification of these levels of soil biodiversity remains difficult.

Intensive exploitation of land, soil degradation, processes, soil pollution, soil compaction, soil sealing, habitat, disruption, organic matter decline, invasive species and climate change represent some of the main threats to soil biodiversity. An effective policy for conservation of soil biodiversity should be integrated with both soil protection and broader environmental and sustainability strategies. For the European Union this objective could be achieved through broad application of Soil Thematic Strategy.

In order to compile a map of potential pressures on soil biodiversity (Figure 1), potential threats were selected and ranked on the basis of Expert Evaluation, and applied on the basis of the Budget Allocation approach. A number of threats were considered in the calculation of the indicator, where data existed: Land use change/Habitat disruption, human intensive exploitation, invasive species, soil compaction, soil erosion, soil organic matter decline and soil pollution.

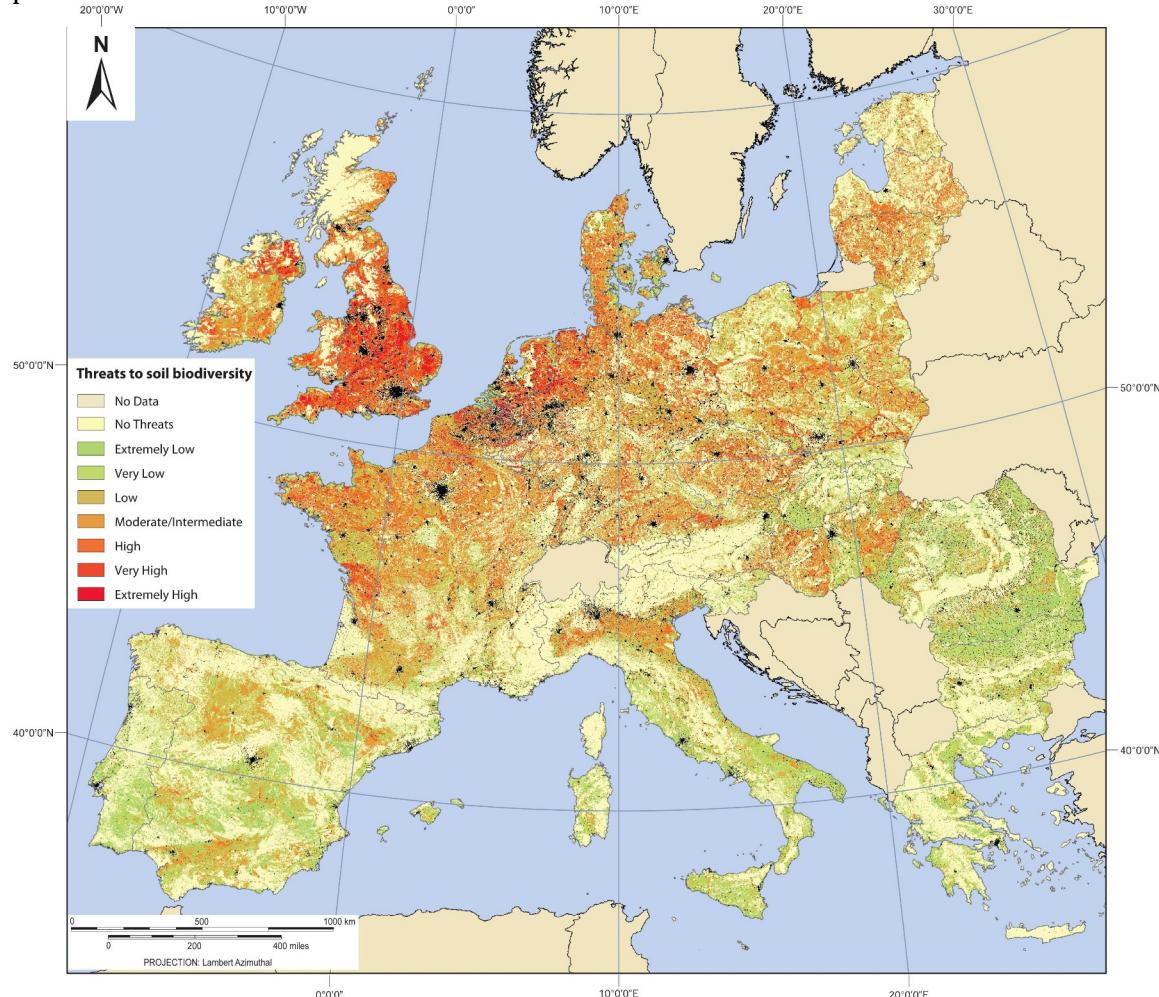


Figure 1: Threats to Soil Biodiversity

The high score (high potential threats) of several parts of the UK and central Europe are the result of the combined effect of a high intensity agriculture, with a high number of invasive species and by the risk for the soil to lose organic carbon. Compared to these situations, the intensive agricultural areas of southern Europe are less affected by the risk of losing organic carbon, and by the effect of invasive species.

It should be kept in mind that the map indicates an evaluation of the potential risk of soil biodiversity decline (with respect to the current situation) and is not a representation of the actual level of soil biodiversity.

Soil Biodiversity Monitoring

The adoption of soil biodiversity monitoring programmes is motivated by both the increasing pressures on soil biodiversity and the limited current knowledge. Monitoring soil biodiversity is encouraged as a method of assessing soil quality or soil health, in order to better inform management and policies related to the use of soil and land. It is also essential for the early detection of a possible decline and to enable the adoption of measures to reverse such decline. Soil biodiversity can be monitored by analyzing soil attributes related to soil organisms and soil processes. The selection of sites for monitoring programmes can be based on either a hierarchical design, or a grid-based scheme. The monitoring starts with the inventory of soil biodiversity (e.g. estimation of taxonomic or functional diversity) and often combined with the measurement of the activity related to soil organisms (e.g. enzymatic activities, number of burrows) at the selected sites at a given time. Subsequent monitoring cycles can also be used to address trends. When changes in land use are known for a long time, initial monitoring analysis can also be used to perform a surrogate trend analysis. For instance, if intensity of ploughing is increased over decades, and one monitoring cycle clearly depicts a relationship between ploughing intensity and a loss of soil biodiversity, it is reasonable to assume a loss of soil biodiversity over decade.

Biodiversity Policies and The Way Forward

In the 70's-80's, both nationally and at European levels, the measures of conservation were targeted at the most endangered species and habitats, where the agreement and consensus could be more easily reached as the evidence of their decline were readily available and abundant (e.g. the EU's Birds Directive). This approach has been changing in recent years. With time, it has become clear that species-based conservation management runs the risk of concentrating the attention of the public, and therefore policymakers, on certain so called "flagship" species that act as a symbol for a defined habitat, issue, campaign or environmental cause. The problem with this is that the bigger picture is often lost and the approach may not necessarily result in comprehensive environmental protection. The focus has thus turned to the protection not only of certain species, but also of the habitats that host them. In the EU, this resulted in the adoption of the Habitats Directive in 1992, focused on the conservation of natural habitats and of wild fauna and flora, which lead to the production of a network of sites considered worthy of special protection, known as Natura 2000 . By the end of 2008, the Natura 2000 sites made up 17% of the terrestrial area of the EU-27, which is an area of approximately 730,000 km².

At European level, biodiversity policy is now largely in place and biodiversity protection concerns have been integrated into the Sustainable Development Strategy, the so-called "Lisbon Strategy". The Soil Thematic Strategy has been instrumental in starting a process of deepening our scientific understanding of soil biodiversity and its link with soil functions. At the same time, it has called for the development of initiatives to bring to light, as it were, the life under our feet to the general public and policymakers. These new developments are paving the way for integrating soil biodiversity aspects into other EU policies such as the Common Agricultural Policy, where the synergies between soil biodiversity and sustainable and productive agriculture have become undeniable.

Developing a Biological Index of Soil Quality as an operational tool for the assessment of agricultural land management sustainability

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Keywords: soil quality, biological index, assessment, sustainability, agriculture

Sustainable agricultural practices mainly emphasize on the issue of sustainable conservation of the environment on a long term basis. In recent years soil quality evaluation has been suggested as a tool for assessing the sustainability of soil and crop management practices. Aim of this work was to develop a composite biological index of soil quality (SQbio) as a tool for the assessment of sustainability of agricultural practices. The development of the index was based on a functional analysis of soil ecosystem focused on sustaining biodiversity and biological activity, the selection of appropriate minimum data set of biological indicators, the establishment of a normalizing methodology based on standardized scoring functions and finally the development of the biological index equation for the calculation of soil quality as a value between 0 and 1. For the operational evaluation of the Biological Index, a field experiment was carried out in a broccoli field, using a Randomized Complete Block experimental design Split-plot in time. For the needs of the experiment seaweed biomass of two species, *Gracilaria* sp. and *Ulva* sp., collected from Thermaikos Gulf and incorporated in two experimental fields of different soil types (Clayloam-CL and Silty-clayloam-SCL). The experimental design included three treatments (addition of *Gracilaria* sp. 1% w.w., addition of *Ulva* sp. 1% w.w., without seaweed biomass-Control) and five repeated measurements in time ($\Delta 1$: before the incorporation of seaweed biomass into soil, $\Delta 2$: One month after the incorporation, $\Delta 3$: Six months after, $\Delta 4$: Twelve months after and $\Delta 5$: Eighteen months after). The soil indicators that were monitored included: a) Soil organic carbon, b) Microbial Carbon Biomass, c) Microbial Nitrogen Biomass, d) Total Kheldhal Nitrogen, e) Carbon Mineralization Rate and f) Nitrogen Mineralization Rate. The evaluation of results revealed that in both CL and SCL soils the calculated soil quality using the Biological Index found to be positively affected by the addition of seaweeds and especially by *Gracilaria* sp., with the highest values of soil quality to be recorded six months after the incorporation of the biomass into the soil. The results of the experiment document that the Biological Index was able: (a) to assess the temporal alteration of soil quality throughout the experimental period, (b) to reveal the differences among the three different treatments and thus to provide operational information regarding the sustainability of land management in the agricultural fields.

Pedobiological matrix of the impact of soil tillage in some agroecosystems from NE Romania

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Keywords: agro-ecosystems, biological activity, soil tillage, Pedo-Biological Matrix, NE Romania

Intensive agricultural practices can cause major changes in soil and environment. By soil cultivation, regardless of applied technology, is exerted on it modifying influences of the natural balance of vital equilibrium with repercussions on the evolution of fertility status. In an integrated and environmentally sustainable agriculture, the methods and technologies of culture must be scientifically proved, on pedobiological and ecopedological principles for obtaining of high production and sustainable management of natural soil resources.

