Belgrade University
Faculty of Forestry

World Association of Soil and Water
Conservation (WASWC)

INTERNATIONAL CONFERENCE ON

"LAND CONSERVATION" – LANDCON 1209

SUSTAINABLE LAND MANAGEMENT

AND CLIMATE CHANGES

September 17-21, 2012
Danube Region/Republic of Serbia

Conference Abstracts

International Sediment
Initiative (ISI-UNESCO)

World Association for
Sedimentation and Erosion
Research (WASER)

European Society for Soil
Conservation (ESSC)

Water Management Institute
"JAROSLAV ČERNI"

INTERNATIONAL CONFERENCE ON „LAND CONSERVATION" – LANDCON 1209

SUSTAINABLE LAND MANAGEMENT AND CLIMATE CHANGES

September 17-21, 2012

Danube Region/Republic of Serbia

CONFERENCE ABSTRACTS

Editors:

Miodrag ZLATIĆ

Stanimir KOSTADINOV

Belgrade, 2012

INTERNATIONAL CONFERENCE ON
„LAND CONSERVATION" – LANDCON 1209
SUSTAINABLE LAND MANAGEMENT AND CLIMATE CHANGES

September 17-21, 2012
Danube Region/Republic of Serbia

Conference Abstracts

Publisher: University of Belgrade, Faculty of Forestry
Editors: Miodrag ZLATIĆ
Stanimir KOSTADINOV

Editorial Office: Faculty of Forestry
Kneza Višeslava 1
11030 Belgrade
Serbia
Phone: +381 11 3053-990
Fax: +381 11 2545-485
e-mail: biblioteka@sfb.bg.ac.rs
www.sfb.bg.ac.rs

Organiser: University of Belgrade, Faculty of Forestry, Belgrade
Co-organisers: World Association of Soil and Water Conservation (WASWC)
Institute for Water Management "Jaroslav Černi", Belgrade
International Sediment Initiative (ISI-UNESCO)
Worl Assotiation for Sedimentation and Erosion Research(WASER)

Lecture: Katarina Lazić
Technical Editor: Saša Sofijanić, Vukašin Milčanović
Circulation: 300
Printing: Planeta print, Belgrade
ISBN: 978-86-7299-205-2

CONTENTS

TOPIC 2: LAND CONSERVATION
Keynote papers

Papers

TOPIC 3: IMPACT OF CLIMATE CHANGE
Keynote papers

Papers

TOPIC 5: IMPLEMENTED GLOBAL/REGIONAL/NATIONAL PROJECTS
Keynote papers

Papers

TOPIC 6: EDUCATION IN LAND CONSERVATION
Papers

PREFACE

Perceived wisdom in the approach to evaluation, use and management of land resources is changing rapidly and dramatically. Past emphasis on land development that focused on maximizing the production and return from land use investments, planned against a background belief that suitable lands for expansion could always be found somewhere, is forced to give way to a more cautious approach - one that recognizes the finite extent of fertile land and the seemingly insatiable demands of a growing human population.

Globally, and in many individual countries, there is clear evidence of impending land shortage. Areas in which the combination of land and freshwater resources is moderately or well suited to agriculture are, for the most part, already in use. The efficient use of these lands is becoming a matter of life and death for the increasing millions of mankind. In addition to Climate Changes, the main present world problem makes mankind worried about the Earth's survival. Future generations in still larger numbers are more seriously at risk. Their livelihood is endangered by the present production choices that degrade different resources on which future agriculture depends. Global production must increase dramatically to meet the foreseen demand, but the levels and means of production targeted locally must be those that are maintained on a sustainable basis. Global and even local land use must be sustainable. „We need a value system which enshrines the principle of sustainability over generations. Sustainable development may mean different things to different people, but the idea itself is simple: "We must work out models for a relatively steady state society, with population in broad balance with resources and the environment." (Tickell, 1993).

This is the second conference in Serbia organized in respect of land conservation (LANDCON). It drew great attention of the scientific as well as general public. Participants from 15 countries from all over the world will be present at the conference. The aim of this Conference is to provide an output of deep plenary sessions based on the issues collected from the sessions with the following topics: Land Degradation, Land Conservation, Climate Change, Socio Economic and Policy Issues of Land Degradation and Land Conservation, Implemented Global/Regional/National Projects, Education in Land Conservation, Environmental issues. The book of Abstracts contains 117 abstracts divided into the above topics. The selected full papers will be published in "Catena Verlag" by a German publisher from Reiskirchen, in one of the books from the "Advances in Geoecology" series. Other papers will be published in the electronic proceedings.

President of the Organising Committee
Prof. Miodrag Zlatic, D. Sc.

LANDCON

Keynote papers

LANDSLIDE ACTIVITY AND ENVIRONMENTAL CHANGE IN THE HIMALAYA

Martin J. HAIGH[1] and J. S. RAWAT[2]

[1]Department of Social Sciences (Geography), Oxford Brookes University, Oxford OX3 0BP, UK. Email: mhaigh@brookes.ac.uk).
[2] Uttarakhand Centre for Climate Change & Centre for Natural Resources Data Management Systems, Kumaun University, Almora, Uttarakhand 263 601, India.

Extreme events may be an inevitable aspect of the passage of time but disasters may also be due to avoidable local human impacts in the environment or to global problems such as climate change. Whatever the cause, affected communities are very concerned to receive a reliable explanation and diagnosis of their problems. Frequently, this desire places environmental scientists in the policy-makers and media spotlight. In September 2010, in the Kumaun Himalaya of India, the most severe late-Monsoon rainfall event in 60-years of record triggered a major landslide swarm that caused serious loss of life, disrupted thousands of kilometres of roadway and caused damages in excess of $125,000,000. The event created national headlines and, in the aftermath, there began a search for causes. This study sought causes on a small part of the affected network, the Almora Lower Mall, a 7.4 *km* reach of roadway that had been part of previous studies.

Because of public interest in this work, findings were classified in a way calculated to resonate with the affected community as well as with the problem itself. In India, tradition observes that troubles have three sources. They may be: adhyatmic – self-inflicted by local human actions – like the hillslope undermining caused by road engineering, adhibhautic – inflicted by the environment through steep slopes or channel incision and, arguably, climate change; or adhidaivic – due to fate or the chance of an extreme rainfall event.

Here, individual landslides were surveyed in the field along with a suite of potential environmental indicators. Results show that the number of landslides on the roadbed was not unusual, so research switched to exploring factors that may have enhanced landslide volume. Local opinion blames landslides on recent urban developments or innate geological weaknesses. However, results show that (adhyatmic) human impacts such as building construction, deforestation, and agricultural terrace collapse were associated with smaller landslides. Similarly, road engineering factors such as the location of another road upslope or collapse of a roadcut-retaining wall were unimportant, although roadcut height proved significant. Against expectation, (adhibhautic) geological factors showed no significant correlations with landslide volume unlike steepness of the hillside upslope and channel incision undermining the roadbed. A rank-size graph of the recorded landslides demonstrates the underlying presence of the fractal power-law that signals

the unpredictable (adhidaivic) landslide generation on slopes close to their critical limits of stability. However, the finding that larger landslides are mainly unpredictable, if nevertheless more associated with steeper slopes and higher roadcuts, conflicts with popular wisdom and still proves 'hard to sell'.

Key words: landslides, landslide swarm, hazard management, community education, Uttarakhand, Himalaya.

A BRIEF INTRODUCTION ON THE WORLD ASSOCIATION OF SOIL AND WATER CONSERVATION (WASWAC)

Li RUI

President of WASWAC,
Institute of Soil and Water Conservation, CAS/MRW, NWSUAF,
Yangling 712100, China.
lirui@ms.iswc.ac.cn

The World Association of Soil and Water Conservation (WASWAC) was established in 1983. Since its founding, WASWAC has devoted itself to a worldwide promotion of the application of wise soil and water management practices that will improve and safeguard the quality of land and water resources. After a 30-year development WASWAC has more than 5000 members from 120 countries in the world. Now WASWAC publications are HOT NEWS (monthly), Bulletin (quarterly) and books (occasionally). The association holds the World Conference every three years with a series of regional or special professional LANDCON meetings. In the field of desertification, WASWAC as a powerful platform plays an important role on providing researchers with many useful technologies and experiences. We will continue to meet the needs of soil and water resources conservation and utilization through international contacts among scientists, engineers, organizations, institutions, and governments.