Our researches were conducted on a haplic chernozem (WRB, 2006) from Didactical and Experimental Station of University of Agricultural Science and Veterinary Medicine Iași, Romania, on irrigated and unfertilized agrofond, and fertilized with moderate doses of nitrogen and phosphorus in the autumn seasons of 2009 and spring and summer season of 2010. The soil samples were taken on 0-15 cm and 15-30 cm depth, as loosening depths by soil tillage on wheat, soya and maize crop. For the knowing of the effects of anthropogenic intervention in the agro-ecosystems, technological elements and soil management, we determined experimentally the physiological activity of the soil, as soil respiration and cellulolysae, enzymatic activity, as catalase, sacharase, urease and total phosphatase, dehydrogenase activity, as oxidative power of the soil and synthetic indicators of soil fertility, as Indicator of Vital Activity Potential (IVAP), Indicator of Enzymatic Activity Potential (IEAP) and Biological Synthetic Indicator (BSI). Whole these indicators have lead to establishment of the Matrix of Pedo-Biological Diagnosis of Soil Resources for the quantifying of the impact of conventional and minimum tillage in case of the three mentioned crops and seasons. Thus, the Pedo-Biological Diagnosis for wheat crop have increased values, starting in spring and continuing into the wet summer of 2010.

Comparatively with the values of the same period in wheat crop, in case of soybean we pointed out higher values, as effect of intense activity of rhizosphere. The values and scores which characterize the biological activity in maize crop, in summer season, are much higher than those for wheat, but slightly lower than those of soybean, in this way pointing out the beneficial effect of leguminous plants and loosening on biological activity.

The fertilization with moderate doses of nitrogen and phosphorus improves the biological activity, particularly on the enzymes.

Organic matter and microbial community in anthropogenic soils of arid environment

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Keywords: anthropogenic soils, soil organic matter, microbial community, arid environments

Agricultural activity has a strong influence on chemical and biological quality of soil, mainly in arid and desert environments where extreme pedoclimatic conditions restrain the soil resilience and rise the threat of a long term land degradation. This study aimed at investigating the characteristics of organic matter and microbial community in anthropogenic soils in arid-desert area, located on the western side of the Cordillera de los Andes Occidental (Arequipa Department- Peru). In the study site, natural soils were partially converted into arable soils through an impressive impact on original soilscape, which were terraced. Three soils, uniform for parent material, physical-chemical properties, topography and agronomic practices were chosen according to the chronosequence of 5, 35, 65 years of conversion to agriculture use (YV, CU, YB respectively) and sampled (0-20 cm). Total organic carbon (Corg), extractable carbon (Cext), humic and fulvic acids carbon (Cha+fa) and soil biomass carbon (Cbiom) were determined to assess the organic carbon amount and distribution in the different soil organic matter pools. The microbial community characteristics were evaluated through the assessment of microbial colonies number (CFU), microbial respiration and microbial substrate utilization (CLPP). Moreover, from these data, soil organic matter humification parameters (Degree, Rate and Humification Index, DH RH and HI respectively) and microbial ecophysiological parameters were calculated. The results showed that the Corg content was higher in the 65 years cultivated soil (YB). Lower and similar values were recorded in 5 years (YV) and 35 years (CU) cultivated soils. The increasing Cext fraction and the constant Cha+fa amount, along the chronosequence, suggested that the observed Corg increase in YB is due mainly to an enlarging of more labile, not humified fraction and by an higher amount of the not soluble humin fraction. The aptitude to humify the available organic materials, i.e. to transform them into humic and fulvic fractions, is minor in YB comparing to YV and CU, as can be deduced from the lower degree of humification value (DH). Cbiom values were very low in all soils, less than 1% of Corg, as well as the CFU values. Nevertheless, detectable differences in microbial activity were recorded in YB by an higher basal and cumulative respiration, while YV and CU showed similar and lower respiration curves. Microbial Substrate Utilization assay reported similar values in the Average Well Colour Development (AWCD) of the soils, although YB showed a slower microbial activity, probably due to a metabolic microbial specialization for a major availability of soil labile organic substrates. Our results showed that in arid-desert regions, the soil cultivation takes a long time (in the specific case 65 years) to increase the organic carbon content and the more labile organic carbon fractions, thus enhancing the soil microbial community activity, an important component of soil quality.

Conservation agriculture as a tool for improving biodiversity

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Keywords: minimum tillage, conservation agriculture, soil erosion, biodiversity

The best method for conservation and management of biodiversity is the application of conservation agriculture. Compared to conventional agriculture, conservation agriculture (CA) is beneficial for the soil, for the environment including on-site and off-site effects, the latter having local, regional or global importance. From global aspects the reduction of greenhouse gas emissions is very important. CA offers better nesting sites and better food supplies, CA fields host higher bird, small mammal and game populations. The benefits for soil biodiversity are also evident. The objective of this paper is to present results of the SOWAP (SOil and WAter Protection) project obtained on biodiversity and soil microbiology in Hungary. Other topics of the project include the study of soil erosion, runoff, nutrient loss, agronomy and economics.

The study areas are at Szentgyörgyvár and Dióskál, near Lake Balaton in West Hungary. For the soil erosion survey 4 plots, for the ecological survey 24 plots were installed, half under conventional, half under conservation tillage. The ecological study includes the survey of weeds, soil microorganisms, birds, earthworms, insects, seeds.

Conservation agriculture plots proved to be more favorable for birds, first of all for small warblers like Skylark (*Alauda arvensis*), Goldfinch (*Carduelis carduelis*), Yellowhammer (*Emberiza citrinella*), Greenfinch (*Carduelis chloris*) and Tree Sparrow (*Passer montanus*), than traditional plots in both of the winter seasons investigated. Conservation agriculture provides a better food supply and improves winter survival reducing the negative effect of agriculture on bird fauna.

Conservation agriculture offers better conditions for the activity of earthworms. The number of earthworms on the conservation plots was significantly higher than on the traditional plots. This was the case during the whole monitoring period of two years under two different crop rotations.

Conservation tillage techniques reduced soil loss, run-off, nutrient loss is and soil moisture conditions are better. Rainfall simulation experiments point to the protecting effect of plant residues. The main conclusion is that conservation agriculture has significant advantages for biodiversity and also for the soil and for the environment.

Physical attributes of soil tillage with different sources and rates of organic matter

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Keywords: aggregate stability, particle size, corn

The poultry litter with a great pollutant potential can be recycled, using it as fertilizer and soil conditioner. The aim of this study was to evaluate the use of poultry litter on soil physical properties under conventional and direct planting cultivated with corn. An experiment was installed in the municipality of Abatia located in the state of Parana in direct planting system on soil classified as eutrophic red Oxisol. The experiment outlined was completed in blocks design in a 3x5 factorial arrangement was composed of 03 types poultry litter (rice straw, wood shavings and peanut shell), with 05 doses (0, 2.5, 5, 10 and 20 t ha⁻¹) and a sample consisting of mineral fertilizer, being 13 treatments with four consisting repetitions of: T1 (mineral fertilizer - AM), T2, 3,4,5 (1 / 3 AM poultry litter with rice straw, respectively 2, 5, 5, 10 and 20 t ha⁻¹), T 6,7,8, 9 (1/3AM poultry litter with wood shavings, respectively 2.5, 5, 10 and 20 t ha⁻¹), T10, 11 , 12 and 13 (1 / 3 AM poultry litter with peanut shells, respectively 2.5, 5, 10 and 20 t ha⁻¹). The poultry litter came from trading in the third batch. Soil samples were collected at the beginning and in the end of the experiment, where soil samples were collected to a depth of 0-10 cm and 10-20 and analyzed as: porosity, soil and particle density size and aggregate stability. It can be concluded that there was an increase of the macro porosity, decreased as soil density and higher soil aggregation with the use of organic waste coming from the litter, regardless of the sources and doses. Economically it is recommended that the dose of 2.5 t ha⁻¹, regardless of source.

Effects Of Revegetation On Carbon Dynamics In Former Arable Lands In Lithuania

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Keywords: afforestation, abandoned arable land, biomass, land use, Lithuania, soil organic matter.

In Lithuania agricultural lands mainly cover areas of former forests. This conversion was particularly prevalent under the conditions of intensive farming from 1960-1990. Extensive European areas of the former Soviet Union were transformed from forest to agriculture, irrespective of inherent natural heterogeneity. Currently, much of these highly fragmented tracts are situated in areas which are less-favoured for agriculture. Numerous recommendations are available on appropriate management strategies for such land with infertile and ecologically-sensitive soils. Afforestation is often proposed, especially on the most infertile land. However, conversion to grassland is an appropriate option to both conserve traditional and typical Lithuanian landscapes and enhance biodiversity. Such land use would also initially accumulate significant quantities of biomass and associated biogenic components, as arable (Ap) soil horizons accumulated large concentrations of nutrients during former agricultural periods. This study presents research conducted on several low fertility soils over 15-years (1995-2009) in South-East Lithuania. The balances of soil carbon and biomass production were calculated to evaluate both the merits and limitations of various re-vegetation strategies. Experimental results showed that any type of re-vegetation strongly affects carbon dynamics and, consequently, biomass accumulation in ecosystems. Within re-vegetation treatments, afforestation and the establishment of managed perennial grassland were particularly effective in terms of biomass production. Although there are irregular short-term fluctuations, soil carbon concentrations generally decreased in abandoned non-afforested land, compared to arable land. However, semi-natural grassland should be conserved, partly as it encourages biodiversity.

Agricultural land use intensification and soil nematode communities

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Keywords: biodiversity, ecosystem services, metabolic footprint, biofuels

The demand of land for biofuel production is expected to increase: a situation that will probably lead to more intensive cultivation methods and extension of single-crop farming systems. So, it is of high importance to study the effects of agricultural intensification on soil functions and ecosystem services. For this purpose soil biota are frequently used and soil nematode communities are among the most preferred soil quality/soil status bioindicators. This is because nematodes are sensitive to disturbance and pollution and exhibit a variety of life strategies and food preferences (bacteri-, fungi-, herbi-, omni-vorous, and predatory). The present work focuses on the effects of three different levels of agricultural land use intensity (grassland, perennial and annual cultivation) on soil nematode communities in Sweden, United Kingdom, Czech Republic and Greece. Nematode communities are analyzed in terms of abundance, biomass, generic diversity, trophic structure, life strategy and metabolic performance (metabolic footprint). In all regions, soil nematode diversity (composition and structure), quantitative characteristics (abundance and biomass) and metabolic performance were influenced by land use intensity. Along the studied intensity gradient the diversity of the community does not change in number of nematode genera (or trophic groups) but mostly in structure. The increase of land use intensity leads to more even distribution of abundance among genera and a decline of dominant ones. Abundance and biomass of all nematode trophic groups but especially of herbivores is decreasing with land use intensity. A decrease is also observed regarding metabolic performance of microbivorous and predatory nematodes, indicating a change in channels of carbon metabolism as well as carbon allocation.