Key words: Soil and Water Conservation, World Association, international cooperation.

IMPORTANCE OF LANDCON CONFERENCES

Miodrag ZLATIC

University of Belgrade, Faculty of Forestry, Kneza Viseslava 1,
11030 Belgrade, Serbia

The World Association of Soil and Water Conservation (WASWC) is of the opinion that greater feedback can be obtained from various technical and scientific meetings, particularly key international fora and conferences, in the interest of further promoting the issues and benefits of soil and water conservation.

With respect to that, LANDCON conferences were established in 2008, starting to be organized all over the world in 2009. A term abbreviated from the name of a series of meetings held by WASWC and collaborators has been adopted. The name 'LAND CONservation meeting' or 'LANDCON' has been agreed upon in a recent worldwide voting. WASWAC established 10 guidelines for organizers who have to meet 7 out of 10, to get the permission from WASWAC to organize a Conference under the title "LANDCON". Since 2009 until now, it has been proved that organization of such serious meetings used to be and still is a necessity.

Key words: conferences, land, conservation, guide lines, necessity.

Topic 1

LAND DEGRADATION

Keynote papers

Topic 1 - Land degradation

SOIL EROSION ESTIMATES IN A SMALL AGRICULTURAL WATERSHED

Nelu POPA[1], Dumitru NISTOR[1], Romul Mircea MARGINEANU[2]

[1]R&D Center for Soil Erosion Control Perieni, 737405, Romania,
nelu_c_popa@yahoo.com
[2]National Institute of R&D for Physics and Nuclear Engineering,
Magurele, 077125, Romania
romulus@ifin.nipne.ro

The study has been conducted in a small representative watershed located in the Tutova Rolling Hills region of Romania (46° 15'- 46° 16'N, 27° 36'- 27° 37'E) to estimate soil erosion and deposition rates on agricultural fields and to assess the efficiency of soil conservation measures. The study site comprises a range of categories of soil conservation measures according to WOCAT: strip farming, forest belts, a grassed waterway, a drainage system and an adequate agricultural exploitation road network. The first approach for assessing erosion and deposition rates was based on the comparison of the measured Caesium-137 inventories (kBq m^{-2}), along four representative transects through the study site, with a reference value that represents the inventory at a site, where neither erosion nor deposition was observed. Further, a conversional model (Mass Balance Model 3 elaborated by D.E. Walling-2007) was used to assess soil erosion rates from Caesium-137 measurements. The second approach was the use of the revised universal soil erosion equation (RUSLE) module within the IDRISI Andes software. This enabled determination of the spatial pattern of soil loss in the same basin. Calibration of both models was performed by using soil erosion data, which were carried out based on the records since 1985, from some runoff plots cultivated by conventional tillage with different crops as follows: corn, beans, soybeans, winter wheat and bromegrass.

Key words: soil erosion, Caesium-137, RUSLE.

CURRENT STATE AND THREATS OF SOIL RESOURCES IN THE CATCHMENT OF THE RASINA ABOVE THE „CELIJE"WATER RESERVOIR

Snežana BELANOVIĆ[1], Jelena BELOICA[2], Veljko PEROVIĆ[3], Nuri S. ALNAASS[4], Milan KNEZEVIC[5], Ratko KADOVIC[6]

[1] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail:snezana.belanovic@sfb.bg.ac.rs, phone:+381 113053 875
[2] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail: jelena.beloica@sfb.bg.ac.rs
[3] Institute of soil science, Teodora Drajzera 7, Beograd,
e-mail: veljko.s.perovic@gmail.com
[4] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail: nurielnaas@yahoo.com
[5] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail: milan.knezevic@sfb.bg.ac.rs
[6] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail: ratko.kadovic@sfb.bg.ac.rs

This paper presents the status of soils in the catchment of the Rasina River in relation to soil organic matter, acidification and the content of heavy metals. Heavy metals and other sulphate and nitrogen oxides reach terrestrial ecosystems by wet and dry deposition. They accumulate in the surface layers, and cause changes to the chemical composition of soil. The soil was sampled in a cross over the catchment above the „Celije" water reservoir in forest and agricultural ecosystems on dominant soil types. At each site the soil was sampled at 0-5, 5-10, 10 - 20 and 20 - 40 *cm* organic layers, by taking cores, and at each site soil profiles for soil type determination were opened. The air dried soils were milled and digested with *aqua regia* in a reflux system. The contents of heavy metals (Pb, Cd, Cu and Zn) in the extracts were determined by AAS. The VSD model was applied to assess the soil chemistry reaction and simulate the damage and recovery time delays, due to the changing acid deposition. A GIS software was used to show the spatial distribution of different acidification levels.

Key words: soil state, acidificaton, heavy metals, modelling, spatial distribution.

Topic 1 - Land degradation

SOIL ERODIBILITY ASSESSMENT AT DIFFERENT TYPES OF LAND USE ON THE TERRITORY OF MALESHEVSKA MOUNTAIN, SOUTHWESTERN BULGARIA

Emiliya G. VELIZAROVA[1],Ivan Ts. MARINOV[1],Todor Gr. LUBENOV[2]

[1]Forest Research Institute - BAS, 132 Kl. Ohridski Blvd., 1756 Sofia, Bulgaria,
velizars@abv.bg; marinbg@bas.bg
[2]Solar-Terrestrial Influences Institute – BAS,
Bl. 3 Acad. G. Bonchev str. 1113 Sofia, Bulgaria
tlubenov@gmail.com

Land-use conversion may significantly influence ecological processes and lead to changes in soil properties. Some geographical areas in South-western Bulgaria are being seriously degraded due to erosion processes caused by deforestation as a result of human activities, such as overgrazing and extensive forest utilization.

This research focuses on: 1) investigation of the variability of soil texture, organic matter and slope exposure at different land-use types and their influence on soil erodibility, based on the newly established transects, 2) maps development of soil organic carbon and erodibility through application of the geostatistic methods based on estimates (kriging) and simulations for the territory of four small watersheds within the *Sedelska* River, (tributary of the Struma River) whose basin is located in the *Maleshevska* mountain, South-western Bulgaria. The investigated land-use types were: oak branch wood management forests, pastures, abundant arable land and fallow land, which are part of the territory of the experimental station "*Igralishte*", where erosion and hydrological observations have been performed for over 30-years.

The data analysis showed that there are differences in K values, calculated for sunny and shady slopes and type of land-use. K values were higher for the soil of fallow land on southern-exposure slopes (0.043 ±0.002) (*Mg/ha*)[(*MJ/ha*)(*mm/h*)]$^{-1}$, because of the lower soil organic carbon (SOC) and clay contents. The forest lands have a lower value of erodibility (average values of the K factor for watersheds 2 and 3 - 0.029±0.0020) (*Mg/ha*)[(*MJ/ha*)(*mm/h*)]$^{-1}$. The results of a Principal Component Analysis (PCA) showed a high statistical correlation between soil texture (coarse sand clay fractions) and soil erodibility values. An increase in the soil organic matter content favours the aggregate stability and leads to lower values of the K factor.

Key words: Soil erodibility; Land use; Soil organic carbon; GIS; PCA

Topic 1 - Land degradation

TORRENTIAL AND EROSION PROCESS ANALYSIS IN LIGHT OF ONLINE DATA AVAILABILITY

Zoran GAVRILOVIĆ; Mileta MILOJEVIĆ; Nikola ZLATANOVIĆ

Intitute for Development of Water Resources "Jaroslav Černi"LTD
Department for torrent and erosion control
Jaroslava Černog street 80, 11226 Belgrade, Serbia

New technologies have enabled an easy and direct access to various data required for hydrological, erosion and other analyses. Countless scientific and professional research papers are also available from all around the world. Although, at first glance, it seems that substantial scientific progress has been made, a more detailed analysis reveals a process of replicating errors due to a number of reasons.

Analysis of natural phenomena such as erosion, torrents, climate, etc. requires research in the field. As with any other task, some kind of cost analysis must be applied. Unfortunately, field study is often reduced to a minimum on the pretext that everything can be „seen" in available satellite imagery, this most often being freely available online satellite imagery. Answers to many questions that are important for a valid analysis are being avoided, because they cannot be answered with „freely available" sources. These analyses require a broad range of data whose analysis demands the posession of expensive hardware and software, as well as appropriate training for their use.