Approach for functional-ecological assessment of urban constructed soils

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Keywords: soil functions, indicators, functional-ecological assessment, carbon stocks and fluxes

Analysis of soil functions is the basic approach of soil ecological assessment and standardization. The main problem to implement concepts of soil environmental functions in practice is lacking of reliable quantitative indicators to assess them. Quite a few studies represent soil biological features and parameters of soil carbon cycle to be promising indicators of soil sustainability. The aim of the study was to implement information on soil carbon stocks and fluxes as well as soil biological parameters: microbial biomass (Cmic), basal respiration (BR), soil organic matter (Corg) and the specific microbial respiration ($q\text{CO}_2 = \text{BR} / \text{Cmic}$) to characterize three principle soil functions: 1)habitat for microorganisms; 2) gas exchange with the atmosphere and 3) substrate for plant growth. A new methodology was developed to analyze and assess both individual soil functions and integrated parameter of soil functioning sustainability. The methodology was implemented for the specific case of urban constructed soil in Moscow region. Influence of soil morphological features, anthropogenic pressure, bioclimatic factor and land-use on environmental functioning of urban constructed soils was analyzed.

Exploring the potentials of non-inversion tillage to maintain soil quality and reduce sealing and compaction

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Keywords: non-inversion tillage, soil surface sealing, X-ray computed tomography, compaction, soil quality

Several regions in the Belgian Loess Belt suffer from severe soil erosion problems due to the rolling topography, erodible soils and intensive agriculture. Although the rainfall amount in Belgium is equally distributed over the year, rainfall erosivity is much higher during the period May-October. Especially during the early stage of crop development (April – June), when the soils are nearly bare, high intensity rainstorms destroy the exposed aggregates leaving a sealed soil-surface behind. As soil-surface seals reduce the soil's porosity dramatically, infiltration rates drop causing considerable runoff and soil loss to occur. In the scope of erosion mitigation, conservation tillage is proposed as an alternative tillage technique. Furthermore, it is believed to be a promising technique in maintaining soil quality and combating compaction. In Belgium, conservation tillage is applied as shallow (15 cm) or deep (25 cm) non-inversion tillage. During past research, non-inversion tillage proved to reduce runoff with 40% up to 67% and soil erosion with 50% up to 85 % (results presented at COST 634 – Aveiro 2008 by J. Vermang et al.). Nevertheless, the effects on soil quality were less clear cut. Therefore, this research aims at clarifying the influence of non-inversion tillage on soil surface sealing, compaction and water storage using a set of soil quality indicators.

During four years, field trials were set up in the loess belt of Belgium and Northern France, to compare conventional tillage by mouldboard plow with shallow and deep non-inversion tillage. Hydraulic conductivity was followed using a disc infiltrometer, water retention and macro porosity was determined by measuring the soil water retention curve at -5, -15 and -25 cm, and aggregate stability was measured using the three treatments of Le Bissonnais (1996). Compaction was measured by penetration resistance and bulk density measurements. During the fourth year, soil surface sealing was investigated by soil surface observation on a regular grid of 0.25 m² using the typology of Bresson and Boiffin (1990) and by X-ray computed tomography on undisturbed core samples. Results showed strong differences between consecutive years. The soil water content during harvest of the preceding crop determined the degree of compaction. Furthermore, the soil water content at the moment of seedbed preparation determined the extent to which the soil could be decompacted. The interplay of the (de)compaction effect during both crucial moments determined the final results of the soil quality indicators. As such, in years of low soil water contents during field operations, good results under non-inversion tillage were found for the hydraulic conductivity and penetration resistance. On the contrary, in years with wet conditions during harvest and/or seedbed preparation, non-inversion tillage proved not be able to sufficiently decompact the soil in order to maintain the hydraulic conductivity as compared to conventional tillage. The differences in macro porosity and water retention

were not significant. An improvement in aggregate stability could be found, irrespective of the field conditions during preceding field operations. Soil surface sealing was more pronounced under conventional tillage. X-ray tomography proved a clear stratification in porosity over increasing depth.

POSTER PRESENTATIONS

Efficiency of chemical and thermal hygienization processes in sewage sludge used as conditioner and fertilizer

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Keywords: sustainability, pathogens, liming, pasteurization

The use of sewage sludge in agriculture has increased in recent years, since this material acts as a conditioner and fertilizer, favoring the physical, chemical and biological properties of soils. Thus, the use of the sewage sludge contributes to nutrient and soil organic matter cycling, restoring the structure, improving the circulation of air and water essential for plant development. However, its use becomes restricted due to problems with pathogens present in their composition. The sludge hygienization consists of the removal or inactivation of pathogenic microorganisms by physical, chemical and/or biological mechanisms. In this sense, the aim of the present study was to evaluate the efficiency of the chemical and thermal hygienization processes of sewage sludge used as conditioner and fertilizer. The material for the study was collected in a decanting pond, removing 40 samples, randomly, which were homogenized and then cleaned according to the treatment. Then the samples were transported to the laboratory for microbiological analysis. There were evaluated the following treatments: fresh sludge - control, pasteurized and lime-treated. The experiment was a completely randomized design with three treatments and three replications. After the hygienization the presence of the following total coliforms was evaluated: *Salmonella* spp., protozoa and helminths. The fresh sludge showed higher most probable number (MPN) of coliform (50666.67 MPN g MS-1) compared to the hygienized materials, lime-treated (11.67 MPN g MS-1) and pasteurized sludge (1666.67 MPN g MS-1). The results were similar to the positive incidence of *Salmonella* spp. and protozoa in the fresh sludge. With respect to the helminths all treatments had no presence of these organisms. The chemical and thermal hygienization processes were efficient regarding pathogens reduction, resulting in a product suitable for agriculture use.

Chemical quality of sewage sludge after hygienization treatment

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Keywords: virgin lime, macronutrients, micronutrients, pasteurization, fertilizer

Nowadays there is increasing awareness of the society about sustainable or ecological systems. Sewage sludge is an important alternative for agricultural use because the material that has long been kept in sanitary landfills can be used as a source of plant nutrients, reducing the environmental impacts and, at the same time, promoting sustainable agriculture. In this sense, the objective of this study was to evaluate the quality of sewage sludge, from a decanting pond after hygienization treatment by pasteurization and liming. The material quality characterization was made by analysis of chemical properties. The experimental design was completely randomized with three treatments (fresh sludge - control, pasteurized and lime-treated) and three replications. For each treatment 40 samples were collected, at random, mixed and transported to the laboratory for the analysis of organic material. The following elements were evaluated: N, P₂O₅, K₂O, Ca, Mg, S, Na, Cu, Fe, Zn and pH. With respect to the chemical properties there were no significant differences between treatments with fresh and pasteurized sludge. However, the lime-treated sludge showed different characteristics in relation to the others, especially with higher values of pH (12.17), Ca (83.77 g kg⁻¹), Mg (34.33 g kg⁻¹), Na (430 mg kg⁻¹) and Mn (55.67 mg kg⁻¹) and lower values of N (5.87 g kg⁻¹), P₂O₅ (2.53 g kg⁻¹), K₂O (0.33 g kg⁻¹), S (2.87 g kg⁻¹), Cu (38.33 mg kg⁻¹), Fe (4800 mg kg⁻¹) and Zn (140.67 mg kg⁻¹). The results indicate that the pasteurized sewage sludge maintains the chemical properties similar to the fresh sludge and the lime-treated sludge modifies these properties, making their use restrictive, when fully utilized in the cultivation of vegetables, due to high pH value and some nutrients that, in high concentrations, can cause toxicity problems.

Reducing risk factors by reconversion of organic vegetable production to organic system of sustainable agriculture

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Keywords: vegetable ecosystems, soil quality, eco-pedological diagnosis, conventional system, organic system

Sustainable development involves the optimizing of technological factors for the long exploit of natural resources, being necessary the reconciliation and optimize of the interactions between technological, environmental and economic and social factors. Our researches were conducted in representative and traditional vegetable ecosystems from NE Romania on hortic anthrosol (WRB 2006) in solarium. The soil samples were collected on 0-20cm depth from different vegetable species both cultivated under conventional system and organic system.

The Eco-Pedological Diagnosis of the Effective Trophicity of Soil Resources (EPDETSR), like synthetic and integrator indicator of soil quality represents the resultant of correlation and interaction of eco-pedological factors (climatical, pedological and pedobiological) of the biotopes through a synthetic analysis of the quality and lack soil fund in the zonal and local ecological context that with aggressive, intensive and uncontrolled anthropogenic impact can attenuate, stress or increase the level of the potential soil trophic fund, the nutrition and physiological processes of plant development being restricted and stressed and also the productivity of vegetables in the local context, particularly in the excessive droughty summer season. We considered that the assessment file of soil quality must include the most important 10 physico-mechanical, chemical and biological factors and determinants, for the characterization of the soil effective trophicity under traditional vegetable ecosystems from NE part of Romania for the reconversion to organic vegetable. The quantitative values of them were noted with notes 1 to 10, according to assessment scale. The sumed value of the notes for the 10 soil quality indicators indicates more differentiated scores for the Eco-Pedological Diagnosis of the Effective Trophicity of Soil Resources cultivated with vegetables in solarium, under conventional system, comparatively with organic system. Thus, in case of the vegetable crops in solarium, under organic system, the EPDETSR values pointed out a good and very good trophic level with scores between 70-90 points, comparatively with the medium values under conventional system (50-60 points). These values represents the consequence of the positive aspects created by organic vegetable technology that positively influence the quality chemical properties, particularly those soil fertility and biological quality under mitigation and restriction of the effects of risk factors induced by the organic vegetable system, comparatively with the traditional and conventional system where the risk factors (pesticides, chemical fertilizers) have a major restrictive and stressed role.