On the other hand, numerous methodologies are in use that are „modified" without prior knowledge of the specific limitations and investigative methods that are essential components of a certain methodology. This sometimes even leads to modifications of the modified methodology.

Every professional with extensive experience can easily compare results obtained from different methods and find the method that best suits his/her needs. A more important issue are students and beginners who do not yet possess enough knowledge and experience to properly select the methods and estimate numerous coefficients that are unavoidable for every method, especially if field studies are not performed.

New technologies and data availability are very powerful tools, if used correctly. Funding is always a limiting factor of every work task and thus these freely available technologies and data must be used in combination with the more detailed, and costly, data and technologies.

This paper shows examples of typical errors that arise when avoiding field research, as well as errors due to incorrect application of some methodologies. Special attention is paid to defining the necessary ratio of field and desk work, and the use of freely available and other data in the analysis of torrents and erosion processes.

Key words: torrent, erosion, hydrology.

Papers

USING GULLY CHARACTERISTICS FOR ESTIMATING GULLY VOLUME

Azade MEHDIPOUR[1], Majid SOUFI, Hassan AHMADI

[1]Scientific & Research Branch of Islamic Azad University, Tehran, Iran.
Agriculture Engineering Research Institute. Karaj, Iran.
E-mail: azhmahdipour@yahoo.com

This research project was done to provide a regional model to estimate gully volume. Thirty gullies were selected. The situation and heights of all gullies were determined by GPS. Gully characteristics including: length, slope above headcut, drainage area, soil characteristics and the volume of gullies were determined. To determine gully volume, each gully was divided into segments and in each segment cross sections and their distance were measured. Partial volume was determined by multiplying the length of a segment with an average of a cross section. The total volume of a gully was calculated by the summation of partial volumes.

Then, the relationship between the volume of gullies and their characteristics were analyzed using SPSS. The results showed the volume of gullies had a positive correlation with the length of gullies. So, it is possible to measure the length of a gully in the field or using aerial photos to estimate gully volume. This result is in line with the results of researchers in other regions of the world.

Key words: GPS, Gully, Aerial photo.

A HYDROLOGICAL ANALYSIS OF THE WATERCOURSES IN THE REGION OF GORA - SOUTHERN SERBIA

Damir AJRANOVIĆ[1]

[1]University of Belgrade Faculty of Forestry, Kneza Višeslava 1, Belgrade
E-mail: ajranovic@orion.rs

Gora is a mountainous plateau in the very south of Serbia, on the hillsides of the Šar Mountain. The Brodska and the Restelička, two rivers which flow into the Plavska River, have their stream beds cut deeply into it. These watercourses belong to the drainage basin of the White Drim and therefore to the Adriatic Sea. Until 1999, daily monitorings of the flow rate and water level were conducted by the Hydrometeorological Service of Serbia, in the following hydrological stations: HS "Orćuša"on the Plavska River, HS "Mlike"on the Brodska River and HS "Kruševo"on the Restelička River. Climatological parameters representative of this area are recorded in the climatological station "Dragaš". In this paper a hydrological analysis of the mentioned hydrological stations i.e. watercourses will be carried out. In addition to that, the sizes of the base and direct runoff will be presented. An analysis of the flow rate and precipitation in a sequence of thirty years has been carried out. The value of the base flow has been brought into relation with the geological composition of the terrain in the drainage areas of the analyzed hydrological stations.

Key words: waters regime, precipitation, Gora, base runoff, hydrological station.

Topic 1 - Land degradation

FLOATING DEBRIS AS A NEW PARAMETER OF THE SURFACE WATER POLLUTION

Danica ZUPANSKI

Water Management Institute „Jaroslav Cerni“, Belgrade, Serbia
dzupanski@gmail.com

Many old, uncontrolled landfills are located in the riparian areas and interface land, rivers or streams. Such landfills are the source of environmental contamination by leachate and gases. In the contact with surface waters, floatable parts of waste became floating debris. We believe that floating debris should be investigated as a new parameter for quantifying surface water pollution. In this paper we present conceptual models of transportation mode for leachate, gaseous and floating debris from landfills: Okucje in the Bajina Basta county, Sljunkara in the Ljubovija and the Main landfill of Loznica county. We found that an overflow of dams is crucial transport mechanism for floating debris on the Drina River catchment area of 19,579 km^2.

A preliminary landfill risk assessment was done for better understanding the source-pathway-receptor linkage. Because current risk assessment methodologies do not consider the risk from floating debris, we adopted the methodology proposed by the EPA Ireland, 2007. They found that the distance from the landfill to the surface water is the main parameter affecting the risk score.

We present the results of the monitoring of the amount and type of floating debris from 2009-2011, found in three reservoirs of hydropower plants, and assess the amount of floating debris which entered the Drina River, each year. The volumes of the leachate were calculated per year, according to Jahic (1980), and the volumes of landfill gaseous debris were calculated according to the empirical data used in Serbia. According to the results of the preliminary assessment and conceptual models, different approaches were proposed as mitigation measures for the restoration of damaged riparian areas.

The trans-boundary Drina River has a regional environmental problem of the pollutions transport by media water, which needs a River Basin Management Plan according to The Water Framework Directive, 2000/60, EC.

key words: surface water, floating debris, risk assessment

Topic 1 - Land degradation

DETERMINATION AND MAPPING OF THE HYDROLOGIC SOIL GROUPS FOR REPRESENTATIVE WATERSHEDS OF THE STRUMA RIVER BASIN, BULGARIA

Emiliya G. VELIZAROVA[1], Krasimira M. NIKOLOVA[2],
Irena G. ILCHEVA - MICHAJLOVA[2],
Ivan Ts. MARINOV[1], Ivan I. NIKOLOV

[1]Forest Research Institute, Bulgarian Academy of Sciences
[2]National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences
velizars@abv.bg

Forests have an important role in water conservation and movement because they stabilize soil and filter stormwater runoff. The expected climate changes will alter the quantity, quality, timing, and distribution of water. Hydrologic soil group classes are used in the computation of runoff by the Soil Conservation Service (SCS) method (known at present as the Natural Resources Conversation Service (NRCS)). The purpose of this investigation is to identify and map hydrologic soil groups (HSGs) for representative watersheds of the Struma river basin. The maps of the hydrologic soil groups for 7 representative watersheds on the territory of Struma river basin have been designed using digitalised soil data information about: soil differences, water transmitting soil layer, depth to any layer that is more or less water impermeable, the rock fragments content, based on soil mapping unit and tools of the Arc View version 9.0. Criteria for classification of the studied territory based on infiltration rates into the four hydrologic soil groups - A, B, C and D, were provided by Soil Surveys from NRCS. The results of our study show that the biggest part of the watershed territory (57.3 %) is classified as hydrologic soil group B, having a moderately low runoff potential due to moderate infiltration rates. About 23 % of the studied territory has a high runoff potential due to very slow infiltration rates and is assigned as group D. These soils are shallow with nearly impermeable parent material. Soils having a low runoff potential due to high infiltration rates (group A) occupy only 7.0 % of the territory, while those with a moderately high runoff potential due to slow infiltration rates (group C) cover 12.2 % of the territory of representative watersheds. The Statistical analyses performed exhibited high positive correlation of deciduous forests (R^2 =0.89) with HSG A, while erosion and soils with a depth less than 30 cm contributed to an increase in the areas assigned to HSG C. Accurate determination and spatial distribution of HSGs are of great importance for adequate forest management decisions and activities concerning the expected climate change.

Key words: hydrologic soil groups, Struma river basin, GIS, multiple regression analysis

THE EXPANSION OF BRAZILIAN AGRICULTURE: SOIL EROSION SCENARIOS

Gustavo H. MERTEN[1] & Jean P.G. MINELLA[2]

[1]Institute of Hydraulic Research, Federal University of Rio Grande do Sul, PO Box 15029, Postal Code 91501-970 Porto Alegre, RS, Brazil; merten@iph.ufrgs.br;
[2]Department of Soils, Federal University of Santa Maria, Postal Code 97105-900, Santa Maria, RS, Brazil; jminella@gmail.com

During the next 10 years Brazil will undergo an expansion in its agricultural area to meet the increased domestic and worldwide demand for food, fuel, and fiber. The choices made now as regards land use will determine the degree to which this expansion is accompanied by increased erosion, sediment yield, and degradation of important ecosystems. This paper presents an up-to-date inventory of soil erosion in Brazil by crop system and provides estimates based on different hypothetical management scenarios to accommodate the expansion of Brazilian agricultural activity by the year 2020.

Key words: Land use; conservation agriculture; degraded pasture.

Topic 1 - Land degradation

HEAVY METALS IN SOILS OF PROTECTED AREAS IN CENTRAL SERBIA

Hana J. PETERSKI[1], Milica A. ŽIVANOVIĆ[1], Dragana D. VIDOJEVIĆ[2]

[1] University of Belgrade, Faculty of Geography, Studentski trg 3/III,
11000 Belgrade, Republic of Serbia,
hanapeterski@gmail.com; milicazivanovic90@gmail.com
[2] Ministry of Environment, Mining and Spatial Planning,
Environmental Protection Agency, Ruže Jovanovića 27, 11160 Beograd,
Republic of Serbia,
dragana.vidojevic@sepa.sr.gov.yu

The environment is polluted by many organic and inorganic compounds, including heavy metals that accumulate in all parts of the ecosystem. Soil contamination by heavy metals is particularly threatening because the land as a natural resource is the substrate for growing plants. Using the available data on soil quality and locations of landfills and other polluters as possible causes of soil contamination in central Serbia, we established a Geographical Information System in order to assess the quality of soil in protected areas and the level of degradation. The character of the input data (which also include the natural content of metals in soil) prevents us from reaching firm conclusions on whether the soil contamination is of anthropogenic origin. The concentrations of pollutants in protected areas have been compared with their concentrations on extremely degraded surfaces (Kolubara coal quarry). The main objective of this paper is the assessment of geospatial relationship between contaminated and protected areas and identification of existing and/or potential pollution using GIS tools. Since there is still no systematic soil monitoring in Serbia, this work might initiate the establishment of a spatial database on soil quality in protected areas of central Serbia. Thus, in addition to soil conservation, other components of the environment would be protected, as well as biodiversity in general.

Key words: Soil contamination, heavy metals, protected areas, environment, central Serbia.

Topic 1 - Land degradation

CHANGES IN THE PROPERTIES OF ERODED SOILS IN A LONG TIME PERIOD

Ilyusya GABBASOVA[1], Manfred FRUEHAUF[2], Ilgiz KHABIROV[3]
Ruslan SULEYMANOV[1], Peter LIEBELT[2]

[1]Institute of Biology, Ufa Research Centre, Russian Academy of Sciences
[2]Martin-Luther-University Halle-Wittenberg, Institute of Geosciences, Department of Geoecology
[3]Bashkir State Agrarian University, Department of Farming and Soil Science
[1]rusoils@rambler.ru, [2]manfred.fruehauf@geo.uni-halle.de, [3]ilkhabirov@yandex.ru

The Southern Pre-Urals are the region characterized by aggressive water and wind erosion, being one of the major soil destructive factors. The scale of erosion can be judged from the following data. The total land resources in the Republic of Bashkortostan amount to 14297.4 *ths ha*, of which 7342.9 *ths ha* (51.37 %) are occupied by agricultural lands, 3600 *ths ha* (25.18 %) are threatened by erosion, 3300 *ths ha* (23.08 %) are liable to water erosion, 1050 *ths ha* (7.35 %) to wind erosion, and 12 *ths ha* (0.08 %) to both water and wind erosion.

Water-induced soil erosion is spread mainly in the Southern Pre-Urals whereas wind erosion is characteristic of the Cis-Ural region. At present, potentially possible soil washoff amounts to 9.6 *t/ha* per year, or 45.5 MT of melkozem from all over the ploughing area.

Regarding the development of erosion the general regularity in changing agroecological soil properties is the reduced thickness of humus horizons, humus and nutrient losses; in this case moderately eroded soils are susceptible to further degradation to the highest degree. During long-term agricultural use their state depends therewith on soil cultivation and rotation practices. In the podzolic and typical chernozems under grain-row crop rotation and traditional soil cultivation with the prevailing real tillage procedure, the humus reserves in the plough-layer have reduced from 4-6 % in the uneroded soils to 33 % in the moderately eroded ones.

Key words: soils, water and wind erosion, humus and nutrient losses.

Topic 1 - Land degradation

LAND POLLUTION AND DEGRADATION DUE TO MINING ACTIVITIES IN SERBIA

Ivica M. RISTOVIĆ

University of Belgrade, Faculty of Mining and Geology, Djusina 7, 11000 Belgrade
E-mail: ivica@rgf.bg.ac.rs, Tel.: +381 11 3219199; Fax: +381 11 3241121

Increase in modern civilization's demand for the energy and minerals results in huge exploitation of the energy raw materials, metals, nonmetals and thermal water as a generator of the geothermal energy.

Mining industry is one of the biggest environmental polluters. Exploitation of the mineral resources is a huge environmental risk to water, air and land. Land use, degradation and pollution are present in all phases of mining activities, i.e., mineral resources investigation, exploitation, transportation and utilization. Land use changes and the process of degradation as a result of mining activities take a few decades but they are temporary.

The mining industry in Serbia is going through transition and modernization, and it is not in accordance with modern technological development in developed countries, due to decades of tradition in neglecting environmental protection aspects. This paper presents a number of adverse environmental effects, due to mining activities with particular attention to land degradation, and activities and measures for their prevention and land protection. The appliaction of advanced exploatation, transporatation and production methodologies of minerals, best management practices for slug deposition, modernization of the conveyance process and safe disposal of the waste generated during the processes would very likely decrease the adverse effects of the mining industry.

Key words: land, degradation, pollution, mining activities.

CHARACTERISTICS OF BASIFICATION PROCESSES IN SOME FOREST COMMUNITIES IN THE AREA OF MIROČ MOUNTAIN

Olivera KOŠANIN, Milan KNEŽEVIĆ, Rade CVJETIĆANIN

University of Belgrade, Faculty of Forestry
olivera.kosanin@sfb.bg.ac.rs

In addition to natural pedogenetic factors, the effect of anthropogenic factors on soil and also on all other environmental components has been very high over the past several decades. The deposition of substances reaching the soil from the atmosphere can result in significant changes in soil characteristics. Soil reaction is especially susceptible and liable to changes under the effect of atmospheric deposition. Soil reaction is one of the most important factors that affect the soil properties and soil genesis, as well as plant increment and yield.

The processes of soil acidification caused by anthropogenic factors are far more present worldwide than basification processes. In beech and sessile oak forests in Serbia, acidification processes are as a rule more or less marked in the surface soil horizons. Previous studies (Knežević and Košanin, 2008) reported on the presence of basification processes at the localities in the region of north-eastern Serbia (Majdanpečka Domena and NP "Đerdap"). According to the same authors, the study area is under a strong effect of local polluters, which have an acute effect on forest soil, and also under the effect of the pollutants carried by air currents from different sources in Romania.

This paper presents and analyzes the results of the changes in active and substitution acidity of the soil in the forest ecosystems of the area of Miroč Mountain, located in the far north-east of Serbia, at the border with Romania. The study results show the presence of the process of basification at the studied locality, i.e. that the surface soil horizons have the highest pH values.

Key words: soil reaction, forest ecosystems, basification, atmospheric deposition.

Topic 1 - Land degradation

FLOOD RISK ASSESSMENT USING GIS: A CASE STUDY OF THE NISAVA RIVER SECTOR IN SERBIA

Milica V. MARKOVIC[1], Jelica M. DJURDJANOVIC[2]

[1]Public Water Management Company "Srbijavode", 2 Kralja Aleksandra Square, 18000 Nis, Serbia,
email: milica.markovic@srbijavode.rs
[2] Faculty of Civil Engineering and Architecture, University of Nis, Aleksandra Medvedeva 14, 18000 Nis, Serbia,
email: jelica.djurdjanovic@gmail.com

In the last decades, almost a third of all human losses as a result of natural hazards in the world are victims of flooding. Material damage is measured in billions of dollars. The frequency of flooding increases due to climate change, urbanization and the impact of other natural and anthropogenic factors. Floods are natural phenomena which cannot be prevented. However, through the right measures one can reduce their likelihood and limit their impacts. The 2007/60/EC directive aims to reduce and manage the risks that floods pose regarding human health, the environment, cultural heritage and economic activity. In this study, following the Directive, hydrological, hydraulic, economic, topological and land use data for the Nisava River sector are processed using GIS tools and flood inundation and hazard maps are generated to assist flood risk management. The main goal of this study is to raise the awareness of present and future users of inundation on the flood risk degree, anticipated conditions for construction in flood zones and possible protection measures.