Soil physical attributes obtained in crops of sugar cane production in different cycles

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Keywords: sugar cane, soil density, physical properties

One of the most important crops in Brazil is the sugar cane, but it is from the point of view of soil management, one of the most aggressive, since a large number of machinery operations is performed during different phases of the production process. With the introduction of mechanization in the agriculture some detrimental factors appeared to the good plant growth. Thus the objective of this work was to evaluate the physical properties of soil, collected by volumetric rings, such as soil density, porosity, and through impact penetrometer soil resistance to penetration. Samples were taken at six different stages of harvest of sugar cane. The experiment was conducted at Bandeirantes, Paraná, Brazil, in areas of cultivation of sugar cane, soil classified as eutrophic red Oxisol. The outlined experimental was design by randomized blocks in factorial scheme 6x2 +1, in six stages of the crop (plant cane, 1st, 2nd, 3th, 4th and 5th cut) in two depths sampling of 0-10 and 10 - 20 cm, being one sample (native forest) and four repetitions. The fields evaluated had an approximate area of one hectare. The variables evaluated were: soil density, porosity and soil resistance to penetration. All the results were subjected to analysis of variance using the Tukey's test at 5% of probability. We conclude that the macroporosity and soil density in the depth 0-10cm on the 5th cut of the sugar cane showed values that are less favorable to the development of the culture and to the resistance of penetration was lower in soils under native forest.

Handling of the sugar cane culture in some physical attributes of the soil

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Keywords: sample deformed, particle size, sugar cane

The sugar cane is among the most important commercial crops in Brazil. The physical quality of the soil is fundamental for the sustainability of the agricultural production and its characterization carries out a great interest to the agriculture so far as fundamental processes that occur in the soil as water movement, gases, heat and solutes are related to it and are its main objects of study. The knowledge gained from the physical analysis such as texture, density, aggregate the stability of, resistance in the penetration, porosity, among others, performed in the field or laboratory to help explain the phenomenon related to the environment and the crops productivity. This study aimed to evaluate the particle size and the average diameter of the aggregates of the soil at different stages of the harvest of sugar cane, collected through the sampling deformed method. O experiment was conducted in Bandeirantes, Paraná, Brazil, in areas of cultivation of sugar cane on a land classified as eutrophic red Oxisol. The outlined experimental was randomized in blocks in factorial scheme 6x2 +1, in six stages of the culture (plant cane, 1st, 2nd, 3rd, 4th and 5th cut) in two depths sampling of 0-10 and 10 - 20 cm, and a control (native forest) and four repetitions. The fields evaluated had an approximate area of one hectare. The variables evaluated were: particle size by densimeter method of Boyoocos and stability and the average diameter of the aggregates by using the thames in dry way. The results were subjected to analysis of variance using the Tukey's test at 5% of probability. The results allow us to conclude that the particle sizes and the average diameter of the aggregates were little affected by the different stages in the handling of the sugar cane culture in the clay soil.

Handling of the organic matter in the physical attributes of the soil under conventional

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Keywords: soil conditioner, corn, poultry litter

The poultry litter with a great pollutant potential can be recycled, using it as fertilizer and soil conditioner. The aim of this study was to evaluate the use of poultry litter on soil physical properties under conventional and direct planting cultivated with corn. An experiment was installed in the city of Ibaiti Paraná in conventional planting, on soil classified as Typic Hapludox. A experimental outlined was done in blocks design in factorial arrangement 3x5 +1 was composed for 03 types of poultry litter (rice straw, wood shavings and peanut shell), with 05 doses (0, 2.5, 5, 10 and 20 t ha⁻¹) and a control consisting of mineral fertilizer, and 13 treatments with four repetitions consisting of: T1 (mineral fertilizer - AM), T2, 3,4,5 (1 / 3 MA + poultry litter with rice straw, respectively 2.5, 5, 10 and 20 t ha⁻¹), T 6,7,8, 9 (1/3AM + poultry litter with wood shavings, respectively 2.5, 5, 10 and 20 t ha⁻¹), T10, 11,12 and 13 (1 / 3 MA + poultry litter with peanut shell , respectively 2.5, 5, 10 and 20 t ha⁻¹). Liming was done to raise the base saturation of 70%. The poultry litter came from trading in the third batch. Soil samples were collected at the beginning and end of the experiment, where soil samples were taken at depths of 0-20 and 20-40 cm, and evaluated: grain size, porosity, soil density and particle and aggregate stability. It was concluded that the texture did not vary with the use of organic material, soil density was lower with the different sources and doses of poultry litter. The use of organic and source material, independent of the dose provided greater soil aggregation, and higher porosity results. Economically it is recommended that the dose of 2.5 t ha⁻¹, regardless of source.

Congress Thematic Session

6. Restoration and remediation of degraded lands –
Education in soil conservation and public awareness

ORAL PRESENTATIONS

Challenges and opportunities in the degradation and remediation of Mediterranean soils: Focus on climate change and salt affected areas

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1. The problem of soil salinisation in Mediterranean

Soil salinity is one of the major problems affecting arid and semi-arid environments as the United Nations, FAO and other international organisms indicate and it could be induced also by global climate change (Huq et al., 1999). Thus it is important to determine soil salinity as a parameter to environmental land management. Salinisation is the process that leads to an excessive increase of soluble salts in the soil solution, if compared with the normal and natural moisture of them. High levels of salinity in soils provoke the withering of plants both for the increase of osmotic pressure and for salt toxic effects; when alkalinity processes do take place, pH high levels, in most cases, do not permit life for plants. Damage due to an excess of sodium on the exchange complex, directly concerns the structure of soils, that, deprived of their own structure, do not fit plant growth and are not fit for animal life, as they are asphyctic, easily eroded by water and wind; moreover, salinisation increases impermeability of deep soil layers, does not permit land working activities and, in some particular pedological and geological situations, salinisation may lead to desertification.

The salt accumulation in Mediterranean soils is a natural process favored by the region's ecological conditions (Zalidis et al. 1999). The movement of salts in the weathering crust and in the soil profile is through soil solution. Thus, salt accumulation in a certain area is governed first and foremost by the water balance of the area and particularly by the ratio of evapotranspiration to drainage. The two later processes are controlled by natural ecological factors, both abiotic (climate, geomorphology, hydrogeology etc.) and biotic (flora and fauna). Human activities may profoundly modify these ecological factors in multiple direct and indirect ways and, therefore, may cause salt accumulation (Misopolinos, 1989). The modification pertains mostly to relatively flat arable land. The results of human modifications have been fairly well documented in the countries of the Mediterranean region (Kovda et al., 1973). Salinization has a direct negative effect on soil biology and crop productivity, and an indirect effect leading to loss of soil stability through changes in soil structure (Szabolcs, 1996).

Considerable areas of salt-affected soils have been revealed in the past following the numerous large scale flood control and wetland drainage projects. Man-induced salt accumulation occurred in previous salt-free soils due to errors in designing and constructing irrigation projects. In recent years there has been an effort to correct these errors except in the case of some coastal areas where the low altitude constrains the maintenance of naturally trapped salts below the rooting zone. Presently, the cardinal salt accumulation problem is due to the continuing deterioration of the quality of groundwater used for irrigation. This deterioration was caused by overpumping and the consequent intrusion of sea water into the ground water strata (Zalidis et al., 2002).

2. Climate change and soil salinization

Climate change is expected to modify rainfall, evaporation, runoff, and soil moisture storage. Changes in total seasonal precipitation or in its pattern of variability are both important affecting directly and indirectly the soil salinization processes. Under arid or semi-arid conditions and in regions of poor natural drainage, there is a real hazard of salts accumulation in the near future. There are two main origins for soil salinity, dryland salinity, occurring on land not subject to irrigation and irrigated land salinity. Both describe areas where soils contain high levels of salts that can affect plant and soil organisms (Navarro-Pedreno et al., 1997). It must be

pointed out that, unfortunately the soils which are mainly concerned with this process, are coastal areas which are cultivated with precious and profitable crops or sustain natural vegetation some times of primary importance as for example in protected coastal and deltaic areas. The areas that are mainly interested by the threats of salinisation/sodicisation/alkalisation are mainly on those regions characterized by a low annual rainfall rate, concentrated in short periods of time. Moreover, it is believed that the impact of climate change on physical system in combination with the effect of sea level rise and the intrusion of seawater into the groundwater aquifers would cause a net increase in salinity in the already affected soils in the coastal regions. The problem is expected to be more severe in those areas where intensive cultivation is practiced; therefore, nearly all Mediterranean coastal areas are concerned with this problem.

However, the uncertainty inherent in predictions is a very important feature of climate change impact studies, and work has begun to develop explicit methods to deal with the concept. Earlier studies had often used "best estimate" scenarios that were based on the mid-points of the predicted range of expected change in temperature, precipitation, or other parameters. Including the entire range from the upper to the lower bounds of predicted effects is a more prudent and realistic approach, which may clarify the way that uncertainty can propagate throughout a modeled or a real system.

3. Bridging the gap between science and practice

On salinisation and sodicisation many studies and researches have been already carried on, principally in those countries that are mainly concerned with these issues, such as the United States, Australia, Israel, Mediterranean regions, the Carpathian Basin and areas laying below sea level, especially in the Netherlands. Research mainly concerns effects and management of irrigation water, impacts to soils, and the behaviour of agricultural and forestry plants as affected by global warming (Van-Camp et al., 2004). On soil, research has been aimed at:

- finding out biochemical processes in which salinisation and sodicization are concerned
- studying biochemical processes affected by global warming;
- developing new monitoring systems that improve processes assessment;
- finding out new soil conservation practices in order to avoid degradation due to salinisation;
- developing new agricultural techniques in order to reduce the problems related to salinisation and sodicisation.

Furthermore, several projects designed to tackle soil degradation and land management problems have been set up and run. In these projects, usually the above-mentioned issues are faced on a general perspective with a large scale approach, considering wide areas of different countries without analyzing specific processes with a soil type related approach.

Usually, the productive world is eager to find solutions in order to solve the various and ever increasing number of problems related to soil management. However, there are several reasons why research results are not quickly applied:

- lack of full awareness and knowledge of soil as a resource;
- lack of systems for knowledge dissemination and for technical assistance to the agricultural sector;
- no link between local administrations and Research Institutes;
- studies and research are not promoted by stakeholders and cannot be directly verified at the moment of their application;
- results of monitoring studies and mapping are at large scale; therefore, data application is not enough soil type oriented;
- financial resources are mainly used for research and not for results dissemination;

- researchers usually do not care about results application once projects have been carried out, in order to correct any possible mistakes and find out any gaps.

Since in a society characterized by fast technological developments a continuous contact and link among departments, institutions and economic operators is needed, it is vital to create a strong link among research, public administrations, technical assistance and decision makers. There are two main demands about research approach coming from stakeholders, that are:

- the need of stakeholders' involvement throughout the phases of research planning in such a way that research is developed in order to solve the real problems of land and that its results may be soon applicable.
- the need of reliable data about soil salinisation coming from soil monitoring and mapping both from soil and other compartment sides.

Another important item is the lack between expertises and decision makers in contexts where issues on soil salinisation are discussed and debated; people who talk about soil publicly, that is politicians and environmentalists, often do not have competence about that and have very poor knowledge about soils properties and threats.