Key words: risk assessment, GIS, flood hazard.

ANALYSIS OF TORRENTIAL FLOODS ON THE RIVER PČINJA AND ITS TRIBUTARIES IN TRGOVIŠTE, SOUTHERN SERBIA IN MAY 2010

Milutin STEFANOVIĆ, Mileta MILOJEVIĆ,
Irina MILOVANOVIĆ, Jelena ČOTRIĆ

Institute for the Development of Water Resources „Jaroslav Černi",
11226 Beograd (Pinosava), Jaroslava Cernog 80, Serbia
tel. /fax (+381) 11-3906-461, milutin.stefanovic@jcerni.co.rs

The territory of Serbia is endangered by erosion processes and frequent torrential floods. The confined zone that is menaced by torrential floods occupies 50,000 km^2 of the total 88,000 km^2 of the territory of Serbia of.

Fully organized erosion control activities in southern Serbia began in 1907, including complex works on riverbeds and involving extensive biological and engineering activities in torrent catchments. Administrative measures of erosion control were then implemented for the first time. Extensive works were performed in order to regulate torrents that until then regularly crossed railway and roadway traffic. Eroded surfaces were protected by biological and engineering works.

Orographic features of the terrain create conditions for the generation of torrential floods, such as the Pčinja River near the town of Trgovište. The Pčinja River is a left tributary of the Vardar River, with only one fifth of the catchment in Serbian territory.

This paper will present an analysis of the torrential flood that occurred in May 2010, when extensive precipitation from the Former Yugoslav Republic of Macedonia generated torrential flooding that caused great damage to the infrastructure and agriculture of the area, along with immediate threats to the population and properties.

Key words: torrential flood, erosion control.

Topic 1 - Land degradation

AN OPEN-SOURCE APPROACH TO ECOHYDROLOGICAL ANALYSIS OF UNGAUGED DRAINAGE BASINS IN SERBIA

Nikola ZLATANOVIĆ, Milutin STEFANOVIĆ, Zoran GAVRILOVIĆ

Institute for the Development of Water Resources "Jaroslav Černi"
zzznikola@gmail.com

Drainage basins are for the most part ungauged or poorly gauged, not only in Serbia but in most parts of the world, usually due to insufficient funds, but also the decommission of river gauges in upland catchments to focus on downstream areas which are more populated. Predictions in ungauged or poorly gauged catchments are not only highly uncertain but very data-intensive. Hydrological analyses of these catchments usually require vast amounts of data such as landscape data, land use, various soil data, meteorological data, discharge measurements etc. Accurate data of this type is usually either scattered between different institutions, incomplete, or sometimes even non-existent, resulting in more time spent on collecting and cataloging data than on actual hydrological modelling.

This paper deals with the application of freely available datasets on the global, European and local level coupled with open-source GIS (Geographic Information Systems) software in hydrological modelling, greatly improving cost and time effectiveness. The method presented utilizes the SRTM (Shuttle Radar Topography Mission) digital elevation model with near-global coverage for landscape and terrain topography, CORINE (Coordination of Information on the Environment) Land Cover dataset with European coverage together with soil, meteorological and hydrological data, as input parameters for the NRCS (National Resources Conservation Service) method for estimating runoff predictions in ungauged basins. The methods presented form a very cost-effective and solid basis for further ecohydrological analysis (e.g. effects of deforestation and urbanization, biodiversity resilience, flood control, pollutant transfer etc.).

Key words: ecohydrology, ungauged basins, open source, SRTM, CORINE.

Topic 1 - Land degradation

LONG-TERM IMPACTS OF LAND DEGRADATION BY MINE TAILINGS: A CASE STUDY IN THE TIMOK WATERSHED

Nina NIKOLIC*, Ljiljana KOSTIC KRAVLJANAC, Miroslav NIKOLIC

Institute for Multidisciplinary Research, University of Belgrade,
Kneza Viseslava 1, 11030 Belgrade, Serbia;
*correspondence to nina@imsi.rs

Failures of tailing dams, followed by a discharge of metal mining waste into the local river systems, have severely degraded large areas of alluvial arable land worldwide, and concomitant studies of soil pollution are abundant. Yet, it is seldom feasible to study the long-term fate of such contaminants and their actual impact on the quality of agricultural land under field conditions.

We will report the results of the case study from an exceptional research locality (the Timok watershed, Serbia) where pyrite-rich Cu tailings from the Bor copper mine had been deposited over alluvial fields during almost 50 years of regular annual flooding, and no remediation undertaken.

Detailed surveys of soil properties and vegetation (species abundance, biomass, foliar analyses) were conducted within a gradient approach framework, and the results were jointly analysed by multivariate statistics. We were able to identify clear and consistent patterns of change in soil properties and responses of both crop plants and spontaneous vegetation which could not have been demonstrated by other studies published so far (Nikolic et al., 2011; Nikolic & Nikolic, 2012). We shall focus on two aspects of our findings: 1) The major soil limiting factors for cropping and their trends along the spatial and land use-intensity gradient, and 2) The process of spontaneous restoration of this land (including the conceptual model of vegetation successions) and its relevance for sustainable land use planning.

We shall discuss the implications of our results for a "would be" scenario on similar mining-affected sites, especially long term pollutant dynamics in conjunction with actual land use and potentials for spontaneous recovery if this degraded land is left to its own devices.

Key words: land degradation; soil pollution; mining waste; copper; pyrite; gradient analysis; spontaneous restoration.

GEOENVIRONMENTAL INVESTIGATION AT A LOCALITY OF A SMELTER UNDER RECONSTRUCTION IN BOR (EAST SERBIA)

Petar PAPIĆ[1], Zvonimir MILIJIĆ[2], Jana STOJKOVIĆ[1], Jovana MILOSAVLJEVIĆ[1], Maja TODOROVIĆ[1], Marina ĆUK[1], Željko KAMBEROVIĆ[3]

[1] University of Belgrade, Faculty of Mining and Geology, ppapic@rgf.bg.ac.rs
[2] RTB Bor group
[3] University of Belgrade, Faculty of Tehnology and Metallurgy

The goal of these geoenvironmental investigations was to identify and determine the degree of possible contamination present in the areas of a plant planned for redevelopment. The degree of contamination also included a determination of whether the soil underlying the investigated areas would be considered a hazardous waste. The secondary goal was to determine the level of contamination in the surface dust accumulated on the abandoned buildings being prepared for demolition. On the basis of the results, the principal contaminants of concern were heavy metals. Other contaminants were noted as being potentially present in some areas and they included fuels and oils, PCBs, VOCs, PAHs and some pesticides (atrazine and simazine). In borehole soil samples, Pb, Hg, As and PCB were above the action level (according to the New Dutch list) in many samples. The contaminated soils should mainly remain *in situ* and undisturbed, since groundwater leaching would not appear to be a significant issue. According to TCLP (leaching of heavy metals from soil) there would be a negative impact to workers during demolition and construction activities. According to geochemical and geomechanical investigations, the possibility of relocating the plant was recommended for consideration, and it was necessary to excavate the contaminated soil.

Key words: soil, geochemistry, heavy metals, organic pollutants.

THE ĐERDAP 1 FLOWING STORAGE RESERVOIR DEPOSIT REGIMEN AND MORPHOLOGY MODIFICATION

Predrag M. RADOSAVLJEVIĆ*, Zoran N. NIKIĆ**,
Ratko U. RISTIĆ**, Boris P. RADIĆ**

* HPP Djerdap Co, Trg Kralja Petra 1, 19320 Kladovo. Serbia. E-mail: predrag.radosavljevic@djerdap.com
**University of Belgrade, Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade. Serbia.

The Đerdap 1 is an artificial flowing reservoir formed in 1972 by a dam across the Danube at Kladovo between Serbia and Romania for power generation and navigation through the Đerdap Gorge. The Danube and the tributaries form a complex system. Under the average hydrologic conditions in the reservoir, the mean flow rate is 5860 m^3/s and the storage is 3.5 x 10^9 m^3 through a length of 315 *km* from the dam to Novi Sad. The Danube upstream of the dam drains an area of 577,000 km^2. The sedimentary deposit laid down on the reservoir floor consists of different erosion products from the area of the population of more than eighty million, including large cities of Belgrade, Budapest and Vienna, and of developed industry and agriculture. The sediment transport by the river has changed both upstream and downstream of the dam. Suspended sediment depositing in the Đerdap 1 reservoir is far more abundant than the stream load. Its concentration is continuously observed over the year at representative psammite gauging stations on the reservoir and its main tributaries. The reported deposition regimen is based on the records from seven psammite gauging stations: four tributary inlets (upstream of Novi Sad on the Danube, Sremska Mitrovica on the Sava, Titel on the Tisa and Ljubičevski Most on the Velika Morava), two control stations on the reservoir (Stari Banovci and Smederevo) and one outlet (on the Đerdap 1 Dam). The analysed period is from 1974 (beginning of systematic measurement) to 2010. The morphology modification of the Danube and the mentioned tributaries' channels are considered from the beginning of the reservoir to date. The chemical composition of the riverbed deposit is also given. The rate of sedimentation is interpreted under the prevailing conditions in the reservoir. A trend of future sediment deposition in the reservoir, based on the available data synthesis, is indicated, as well as its effect on the immediate environment.

Key words: the Đerdap 1 reservoir; suspended sediment; deposit regimen; trend sediment deposition; morphology modification.

Topic 1 - Land degradation

CHEMICALLY DISSOLVED AND SUSPENDED LOAD IN THE MLAVA RIVER BASIN

Predrag MANOJLOVIĆ[1], Sanja MUSTAFIĆ[1],
Jelena LUKOVIĆ[1], Marko MILOŠEVIĆ[2]

[1] University of Belgrade Faculty of Geography, Studentski trg 3/III, 11000 Belgrade
[2] Institute of Geography "Jovan Cvijic", Serbian Academy of Art and Sciences,
Djure Jaksica 9, 11000 Belgrade
peca@gef.bg.ac.rs

This paper deals with the ratio between suspended and dissolved load in the Mlava River basin. The Mlava drainage basin covers the area of 1,830 km^2. The sampling was carried at three profiles (Zagubica, Gornjak and Petrovac) in the period from October 2001 to November 2002. The Mlava River is generally characterized by low discharges. However, in the period of investigation higher discharges were recorded.

Following weather conditions great discharges were particularly high at the end of January and the beginning of February, and at the end of April, June and August. The amount of chemically dissolved substances was 2.5 higher than the amount of suspended load. In contrast to the suspended load the dissolved load showed annual variability.

The biggest discharge was recorded in June. During that period the suspended load was 2.6 times greater than the dissolved load. This amounted to 72 % of the total suspended load, and only 7.4 % of the dissolved load.

Key words: dissolved load, suspended load,the Mlava drainage basin, Serbia

Topic 1 - Land degradation

THE INFLUENCE OF SOIL ORGANIC CARBON ON SOIL ERODIBILITY OF FOREST SOILS IN THE CATCHMENT OF THE RASINA

Ratko KADOVIĆ[1], Snežana BELANOVIĆ[2] ,
Stanimir KOSTADINOV[3], Jelena BELOICA[4],
Mirjana TODOSIJEVIĆ[5]

[1] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail:ratko.kadovic@sfb.bg.ac.rs,
[2] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail:snezana.belanovic@sfb.bg.ac.rs, phone:+381 113053 875
[3] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e- mail:stanimir.kostadinov@sfb.bg.ac.rs,
[4] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail:jelena.beloica@sfb.bg.ac.rs,
[5] University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail:mirjana.todosijevic@sfb.bg.ac.rs,

The aim of this study is to determine the effect of soil carbon on soil erodibility of forest soils in the Catchment of the Rasina. The Soil was sampled in the cross over the catchment above the „Celije" water reservoir in the forest ecosystems on dominant soil types. At each site the soil was sampled at 0-5, 5-10, 10 -20 and 20 - 40 *cm* organic layers. The soil samples for C analysis were air-dried, sieved, handpicked to remove fine roots, and then ground in a ball mill. SOC was measured using the Tyurin method (for mineral layers). The soil granulometric fractions were separated using the combined method of sieving using 0.2 *mm* mesh sieves and via the pyrophosphate pipette B-method, after the removal of organic matter and calcium carbonates. Soil erodibility was callculated using the Wishmauer and Smith (1978) model, and simple calculating relation was proposed by Römkens *et al.* (1986) and revised by Renard *et al.* (1997), as well as the equation from the EPIC model (Sharply and Williams, 1990, Williams and Renard, 1983, cit. Zhang *et al.*, 2011).

Key words: erosion, soil erodobility, soil organic carbon.

DETERMINATION OF THE RAINFALL EROSIVITY FACTOR (R) IN THE REGION OF BELGRADE AND VRANJE - APPLICATION OF THE USLE METHOD IN SERBIA

Sonja Z. BRAUNOVIĆ, Mihailo RATKNIĆ

Institute of Forestry, Kneza Višeslava 3, 11030 Belgrade, Serbia
sonjabraunovic@yahoo.com, mihailoratknic@yahoo.com

Rainfall erosivity was determined by calculating the factor of rainfall erosive power (R) based on pluviograph data of rainfall episodes recorded by a raingauge during a sequence of 20 years at Climatological stations in Belgrade and Vranje. All >5 mm and >30 min rain episodes were analyzed by the USLE method (quantity, duration, mean intensity and maximum 30-minute intensity for 1018 recorded rain events), and the results obtained have been compared.

The determination of the R factor, as well as of other USLE parameters, enables the calculation of soil loss, as well as the planning of alternative methods of land use in the aim of soil conservation.

Key words: erosivity, rainfall erosivity factor (R), kinetic energy (E), land use, USLE.

INFLUENCE OF THE WEATHERING CHANGE TREND ON EROSION AND ITS THREAT TO WATER QUALITY

Svetlana VUJEVIĆ[1], Ana PAVLOVIĆ[2], Srđan KOLAKOVIĆ[3]

[1]Department of Civil Engineering, Faculty of Technical Sciences Novi Sad, Serbia
[2]Department of Civil Engineering, Faculty of Technical Sciences Novi Sad, Serbia, annaftn@uns.ac.rs
[3]Department of Civil Engineering, Faculty of Technical Sciences Novi Sad, Serbia, kolak@uns.ac.rs

The most important characteristic of Nature Parks is their integrity and untouched ecosystems. The threats to all such natural beauty are changes coming from external sources. Climate change affects both the physico-chemical water quality, also directly affecting the temperature of water. Indirectly, the physical and chemical processes related to the temperature in the water column will cause change. Changes that are expected to occur include increased rates of (bio-) chemical processes, a decrease in oxygen concentration and changes in the stratification patterns.

The changing hydrology will indirectly affect the physico-chemical water quality. At one, extreme, flood peaks can cause more erosion, resulting in increased turbidity and concentrated pulses of pollutants. This will create challenges to water treatment plant operators ability to produce safe drinking water. All studies on soil erosion show that the expected increase in rainfall intensity will lead to greater rates of erosion. Additionally, the shift of winter precipitation from less erosive snow, to more erosive rainfall, (due to increasing winter temperatures) will enhance erosion. At the other extreme, lower summer and fall flows may result in greater concentrations of contaminants during these seasons. These changes in streamflow timing may require a new approach to discharge permissions and non-point source pollution.

In general, it is expected that climate change will reduce the physico-chemical water quality.

This paper outlines the necessity of multi-layered analytical methodologies that aim to preserve Natural Park Resources and prevent their degradation.

Key words: weathering, climate change, erosion, water quality, hydrology, water resources, land and water quality degradation.