4. Priorities and recommendations in soil conservation and restoration

In respect to climate change and global warming, the prevention of soil salinisation and the conservation of soil resources are among the most challenging aspects of environmental management in Mediterranean. Priorities, recommendations and measures towards sustainability include:

- Set a common implementation strategy and specific guidelines for the implementation of the EU Thematic Strategy for Soil Protection (COM(2006)231 final) and the forthcoming Soil Framework Directive (COM(2006) 232)
- Adopt an integrated approach of environmental management of soil and water resources through the joint implementation of Water Framework Directive (2000/60/EC) and the forthcoming Soil Framework Directive.
- Conservation and restoration of transitional water bodies related to wetland soils and ecosystems may reduce the risk of salinisation in adjacent terrestrial ecosystems.
- Development of dynamic monitoring indicators to assess the trends and impacts of climate change on soil quality.
- Develop research programs focused on soil types of concerned areas and to build up programs for detailed monitoring (scale of surveying between 1:50.000 and 1:10.000) specific for the areas concerned with both salinisation and sodicisation, evaluating research applicability on soils and on the different conditions of the singled out areas.
- Develop a European networking on salinisation and sodicisation to allow an exchange of stakeholders' experience in order to monitor the developing situation, and to build up programs for detailed monitoring (scale of surveying between 1:50.000 and 1:10.000) specific for the areas concerned with both salinisation and sodicisation.
- Single out and develop, within the EU soil monitoring network and the EU soil database, all the elements and features concerning salinisation and sodicisation, in order to insert them in every monitoring programme and project regarding salinisation and sodicisation.
- Develop research programs focused on soil-plants interactions aiming at evaluating resistance to salinisation and sodicisation in relation to different soil type, and developing climate conditions and water availability.

- Develop research programmes focused on irrigation waters and techniques (e.g. deficient irrigation), aiming at finding economical systems to diminish the risk of salinisation in the years to come and at searching economical systems in order to treat wastewaters and re-use them for irrigation purposes (e.g. constructed wetlands).
- Development of detailed risk assessment studies and models incorporating climatic parameters in order to support decision making and policy planning.
- Land use planning at watershed level and strategic impact assessment that takes into account issues of salinisation and sodicisation.
- Special protection should be paid in threatened soils adjacent to protected areas in coastal and transitional waters in respect to Directive 92/43/EC.
- Development of formal and non-formal environmental educational activities and programs in order to raise public awareness regarding the conservation of soil resources and the problem of soil salinity.
- Development of dissemination activities to apply techniques resulted from research in the field with the involvement of farmers and technical consulting.

Finally it has to be underlined that due to the enormous variability of soils across Europe, a "one-fits-all" approach could not be adopted as the basis for European soil conservation policy. In any case, soil shall be guaranteed the same level of protection as provided to other environmental media, such as air or water, because soil functions are crucial for human and ecosystem survival.

Effect of zeolite application to acidic and limed soil in Cu and Zn availability to ryegrass

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Keywords: heavy metals, remediation, acidic soil, contaminated soil

Trace element availability in acidic soils is high due to elevated H⁺ activity in the soil solution, which leads to competition with cationic elements for the colloidal adsorption sites. As a result acidic soils contaminated with trace elements need to be remediated, either by addition of soil amendments with high cation exchange capacity (such as zeolite) so that metal retention may be increased, or by liming the soil. In this experiment we aimed at studying the role of zeolite and liming in reducing trace element availability, as assessed by soil extractions and test crop (ryegrass, *Lolium perenne* L.) uptake. For this reason in an acidic soil (with pH 3.8) we added lime to improve pH to the value of 6.5. We then added to both treatments 15.5 mg Zn kg⁻¹ and 6.2 mg Cu kg⁻¹ and we amended soils with zeolite at three rates (equivalent to 0, 2 and 5 t ha⁻¹). Each treatment was replicated three times and was sown with ryegrass in one-kg soil pots. This resulted in 36 pots (2 pH values x 2 trace element levels x 3 zeolite rates x 3 replicates), which were placed in a greenhouse for 100 days. We found that soil extractability of Zn (with DTPA) decreased significantly with lime and was further reduced with zeolite amendment. The same was observed with Zn concentrations in plant (above-ground plant biomass was measured). However, Zn levels in all treatments were significantly higher than the unamended control. DTPA-extractable Cu, although it decreased in limed soils, did not exhibit any further reduction with zeolite additions. Copper and Zn availability was also found significantly reduced with liming and zeolite addition, when assessed with the estimation of metal transfer coefficients (g of metal in plant per kg of metal in soil).

Remediation of oil spills using zeolites

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Keywords: chabazite, clinoptilolite, oil, phillipsite, zeolites

Current research is testing the hypothesis that zeolites can efficiently and cost-effectively adsorb oil spills. To date, this aspect of zeolites science has received little attention. A series of five Master of Science (M.Sc.) Projects at the University of Wolverhampton have shown that the zeolite clinoptilolite can effectively adsorb oil. Various sand-clinoptilolite mixes were tested in replicated laboratory analyses in terms of their ability to adsorb engine oil. Adsorption increased with clinoptilolite amount. The relationship between percentage clinoptilolite and oil adsorption was asymptotic. Thus, on a cost-effective basis, a 20% clinoptilolite: 80% sand mix seems the most cost-effective mix. However, a particularly exciting finding was that it was possible to burn the oil-sand-zeolite mix and reuse the ignited mix for further oil adsorption. Experiments are ongoing, but to date the ignition and adsorption cycle has been repeated, on a replicated basis, seven times. Still, the ignited mix adsorbs significantly more oil than the sand control. Initial results suggest that the temperature of ignition is critical, as high temperatures can destroy the crystal and micro-pore structure of zeolites. Thus, low temperature ignition (~400°C) seems to allow the retention of structural integrity. Similar results were obtained using the zeolite chabazite and experiments are in progress on phillipsite, which is the third major zeolite mineral. If the hypotheses can be proven, there are potentially immense benefits. Sand-zeolite mixtures could be used to effectively adsorb terrestrial oil spills (i.e. at oil refinery plants, road accidents, beach spills from oil tankers and spills at petrol stations) and thus remediate oil-contaminated soils. The contaminated mix could be ignited and, given the appropriate infrastructure, the energy emission of combustion could be used as a source for electrical power. Then, the ignited mix could be reused in subsequent oil spills. This offers enormous potential for an environmentally-friendly sustainable 'green' technology. It would also represent intelligent use of zeolite resources. On a global scale, including Europe, clinoptilolite is the most common and inexpensive zeolite resource.

Soil physicochemical properties and vegetation cover in an arid environment revegetated with Atriplex lentiformis

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Keywords: Atriplex.spp, soil physicochemical properties, bulk density, soil water content, plant frequency, arid environment

In an ecological sense with same geological condition, landscape sensitivity relates to changes in the type of vegetation cover .The main aim of this study is to quantify the impact of Atriplex.spp on soil physicochemical properties and vegetation cover in an artificial shrub land. Three sites were selected for sampling; protected area, grazing area, and control area. Dominant plant in the grazing and protected area is Atriplex lentiformis. The control area was selected in the vicinity of Atriplex shrub land with the same geological and soil condition. Two hundred transects were established randomly at each area. Along each transect ten 10 m² plot were established approximately every 6 m. Soil samples in control area and under mid canopy and at canopy gap in Atriplex shrub land were collected from two soil layers; 0-20 and 20-40 cm. The results show that both physical and chemical soil properties were affected by planted Atriplex. For top soil layer, minimum of bulk density was observed in the mid canopy in the protected area .Bulk density was higher in the canopy gap than mid canopy in the grazing area. Soil water content was decreased with increasing of bulk density. Soil salinity in sub soil layer significantly reduced in both protected and grazing area compared to control area. Although soil ions were reduced in the sub soil layer in the area re-vegetated with Artiplex lantiformis, reductions were much less in the protected area than grazing area. Plant frequency was increased significantly in the protected and grazing area compared to control area.

Establishment of semi natural grassland by using site specific plant and seed material

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Keywords: high nature value farmland, harvesting methods, species-rich, biodiversity

The 1992 Rio de Janeiro Convention on Biological Conservation and the recent EU regulations promote the protection of biodiversity and denote the strong biodiversity decrease in Europe. To implement this aim, the involved institutions need the availability of site specific native plant material. In the case of grasslands, this requirement is not sufficiently met in Central Europe, where seed of herbaceous native ecotypes is seldom available in large amounts. Extensively managed semi-natural grasslands (the most important type of High Nature Value Farmland - HNVF) can be regarded as a seed source useful to establish new HNV Areas. Indeed, they are normally rich in species of native provenance and for this reason can be harvested to obtain valuable propagation material. The normally used techniques to create forage meadows or re-vegetate degraded areas, areas of opencast mining, brown fields, railway reserves or areas of erosion with the help of commercial seed mixtures is not comparable with ecological restoration done with propagation material from semi-natural grassland. Therefore essential parameters to be observed in planning are the substrate and, if necessary, the instructions for cultivation measures. The substrate properties in suitable areas generally lie in the damp to wet or semidry to very dry range. Due to the substrate properties the tendency for the development and spreading of bushes is comparatively slight and is generally avoided through extensive cultivation, respectively, agricultural measures (mowed annually or biannually). Therefore a large number of different harvesting methods and application techniques have been developed for exploitation and application of site specific seed or plant material. Recommended methods for ecological restoration of semi-natural grassland are the seeding of collected or propagated local seeds, fresh-cutting ('green hay') or hay mulch seeding, threshed hay seeding, topsoil transfer or the application of local plant material (grass-swards or pre-cultivated plant elements).

Soil and water conservation in the frame of the land consolidation process in Hubenov cadastre

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Keywords: soil and water conservation, land consolidation, protective measures

After the year 1989 state and cooperative farms were disbanded and the soil came back into private hands in the Czech Republic. To excite new private agricultural business and farming it was necessary to clear up the land ownership, consolidate fragmented and narrow parcels, make blocks of fields accessible. For this purpose the process of the land consolidation started. Complex land consolidation in a cadastre is initiated on the land owners' petition and it is managed by the land offices. Process complies with the land consolidation act No 139 of 2002. It provides that soil, water and environment conservation is an important and publicly needful aspect of every complex land consolidation. Hence land consolidation creates a space for the designing and realization of the erosion and flood control measures. Land consolidation designs are supported by the state and the EU funds are used for the realization of protective and ecological measures. Our report intends to show results and possibilities of enforcement of erosion and flood control measures in an agriculture landscape by means of land consolidation process in the Czech Republic. Soil, water and environment conservation is an important and publicly needful aspect of every complex land consolidation. Successful realization of designed arrangement is presented on the Hubenov cadastre. We can state, that measures realized in the Hubenov cadastre in the frame of land consolidation fully meet the requirements of water and soil conservation. Grassed areas, cascade of small water sheets, balks planted with trees well fit the character of the highland landscape and escalate its aesthetic value. According to the report of the Czech Ministry of Agriculture on the 31st December 2009 there were 1.010 cadastres with finished project of the complex land consolidation (i.e. 6% of the republic area). Currently projects are running in 747 cadastres (5% of the republic area). Although the land consolidation process does not advance as quickly as would be requisite, it brings unquestionable positive results. Realized and running projects aim at cadastres with highest interest of farmers to manage their business on available consolidated plots. But it is only one of the points of views. Land use adjustment projects aims simultaneously at the areas of the significant erosion and flood threat, where societal interest is to enforce and build measures of soil and water conservation. This study is supported by the Ministry of Agriculture of the Czech Republic within the project No. QI92A012.

High altitude restoration in the Alps The current state of the art

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Keywords: ecological restoration, alpine species, erosion protection, site specific

In the European Alps, thousands of hectares of ground are annually levelled within the sphere of tourism development and infrastructural adaptation. All those interventions lead every year to intensive building activity, after which restoration is required. In and below the montane altitudinal zone, the use of standard techniques and agricultural seed mixtures is successful in most cases. With increasing altitude, especially in the sub-alpine and alpine zone, restoration becomes more difficult due to rapidly worsening climatic conditions. In some parts of the alpine region, inadequate but cheap restoration processes are still in use, combined with non-site-specific, cheap seed mixtures. The ecological, and often economic, damage caused is comprehensive; soil erosion, increased surface drainage, insufficient vegetation cover, high costs for ecologically questionable fertilising measures, disproportionate cultivation expenditure and flora adulteration are only some of the resulting effects. Above all, winter tourism accordingly received a very negative image. More than twenty years ago efforts were started to improve the prospects of success in the restoration of ski slopes in high zones through the combined use of high-quality techniques and site-specific seed mixtures. In the meantime, a commercial production of site-specific species for restoration in high altitudes was started. International research projects were carried out with the participation of research groups and firms from Austria, Italy, Germany and Switzerland. Within the sphere of these projects, an exact scientific comparison between the usual technological developments, high-quality application techniques and site-specific seeds was carried out on ski runs in Austria, Germany, Italy and Switzerland, whereby it could be proved that only a combination of high-quality application techniques and site-specific vegetation or seed mixtures leads to stable, enduring and ecologically adapted plant stands. As an additional effect, fertilisation and cultivation measures can be clearly reduced, which also make site-specific restoration in the medium-term economically viable. The standards developed through these research projects are representing the current state of the art in high-altitude restoration. Hydro-seeding with herbaceous species for road-cut slope stabilization in Egnatia highway.

Hydro-seeding with herbaceous species for road-cut slope stabilization in Egnatia high way

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Keywords: seeding period, soil cover, slope exposure, seed quality, bedrock

Hydro-seeding with herbaceous species was applied on road-cut slopes at three ecological zones of Egnatia high way (west, center and east) for road-cut slope stabilization. Measurements were carried out at the end of each season during the year 2000 at different sites within each zone based on the period of seeding (autumn and spring), the exposure of slope (north and south) and the soil cover (juta-net and bare soil). A frame of 1 m² in size was used to ocularly assess the total vegetation cover, the cover of seeded species and the species composition. The species used were: *Dactylis glomerata*, *Lolium perenne*, *Festuca spp.*, *Onobrychis sativa*, *Sanguisorba minor*, *Phacelia tanacetifolia*, *Plantago lanceolata*, *Trifolium repens*, *Lotus corniculatus*, *Melilotus albus*, *Melilotus officinalis* and *Medicago spp.* The highest vegetation cover was found on the slopes covered with juta-net and those seeded in autumn in all sites. The species composition varied among the three different zones: on the west, grasses and forbs had similar cover; on the center, the most successful species were *Dactylis glomerata*, *Festuca spp.*, *Phacelia tanacetifolia* and *Melilotus spp.*; and on the east, perennial grasses were dominating. The success of hydro-seeding was affected by the seeding period, the nature of bedrock, the slope, the quality of seeds and their distribution, and the cover with juta-net.

Irrigation, organic amendments and mulches as success factors in soil restoration in semiarid limestone quarries

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Keywords: drip irrigation, organic amendments, mulching, water stress, erosion control

Very few soil restoration projects have been carried out in limestone quarries in semiarid Mediterranean areas with annual precipitation < 300 mm. An experimental soil restoration started in early 2008 with the aim to know the effects of supplemental irrigation, organic wastes, mulches and plantation of native plants. Two types of organic wastes (sewage sludge from urban water treatment plant and compost derived from urban solid wastes) and two types of mulch (chopped forest waste and gravel) were applied in experimental plots in the eastern versant of Sierra de Gador, in SE Spain. Sixteen plots on two different substrates, a bare marl (no organic carbon, no seed bank) and a topsoil (2.5% organic matter content and presence of a seed bank and opportunistic vegetation), were previously sub soiled with a ripper following the contour lines, before adding the organic amendments and the mulches. In each plot (n=16), 3 perennial autonomous species from nursery (*Stipa tenacissima*, *Antyllis terniflora* and *Anthyllis cytisoides*) were planted in subplots (n=48). To avoid plant wilting and probable death during the initial growth stage under dry climate conditions, a drip irrigation system was implemented to provide support water to every seedling during the first months after plantation (late spring and summer). Two years after the plantation 67% of the plants survived. Survival was higher in the plots on marly soils than in the plots on topsoil where abundant opportunistic vegetation might have had a negative impact, though a positive impact in erosion reduction. Survival was the highest for *Stipa tenacissima* and the lowest for *Anthyllis terniflora*. Plant cover is significantly correlated to organic amendments and especially to sewage sludge over the marl substrate. A plant vigor index, consisting in the plant volume (plant height multiplied by the average width) and plant density (number of stems or leaves), measured only in the planted species, has revealed that *Stipa tenacissima* reached the highest vigor average value, followed in decreasing order by *Anthyllis cytisoides* and *Anthyllis terniflora*. However, when comparing the different treatments, the highest plant vigor corresponds to *Anthyllis cytisoides* in plots which combine the use of organic amendments and mineral mulch. As no plots were set without irrigation, this parameter could not be considered in a General Linear Model (GLM) analysis, though most probably irrigation is an essential factor for plant survival. The actual GLM indicated that the addition of organic amendments and the use of mulches were the main factors in explaining the success in the vegetation establishment and growth in this semiarid environment.

GS SOIL: Development of a GEOPORTAL to offer access to multilingual soil data to the European citizens.

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Keywords: INSPIRE, metadata, harmonization, web portal, soil data, information administration systems.

This paper describes the GS Soil project, and its purpose is to inform European scientists about the ongoing work of database development on soil distribution, soil properties or soil data in general and to inform the European citizens about the multilingual GS Soil portal through which soil data can be accessed and used according to the INSPIRE directive specifications, by different stakeholders. The GS Soil project is funded by the EC e-Contentplus, FP7 programme. The project aims to develop a soil data inventory for the whole of Europe, which will include all soil related data and information, as well as the way it could be accessed. It will be harmonized according to the 1205/2008 specifications. Good practices for metadata development and maintenance will be proposed. Harmonization, technical and semantic interoperability will be developed in parallel with the GS Soil portal based on Open Geographical Components (OGC) in order that each stakeholder to have access to the soil data. The system will be tested and evaluated and its long term sustainability will be ensured in conjunction to its dissemination to the European stakeholders.

Issues or properties related to environmental activities or the status of soil degradation processes could be easily accessed. Soil Thematic Strategy will be favored by all these tools and approaches.

Learning by doing: Student's Forum of World Association of Soil and Water Conservation

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Keywords: learning by doing, Student's Forum, decentralisation, education

In Jun 27th 2005 at the Faculty of Forestry of Belgrade University was established Student's Forum of World Association of Soil and Water Conservation. It is the first time in the world that such association is formed. So it is the new unit of WASWAC. This initiative was very well evaluated and accepted by both sides: professors and students. Forum is organized on decentralization principle (similar to DP program of WASWC). For this propose statute/by law is prepared with the statements of the name, place, aims, activities, registration of new members, rights and obligations, membership, Assembly, Council, Supervisory Board, procedure of meetings, etc. Aims of the Forum are: advanced trainings in SWC with the field and laboratory work/practice; promoting SWC approaches; raising SLM awareness in theory as well as in practice, disseminating WASWC idea with students, strengthening of membership, helping/supporting in establishing similar forums in Balkans and worldwide and strengthening their network in this region and wider, organizing students meetings/seminars, excursions, exhibitions, publishing reports of own work to WASWAC, etc.

This Forum is involved in WASWC activities as "WOCAT Program" ("World Overview of Conservation Approaches and Technologies"), "Community Based Rehabilitation of Degraded Land in Balkans", activities and research of the Department of Ecological Engineering at the Faculty of Forestry of Belgrade University - as involvement in organization matters of LANDCON Conference. Results of their work, connected to WOCAT, were presented at 12th WOCAT workshop in Philippines. There appeared possibility to organize similar Forum in Katmandu in Nepal as well as in Orissa in India, Punjab University in India and Jangling University in China. The idea of this new unit of WASWAC becomes more and more possible to be adopted and adapted globally.

POSTER PRESENTATIONS

The Environmental Programs in Primary Education in the Prefecture of Larissa

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Keywords: environmental education, implementation, team-teaching, project, cross-curriculum approach

The last four years more than 6000 primary school students and approximately 500 teachers in the prefecture of Larissa are dealing with environmental programmes. The methods used for the implementation of the programmes is work in the classroom, field study, education in the Environmental Education Centres and various other actions, which are framed by scientists, agencies and bodies of local society. Teachers have the opportunity to attend workshops, seminars and field education, in order to be able to get environmental information and education. The time usually disseminated for environmental programs in the classroom, is two hours weekly. However, the new books of primary school provide the opportunity for longer time cross-thematic connections. Also, multidisciplinary and interdisciplinary models are suggested for the integration of environmental education in the educational system. A more general approach, such as cross-curriculum approach enables students to establish a uniform set of knowledge and skills, a holistic concept of knowledge, in order to create a personal opinion on matters of science which are related to each other and with issues of everyday life. In this way, pupils could view of the world must know, love and live. The cross-curriculum approach is supported by active knowledge acquisition methods. Indicative teaching strategies that can be used, depending on the educational section, the needs of learners and the conditions of the school or the resources available to the teacher, are: (a) Investigation and discovery (proactive approach of knowledge), which aims to help students thinking, to handle complex concepts, to investigate and to reach their own knowledge, which ultimately learn "how to learn". (b) Experiential learning: contact with the environment, where necessary and possible, ensure immediate information that can be used in a variety of ways, and contributes to the experiential approach to knowledge. (c) Team-teaching forms of teaching: the momentum developed by student small-group may well be utilized either as collective processing of data or as a framework to support individual learning. The team-teaching form of teaching is suitable for developing work plans (projects), offered to organize cross-thematic character activities. Research appears pupils eligible during the implementation of the project, concerning their academic performance, motivation, self-efficacy and their attitude to the values associated with environmental education. Also, concerning their participation in working groups, the acceptance from the group and their engagement in learning processes, showed positive results. Children appeared to prefer learning based on the experience comparing to the traditional learning methods.