Topic 1 - Land degradation

MULTICRITERIA SPATIAL ANALYISIS OF EROSION RISK TO A ROAD NETWORK

Tatjana KOJCHEVSKA[1], Christos CHALKIAS[2], Ivan BLINKOV[3]

[1]Department of Environmental Management, Mediterranean Agronomic Institute of Chania, Alsyllio Agrokepiou PO Box 85, Chania 73100, Crete, Greece
e-mail: ivatatjana@yahoo.com
[2]Harokopio University of Athens, Depatrtment of Geography,
70 El. Venizelou Str., Kallithea- Athens
Post Box 17671, Greece
[3]University Ss. Cyril and Methodius University in Skopje, Faculty of Forestry,
Skopje, bul. Aleksandar Makedonski bb, MK-1000 Skopje, RM

The facilitation of tourism requires investments in road construction and maintenance. Many human activities including road construction remove vegetation from an area, making the soil susceptible to erosion. This study was conducted on Gavdos Island in the Medietarrenean Sea near Crete. Vast areas of Mediterranean Europe, including the island of Gavdos, have been affected by erosion in the last few decades. In order to understand the behavior of erosion it is necessary to identify the physical and anthropogenic processes that have acted on the land and their interrelations. The reliability and vulnerability of critical infrastructures have as well attracted a lot of attention recently. In order to assess these issues quantitatively operational measures are needed. Such measures can also be used as guidance to road administrations in their prioritization of maintenance and repair of roads, as well as for avoiding unnecessary disturbances in the planning of roadwork. This problem is one of the multiple processes overlapping at different temporal and spatial scales and different systems. This study focused on different factors of erosionability by using remote sensing data (digital data) and an analog map of Gavdos Island with a 1:50000 scale. The multi criteria analysis method is examined in order to investigate two main scenarios of erosion risk on roads to be produced, using erosion factors as follows: slope and aspect, stream network, distances and geological and vegetation (land cover) data for the study area of Gavdos Island and data for road/path network in 3 layers (paved roads, well paved gravel road and footpaths). The data were treated in few stages: digitizing, spatial analyses, weighing and reclassifying. All of the pervious stages and different steps at every stage are summarized in the chart by a Model Builder of Arc Map showing the different layers as input and output at every step and stage. The vector data for roads/paths were rasterized as well as the overlap with final output for erosion risk analyses. Then, pixels were derived from road layers that belong to high erosion risk area. The first result of this study was the erosion risk map of the whole area in the raster format. The second result is derived part of the road/path network that belongs to the high

erosionability area prone to damages. The third result is that, according to the analyses, 23% of paved roads, 34% of well paved gravel road and 43% of footpaths belong to the highly erodible area. The resulting maps represent the most risky areas with the greatest demand for urgent intervention by the authorities responsible for road maintenance.

Key words: multicriteria decision making, erosionability, GIS modelling.

A HYDROLOGICAL ANALYSIS OF A SMALL WATERSHED WITH THE PURPOSE OF EROSION USING A GEOGRAPHIC INFORMATION SYSTEM

Tekin SUSAM

Gaziosmanpaşa University, Faculty of Engineering and Natural Sciences,
Department of Surveying Engineering
e-mail: tekin.susam@gop.edu.tr

As it is known, Geographic Information System (GIS) techniques allow effective integration of various data for calculating the erosion potential of the area of interest. This study has been done in a small catchment in the province of Tokat inTurkey. It has a severe erosion and flood risk. This study is aimed at determining some physical and hydrological characteristics of the watershed that are used to calculate the erosion potential using GIS. In this context, information derived by GIS techniques can help researchers to prepare a resource database for erosion reducing the time and costs and helping them in linking those data with other types of data related to erosion. It was also observed that the scale of digitial elevation data used plays a great role in the accuracy of data derived from it.

Key words: GIS, Hydrology, Erosion, DEM

THE ORIGIN OF RIVER SEDIMENT AND ITS HYDRAULIC TRANSPORT

Vojislav ĐEKOVIĆ, Aleksandar ANĐELKOVIĆ, Neđo MILOŠEVIĆ,
Jelena ĐEKOVIĆ KERNALIS, Milica MARINKOVIĆ

University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
vojislav.djekovic@sfb.bc.ac.rs

The yield of erosion material in hilly and mountainous drainage basins depends on various factors, but first of all on bedrock type, condition and preservation of vegetation, and the energetic potencial of the formed surface flows. Sediment detachment and its downstream transport from its place of origin is under the impact of the gravity force and the stream turbulent characteristics. The study presents the effect of sediment geomechanical characteristics and the geological structure of the drainage basin on the river sediment characteristics, the degree of particle rounded texture and size, as well as the transport mechanism of the abrasive sediment under the influence of hydrologic-hydraulic factors of the stream in the profiles of the Gvozdačka River and its tributaries on Goč Mt. in Serbia.

Key words: sediment particle-size composition, bedload, tractive forces.

AN ANALYSIS OF ARIDITY INDICATORS IN THE DELIBLATO SANDS

Yousef Mansour Ali BOHAJAR[1], Petar SPASOV[2], Ratko KADOVIĆ[1],
Snežana BELANOVIĆ[1], Olivera KOŠANIN[1]

[1]University of Belgrade Faculty of Forestry, Kneza Viseslava 1,
e-mail: ratko.kadovic@sfb.bg.ac.rs
[2]Republic Hydrometeorological Service of Serbia,
Kneza Višeslava 66, 11000 Belgrade

The Deliblato Sands are located in the southern part of Banat region in the province of Vojvodina. According to the estimated changes of basic climate parameters in this part of the Republic of Serbia, a very strong growth in annual air temperatures (T), with an average of 0.52°C per decade, was recorded during the past decades. This growth of temperature has increased the potential evapotranspiration (PET), which together with precipitation can increase the degree of aridity of the climate in the considered area. However, during the same period, an increase in the annual precipitation sum (P), with an average of about 35 *mm* per decade was observed, which may somewhat slow down the aridisation of desert sands. Considering the nature, origin and significance of the Deliblato Sands ecosystem, the main goal of this paper is to analyze the drought and aridity index (AI = P / PET), analyze the trend of the aridisation process and its possible impact on the ecosystems of this special nature reserve. The aridity index analyses were performed for the meteorological station Banatski Karlovac, Vrsac and Bela Crkva, for the period 1981-2010, at the annual values and for the growing season. The results showed that the Deliblato desert sands (Banatski Karlovac) stand at a higher frequency of arid years (AI < 0.65) compared to the locations of Vršac and Bela Crkva. On the other hand, the level of aridity has considerably increased during the vegetation period, both in the desert sands and in their surroundings. This intensified aridity is the result of considerable increase in potential evapotranspiration (PET) in relation to seasonal precipitation.

Key words: Deliblato sands, aridity indicators, soil degradation, forest ecosystems.

Topic 1 - Land degradation

AN APPROACH FOR FLOOD HAZARD MODELING ON RIVER OUTFALL STRECHES

Zsuzsanna ENGI, Franci STEINMAN

West-transdanubian Water Directorate, Szombathely,
Vörösmarty u. 2. 9700 - Hungary
engi.zsuzsanna@nyuduvizig.hu
University of Ljubljana, FGG, Department of Built Environment,
Ljubljana, Hajdrihova 28. 1000 - Slovenia,
franci.steinman@fgg.uni-lj.si

The EU Flood Directive in its current flood hazard maps preparation approach neglects the possibility that the main channel of a river may change its course over time. In reality, however, relocation of the main channel course can occur in various sections. To address this issue, a method that considers temporal change of the channel line and expansion of the inundation area was developed and is the object of this work.

The presented method is based on the concept that measured silting-up process and its historical development should be used for the hydraulic modeling of the outfall stretches of watercourses, at least where such processes are identified as significant. Results of geomorphologic studies can be used for the calibration of a hydraulic model, if documented flood events could be associated with the data of sediment samples' age determination. Different old maps, especially historical maps and military surveys, provide topographic data of the inundation area for historical flood events modelling, while the consequences of anthropogenic interventions to the course of the riverbed can as well be identified by sediment analysis. The latter allows determination of the age of sediment layers, and sources of contaminants and natural materials. The aim is to determine relations between the floods and change of channel course in the inundation area. A research of the historical development of flood plains can be performed by a synthesis of hydraulics, topography and other sciences, implementing geomorphologic research methods into hydraulic modeling of flood plains.

The results of hydraulic models and data from historical topographic maps could be compared with geomorphologic results to verify the historical dynamics of watercourses and the process of silting-up. The relationship obtained between the process of flooding and variation of the riverbed should prove that flood-prone areas have a distinctive time-dependent dynamics, and that flooded areas therefore require a specific consideration. This work should result in a proposed new approach that will be an upgrade of the current steady-state based approach to the preparation of flood hazard maps.

Key words: flood hazard, flood plain, modelling, sedimentation, historical maps.