Study of Cd transfer reduction from soils in plants

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Keywords: Cd, zeolite, bentonite, goethite

In the present investigation we studied the reclamation of Cd-contaminated soils by adding zeolite, bentonite, goethite and two synthetic adsorbent consisting of zeolite and goethite (named I and II). We aimed at reducing Cd availability and uptake by plants grown in these soils. For this purpose we conducted a greenhouse pot experiment in four replicates, as follows: In pots (which contained 1 kg of soil), we added 5 gr of zeolite or bentonite, and 1 gr of goethite or zeolite-goethite I and II. We also added 3 mg of Cd and plant seeds of wheat, maize and cotton. This resulted in 300 pots, including the unamended control. Forty days after germination we collected the plants, identified morphological characteristics and determined available Cd in soil (extracted with DTPA) and the total Cd in plants. The results showed that the largest decrease of soil available Cd was in the goethite and zeolite-goethite I treatment, in pots grown with wheat and maize, respectively. We also found that Cd absorption by plant roots and shoots was significantly reduced in all treated soils especially in the goethite treatment in pots grown with maize, compared to the unamended control.

Soil ecological relationships in a high mountain volcanic environment at Mount Teide Canary Islands

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Keywords: Canary Islands, ecological relationships, volcanic soils, high mountain environment

The Teide National Park (Tenerife, Canary Islands) constitutes a singular framework to study the initial stages in the development of volcanic soils and plant succession, due to the recent age of parent materials, as well as traditional cattle breeding that limited the growth of plant communities to just some decades ago. The main target of this study is to analyze the influence of each soil forming factor on soil properties, the dynamics of vegetation and how soil characteristics may hinder plant re-colonization in a fragile area with high ecological value.

In this work we analyze soil properties and plant inventories on a 173-sample grid along the National Park, using different multivariate techniques to study the ecological inter-relationships of soil and vegetation, together with environmental factors. First, we carried out a Principal Component Analysis of soil properties, so as to have a whole view of the main soil gradients, and a Redundancy Analysis together with parameters related with climate, parent material and topography, so as to identify the abiotic factors most influencing soils. Further on, a Detrended Correspondence Analysis and a Canonical Correspondence Analysis allowed us to establish the main floristic gradients and to relate the main plant communities (broom scrub, rosalito scrub, Canarian pine forest and pioneer vegetation) with soil properties in the environment. The main soil variation gradient relates to climate, so that soils with a more definite andic character, richer in soil organic C and nutrients, and having more favourable texture and structure are located at lower elevations facing the humid NE winds. Steep slopes are associated with eroded, shallow, stony and coarse-textured soils. Soils developed over volcanic lavae show higher SOC and lower pH values, higher available P contents, (basaltic), or richer in clay-sized particles, and available alkaline earth cations (phonolitic). Soils over salic tephra show intense, bright yellowish tones and loose structure. Finally, sedimentary beds give rise to compact, base-rich and stony soils.

Soils under broom scrub are typically andic and sandy but not particularly stony, well-drained and rich in total N and available P. Under rosalito scrub, however, soils are typically lythic, with frequent rocky outcrops. Pine forests are associated with the highest SOC contents, due to litter accumulations, and pioneer vegetation grows over very recent, skeletal, nutrient-poor, basic and poorly structured soils.

The advance of plant re-colonization seems to be tightly related to soil properties, being slower over poor and scarcely developed soils. The results evidence the utility of the knowledge about soil potential to support one plant community or another in this area with singular and vulnerable flora.

Polinuclear aromatic hydrocarbons (PAHs) content in the soils of garbage platform areas

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Keywords: PAHs content in garbage platform areas

PAHs represent a group of highly carcinogenic and mutagenic organic contaminants included in the "priority pollutants" listing produced by the United States Environmental Agency (US EPA) and by the European Commission. Soil is the part of the environment, which accumulates most of the hydrophobic organic contaminants such as PAHs. In the soils of garbage platform areas (Glina-Bucharest and Baraolt-Covasna) receive inputs of these contaminants mainly from garbage storage infringement ecological dump and continuous incineration. The soil samples (0-20 cm) were taken from the distances near wall of garbage dump and far away by source. The soil samples were analyzed for PAHs (16 compounds) content by HPLC method. PAHs concentrations were place over the action trigger values in majority of cases. The higher concentrations were recorded to profile 3; these contents were over 20 times of action trigger value for antracen, 2.8 times for pyrene and 477 times for benzofluoranthene. Because benzofluoranthene, benzo[a]pyrene and other compounds represent a group of highly carcinogenic PAHs and these have the higher values, result dangerous presence of garbage platform areas, specially their incineration for the health of people from these areas.

Impact of planted belt trees on desertification processes in an arid environment

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Keywords: desertification, Haloxilon, soil humidity, chemical soil properties, physical soil properties

Some plants accumulate salt and mineral in special glands in its leaves, and then excrete it onto the leaf surface. These salts accumulate in the surface layer of soil when plants drop their leaves and so they can change soil properties in sub-surface soil layer. The main objective of this paper is an investigation of the effect of Haloxilon vegetation belt on soil humidity and some chemical and physical soil properties. Two 300 meters transects were established under planted trees and also at 50 meter from tree trunk as control area. Soil sample were taken along two transects from three depths, 0-10 cm and 10-20 and 20-30 centimeters. Soil samples were analyzed in laboratory. Measured soil parameters were Ec, pH, Potassium (k), Organic Matter (.O.M.), Sodium (Na), Calcium (Ca), Magnesium (Mg) and soil humidity. Resultd shows that some soil properties such as Ec, pH, K, Na and O.M was increased significantly ($p<0.05$), while soil humidity in all layer was decreased compared with control area.

Ecological restoration of road embankments in Austria Prospects and limitations

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Keywords: regional wild species, sustainable restoration, economic efficiency

Sustainable rehabilitation and restoration of slopes and road embankments should lead to an appealing landscape with satisfying ecological value: no flora falsification, high biodiversity, establishing valuable plant communities, in-situ conservation of rare species, use of regional wild seeds. For establishing regional wild plants, soil preparation following the requirements of the site specific target vegetation type has to be done. As a substrate diaspore-free, humus-poor top soil with low nutrient content should be used. Regional wild plants are not suitable for the restoration of humus and nutrient-rich areas. The following methods can be used for setting up extensive meadows and turfs with regional wild species on road embankments: Seeding of wild collections or the use of seed coming from either hay threshing or hay mulching. Generally, seed density should be between 1 and 5 g/m², a de-mixing of the seed mixture has to be avoided. Fertilisation has to be reduced to a maximum of 4g N m⁻². For the conservation of rare plant species or rare plant communities, the use of sods is a successful, well-established method.

Ecological restoration or rehabilitation, using sustainable plant or seed material combined with optimised application techniques ensures sufficient protection from erosion and enables a reduction of costs, if mid term follow up costs are calculated too: reduced use of fertiliser, reduced maintenance costs, reduced failures, more stable systems.

The effect of growing medium and seedling density on pine seedling

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Keywords: planting stock material, root growth potential, seedling quality

The quality of transplanting material highly affects the success of regeneration and restoration efforts, especially when dealing with different and complex ecosystems. Pines are one of the dominant genus that forms pure stands along different altitudes. The aim of this study was to investigate the effect of soil substrate and seedling density on pine species that occur at different altitudinal ecosystems in Greece. Specifically, *Pinus brutia* and *Pinus nigra* were selected as low and high altitude species, respectively. The soil substrates that were studied were peat and stabilized medium and the seedling densities were 975 and 3.500 seedlings/m². It was hypothesized that both species should response the same under both soil substrates with seedling density having a more profound effect on their growth. Physiological (root growth potential, RGP) and morphological variables (shoot height, SH; leaf area, LA; root dry weight, RDW; shoot dry weight, SDW and their ratio, R/S) were measured for both species. For *P. brutia*, the results indicated greater RGP and SH mean values for the stabilized medium with greater means for the 975 seedling density. On contrary, *P. nigra* indicated greater LA and SDW mean values for the peat and the 975 seedling density. Our results suggest that pine species that occur naturally at different altitudes respond differently when grown under different soil substrate and seedling densities. Those parameters should be further studied to properly grow and transplant seedlings for species derived from different altitudinal origins.

Allocation of soil to drainage classes using visual or rapid soil indicators

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Keywords: drainage, indicators, allocation, grassland

A sustainable nutrient management decision support system is currently being developed for Irish grassland farms with a Soil Moisture Deficit (SMD) model at its core. The SMD model requires little data to run; it uses weather data (rainfall, wind speed, temperature and solar radiation), spatial co-ordinates and a soil drainage class which can be one of: well-drained, moderately-drained or poorly-drained. The perception of drainage class is subjective to user knowledge and experience of a site which do not relate to physical definitions defined within the model. Moreover, the allocation of parcels of land to drainage classes can be unclear when a field is close to a class boundary. A series of context and vegetation indicators along with visual soil indicators are being developed to allow objective allocation of a field to a SMD drainage class. The selected indicators are not absolute but the weighted combination should form clusters representative of one of the SMD drainage class. Topography is an important context indicator accounting for local slope effects relative to landscape position, as the SMD model does not discriminate runoff from leaching (Holden et al., 2007). Furthermore, if visited following rainfall the sound of free water draining or being displaced under the boot is also a context indicator. Plant indicators of relative soil wetness have been selected using the Ellenberg indicator value for British plants (ECOFACT report, 1999) and the presence of weeds which suggests niche opportunity not consistent with well drained and managed grasslands. Soil indicators chosen are surface irregularities arising from cattle hoof and trafficking which provide evidence of excessive soil wetness relative to farm attributes and management. This is then supported by visual soil structure assessment through soil manipulation and comparison with pictures and the assessment of texture and mottling. Using the weight of evidence from these indicators it is possible to reliably and reproducibly allocate a field to a SMD drainage class which means that decision support tools can be built using relatively little site-specific data. Similar rapid methods have been developed as assessment tools for soil and habitat conservation (Schulze et al., 2009) and therefore this approach has potential for SMD drainage class allocation.

Afforestation as a soil remediation method after long-term irrigation with wastewaters from potato starch production

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Keywords: wastewater irrigation, soil, poplar, afforestation

In potato industry, wastewaters result from potato washing and rinsing or from the process of starch processing and production of animal forage from potato protein. The wastewaters, after treatment, have been used in industry for a long time. The Potato Industry Company "Trzemeszno" was established about 120 years ago. In Poland, it is one of the largest manufacturers of potato starch and forage protein. Its wastewaters are treated with the use of modern technology. After treatment, the wastewaters are sprayed on fields covering an area of over 500 ha, including 100-130 ha of pastures grazed by beef cattle (extensive breeding), and the remaining about 400 ha lying fallow. These fields have been irrigated with wastewaters since 1983, usually for a few months every year. Physicochemical properties of wastewaters vary between years, they generally contain high concentrations of organic matter, inorganic suspensions, potassium, nitrogen, and phosphorus. The wastelands, resulting from the agricultural use of potato industry wastewaters for several decades, may be remediated in various ways. In recent years, research has been started on their afforestation, e.g. by planting poplars, which are fast-growing trees, with high biomass production. Thanks to their easy vegetative propagation, numerous poplar cultivars have been introduced into cultivation as a result of selection and breeding. The extensive root systems of poplars, as well as abundant leaf fall, improve the soil structure, increase nutrient cycling, and promote biodiversity. In these wastelands, we planted 10 poplar cultivars (*Populus spp.*) in a plot of 1.5 ha. A control plot (also 1.5 ha) was established in an experimental forest of the Institute of Dendrology in Kórnik. Each plot was established according to orthogonal models. One-year-old cuttings were planted (spaced 5 m × 5 m), in a randomized block design with five replications. Before planting, we measured concentrations of nutrients in the soil (total and bioavailable). Soil samples were collected from the depth of about 20 cm (after removal of leaf litter). We also measured microbial activity in the rhizosphere. After the first and second growing season, we recorded morphological and morphometric parameters of poplar growth and development. We detected changes in soil properties caused by irrigation with wastewater, e.g. acidification, lower N and C content, lower C:N ratio, exceeded bioavailable K content, and deficits of Ca and Mg. Also microbial activity in the soil was significantly reduced. In spite of these changes, poplar growth and development was more intensive in the treated plot than in the control plot. Parameters of growth and development in the treated plot were highest in *P. deltoides × maximowiczii* 'ERIDANO' and *P. × interamericana* 'HOOGVORST', while lowest in *P. × euramericana* 'ROUSTA'. In the control plot, growth parameters were highest in *P. × interamericana* 'HOOGVORST', and lowest in *P. maximowiczii × trichocarpa* NE 42.

The effect of brown coal derived preparation on bioavailability of heavy metals in contaminated soils

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Keywords: brown coal preparation, hevy metals, phytotoxicity, bioavailability, water quality, food chain

Contaminants such as heavy metals, radionuclides, organic pollutants and their mixtures are threatening ecosystems and human health by their impact on water and food quality. Therefore, decontamination of soils and/or reduction of contaminants bioavailability and phytotoxicity are priority topics in environmental legislation. The release of trace metals in biologically available forms, as a result of human activity, may impair or alter both natural and man-made ecosystems. Heavy metals in soils may be present in several forms regarding their degree of solubility, as: (i) dissolved, (ii) exchangeable, (iii) structural components of the lattices in soils and (iv) insolubly precipitated with other soil components. The adsorption and desorption of heavy metals can be associated with soil properties, including: pH, organic matter content, cation exchange capacity (CEC), oxidation-reduction status (Eh), as well as the contents of: clay minerals, calcium carbonate, Fe and Mn oxides. Among them, soil pH and organic matter content were found to play the most important role in bioavailability, due to their strong effects on solubility and speciation of heavy metals in soil. To reduce the risks associated with introduction of heavy metals in the food-chain and their leaching to surface and groundwater, it is very important to know the interaction between metal ions, soil organic matter, plants and water bodies. In this study we assumed that the organic matter present in the brown coal-derived preparation called "Rekulter" after its addition to soil, would decrease the uptake of heavy metals by plants, by forming complex compounds and making the metals immobile. The formation of chelats will cause an exclusion of heavy metals at the stage of their transfer from soil to plants. The experiment was carried out on Haplic Luvisols formed from loamy sand (WRB), in field pots sank into the ground. The "Rekulter" was added to the soil in the amounts of: 180, 360 and 720 g per pot, which is equivalent to: 5, 10 and 20 tons .of organic carbon per ha, respectively. Not amended soil was used as a control. The soil was mixed up with the liquid form of salts: cadmium as Cd(NO₃)₂, lead as Pb(CH₃COO)₂ and zinc as ZnSO₄, which led to the following contents of heavy metals: Zn = 90.0; Pb = 60.4; Cd = 0.80 (mg.kg⁻¹ of soil), as examined by mineralization in 2M HNO₃. Bioavailable forms of heavy metals were determined in EDTA whereas content of Pb, Zn and Cd in the soil samples - using ICP-AES. Single application of the Rekulter at increasing doses resulted in decreased solubility (mobility) of heavy metals in soil, and consequently their bioavailability. The contents of Zn, Pb, Cd in 2M HNO₃ in soil 4 years after the "Rekulter" application have not changed significantly. The content of soluble (EDTA) Zn, Pb , Cd fractions in soil depended on the quantity of organic matter added into soil. Sorption of heavy metals by soil increased with the increased doses of the Rekulter and was the highest at a dose of 720 g per pot. The highest reduction of bioavailability was observed for Cd. The Brown coal preparation can, thus be regarded as an efficient source of organic matter in soil to reduce the bioavailability, and consequently phytotoxicity of heavy metals, as well as their uptake by plants and/or leaching to surface or ground water.

Sustainable Land Management: Educational activities realized by the Education Centre for the Environment and Sustainability of Naoussa

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Keywords: sustainability, land management, educational activities, environment

The need for environmentally conscious citizens is dictated by the crucial environmental issues of our society, as well as by the objective of sustainable development. The role of education in consolidating an environment-friendly culture is, therefore, of great importance. At the Environmental Education Centre of Naoussa – a non-conventional public educational structure – participants (students of all ages and educational levels) are encouraged to adopt sustainable environmental practices, through a critical social theory. The role of the Centre is double, both environmental and educational. Its educational role is implemented through student-oriented methods, such as cooperative team work, field study, the project and the jigsaw approach, learning through experience and encouraging the creativity and critical mind of students and adults alike. On the other hand, the environmental role of the Centre is reflected in its nine (9) programmes, developed on the basis of Naoussa's natural and urban environment, while the themes include water resources, the forest of the area, its industrial heritage and, finally, the sustainable management of its rural land. The study case of this work focuses on the activities – suggested by the members of the pedagogical team of the Centre, in collaboration with scientists – dealing with the sustainable use and management of rural land. The objective of understanding the value and significance of soil as a natural resource lies at the core of the aforementioned programme. All suggested activities are structured in the light of the three poles of sustainability: society – economy – environment. Soil is treated as a multidimensional concept and, at the same time, as a complex natural-biological system, a precious natural resource which is not renewable. The suggested activities attempt a delineation of concepts such as: sustainable land and livestock farming practices, soil horizon, decomposition of organic matter and natural composting. Participants get acquainted with the basic notions of the programme through experience, while visiting fields and farms of the area or interviewing farmers, and through field research. Realizing the significance of ecological balance and adopting life-long sustainable practices is the main objective of the programme.

AMF inoculation increases the Cu uptake of *Nerium oleander* plants grown in mine tailing substrates

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Keywords: *Nerium oleander*, tailings, arbuscular mycorrhiza, copper

Mine tailings -- the waste rock produced in the mining process – pose a serious environmental hazard in parts of the Halkidiki peninsula, Greece. Native plant species, such as *Nerium oleander* are used for the phytoremediation of areas covered by dried tailings and the filter cake produced by the implementation of modern froth-flotation methods. The toxic levels of the metals Cu, Zn, Mn, Pb, Ag present in the mining waste, require the implementation of soil amendment techniques and the biological reinforcement of the plants selected for phytoremediation. The application of commercial arbuscular mycorrhiza inoculum on *Nerium oleander* plants grown in these materials is examined in the current project. Four months old *Nerium oleander* nursery plants were planted in several mixes - 30%, 50% and 60% per volume - of the mine tailing material and the filter cake ,with soil (pH 7,5) and rice hulls. The commercial inoculum was applied upon planting (10g per 2lt pot). The plants were collected after 10 months. The root, shoot and leaf plant tissues were analyzed and the Cu content was measured in relation to the tissue dry weight (bioaccumulation). The arbuscular symbiosis increased the Cu uptake, that was considerably low in the tailing and filter-press non-inoculated mixes, despite the high content of Cu in the mining materials.

Effect of slope characteristics at small watersheds on soil erodibility in Maleshevska mountain, Bulgaria

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Keywords: soil erodibility (K factor), land use, soil organic carbon, particle size distribution, GIS

Soil erosion is a major cause for degradation process in Bulgaria, especially in the southwestern part of Maleshevska Mountain (the Struma river basin). This study was conducted to assess soil erodibility and effect of mountainous slope characteristics like gradient and exposure, as well as land use types such as abandoned arable lands, and oak branch wood management forests in the basin the Sedelska River, a tributary of the Struma River.

A set of 32 representative soil profiles was established in the small watersheds along the down slopes transects on southern/sunny (south, southeast, southwest and west) and northern/shady (north, northwest, northeast and east) exposures. Because of the larger area of watershed 4 and different types of land use, three transects had been established. The Wishmeier et al. (1971) nomograph and the Grade Assessment Method (GAM) used in MERA projects (MARS and Environmental Related Applications) have been applied for the erodibility index calculation. The Arc Info 9.2 software was used to present the spatial distribution of the input and output data. A geographic analysis of the relief and soil databases were used as relevant tools for data analyses and purpose achievement.

The calculated values through the nomograph for soil erodibility vary from 0.009 to 0.036 (t ha h)/(ha MJ mm). The data obtained show that the values of the erodibility coefficient for soils on the slopes with sunny exposure are higher in comparison with those on the shady ones. The grade method for erodibility assessment significantly overestimates the values, obtained through the nomograph method.

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