AN APPROACH FOR GIS BASED CONVERSION OF EROSION DATA PRODUCED BY THE EPM METHOD TO A WEIGHT MEASURE (Preliminary results)

Ivan BLINKOV[1], Tatjana KOJCHEVSKA[2],
Bozin TRENDAFILOV[2], Ivan MINCEV[1]

[1]Ss.Ciryl and Methodius University, Faculty of forestry – Skopje,
bul."Alexandar Makedonski "bb. 1000 Skopje, Republic of Macedonia;
E-mail: ivanblinkov@yahoo.com
[2]Mediterranean Agronomic Institute of Chania,
Department of Environmental Management,
Alsyllio Agrokepiou PO Box 85, Chania 73100, Crete, Greece

Various methods of erosion risk assessment are in use through the world. The most widely used method in the world is USLE with its variants (MUSLE, RUSLE), while in the recent period some new approaches such as PESERA, MESALES and G2 were developed in Europe. However, common characteristic of the above methods is that erosion rates are expressed in *t/ha*. On the other hand, in the ex-SFRY counties, the EPM (Erosion Potential Model) model that recognizes various erosion processes (sheet, rill, gully although mass movement...) is dominantly used, and annual erosion rates are expressed in m^3/km^2.

The main aim of this study was to develop an approach, for the conversion of an already performed estimation of erosion rates and produce an erosion map according to the EPM method in *t/ha*, using all specifics of working in a GIS environment. A preliminary test-study was done on a small basin with an area of about 10 km^2. To be in accordance with other approaches the annual quantity of produced erosive material "E" (According to the EPM methodology) was used. The preliminary estimation of "E" was done using standard methodology and the basic vector database reclassified and rasterized according to the EPM method needs. Besides, soil map and volume mass of the topsoil layers of these soil types was used for conversion. The same GIS procedure (vectorizing and rasterizing) was used in the estimation. Usage of this approach in a larger scale basin is an on-going process. The most difficult usage of this approach is data conversion in areas with rock falls and landslides, because of the difficulty of deriving them using Remote Sensing techniques. This approach with further improvement could be used for conversion of the existing erosion maps (prepared using the EPM method) of the Balkan countries.

Key words: erosion, EPM, GIS.

Topic 2

LAND CONSERVATION

Keynote papers

THE FORESTRY TECHNIQUES SYSTEM OF TORRENT CONTROL IN GREECE (CATEGORIES - HISTORICAL EVALUATION - FUNCTIONALITY - PERSPECTIVES)

Panagiotis STEFANIDIS

Institute of Mountainous Water Management and Control,
Faculty of Forestry and Natural Environment,
Aristotle University of Thessaloniki, PO Box: 268, 54124, Greece.
stefanid@for.auth.gr

Greece is a mountainous country with heavy rainfalls, small forest cover (only 18%) and sensitive geological support. This is the reason for the country's torrential character. Therefore, it has intensive erosion and soil-denudation due to numerous torrential streams and torrents (more than 1000), which flow through the country and transport and deposit 86.000.000 m^3 of soils every year.

The torrential action of these streams had incalculable disasters as a result. The Forest Services of Greece, which are responsible for the management of mountainous watersheds, have implemented the forestry technique system of torrent control for protection against floods and erosion since 1931. This system contains: rural technical, planting technical and technical works.

Rural technical works: stairs, ditches, clayonnage and mattress

Planting technical works: reforestation, farming and management of forests and forest land for better soil protection.

Technical works: bars check dams on the bed of the streams, sediment control dams, beam dams, training walls, aprons, bank revetments, embankments.

With the combination of these works at the watersheds and torrents bed, torrent control and the stability of soils have been achieved.

This paper presents the categories of the works which have been constructed from 1931 until now, their historical evaluation, their functionality and future prospects.

Key words: erosion, torrent control works.

TORRENTS AND TORRENTIAL FLOODS IN SERBIA: CHARACTERISTICS AND POSSIBILITIES OF THEIR CONTROL

Stanimir KOSTADINOV[1], Ana BORISAVLJEVIC[1], Dragan MLADJAN[2]

[1]University of Belgrade, Faculty of Forestry, Kneza Viseslava 1, 11030 Belgrade
[2]Academy of Criminalistic and Police Studies, Cara Dušana 196, 11080 Belgrade

Torrential floods are the sort of natural disasters in Serbia with the most frequent occurrence and often with severe social, economic and environmental consequences. Torrents and torrential floods are the consequence of the intensive erosion processes in the watershed. Over 12,000 torrents, which by floods inflict enormous damages and often cause casualties, are indentified in Serbia. A number of torrential floods were analyzed. However, most of these events are poorly documented, mainly described with some photos with no measured data. Although the population and national economy are highly affected by torrential floods, there is no consistent collection of data and database on torrential floods in Serbia even nowadays. In this paper data collection strategy and characterization of large scale torrential floods are presented defining their frequencies, as well as recommendations for torrential flood control. This work resulted in the first inventory of torrential floods in Serbia and its analysis.

Key words: torrents, torrential floods, inventory, frequency, mortality.

Topic 2 - Land conservation

BEHAVIOUR OF KNO_3 FERTILIZER IN SOIL BY THE VIEW OF LAND CONSERVATION

Sevilay HACIYAKUPOGLU[1], A.Beril TUGRUL[1], A. Filiz BAYTAŞ[1],
Ferhat GÖKBULAK[2], Nesrin ALTINSOY[1],
Nilgun BAYDOĞAN[1], Bülent BÜYÜK[1]

[1]Istanbul Technical University, Energy Institute, Ayazaga Campus, TR-34469, Istanbul, TURKEY,
[2]Istanbul University, Faculty of Forestry, 34473, Bahçeköy, Istanbul, TURKEY,
E-mail: haciyakup1@itu.edu.tr (corresponding author)

It is known that, plants need a number of different chemical elements from the soil. Without nitrogen, phosphorus and potassium, the plant simply cannot grow adequately. If any of the macronutrients are missing or are hard to obtain from the soil, this will limit plant growth. In nature, to make plants grow faster, what you need to do is supply the elements that the plants need in readily available forms. But, in many cases amounts of some essential elements in the soil are not enough. In that case, fertilization is necessary. One of the mainly used fertilizers is potassium nitrate (KNO_3) which is a source of nitrogen and potassium, two important macro nutrients for the plants. Of course, the fertilizing mechanism and behavior of the KNO_3 fertilizer in the soil is important.

In this study, we aimed to observe diffusion of the KNO_3 fertilizer in soil samples by using the radiotracer technique. Soil columns were prepared in the laboratory conditions. To produce the radiotracer ^{42}K, potassium nitrate compound was irradiated at ITU TRIGA Mark II nuclear research reactor at Energy Institute of Istanbul Technical University. The irradiated potassium nitrate samples were sprinkled to the surface of soil columns. Then, the soil was watered with representative amounts of water according to selected rain regimes in Turkey. Radioactivity measurements were carried out by using high efficiency gamma radiogauging system at the outside of the column for different soil depths in different times.

As a result, this study successfully observed behavior of the KNO_3 fertilizer in soil. The experiments were evaluated for different depths, and also for different rainy conditions comparatively by the view of land conservation.

Key words: Fertilizer, land conservation, potassium, radiotracer, TRIGA.

Papers

Topic 2 - Land conservation

USAGE OF INORGANO BENTONITES FOR LAND CONSERVATION MEASURES IN SELENIUM REMOVAL

Esra ORUCOGLU[1], Sevilay HACIYAKUPOGLU[2*]

[1] Istanbul Technical University, Faculty of Mines, TR-34469, Maslak, Istanbul, Turkey
[2*] Istanbul Technical University, Energy Institute, TR-34469, Maslak, Istanbul, Turkey
E-mail: haciyakup1@itu.edu.tr (corresponding author)

Sustainable land and water management fresh water and land resources require conservation. The amount of available land and water resources decreases every day due to the increasing industrial usage that is in proportion with the growing world population. Especially mining activities provide particularly important contribution to this contamination if the necessary precautions and remediation are not taken during and after the mining activities.

Coal mining and its usage for power generation lead to a lot of unwanted soil and water pollution. Selenium, as one of the toxic trace materials, can be exposed during coal related activities and it has detrimental effects on aquatic living species at low levels due to its mobility in soil, toxicity, bioaccumulation and biomagnifications properties. Bentonite minerals are commonly used as a geotechnical barrier in mining activities. Since bentonite could not adsorb anionic species and selenium has anionic species in aqueous environment, in this study the improvement of Turkish Resadiye sodium bentonite with inorganic compounds under different experimental conditions was investigated. The batch adsorption method was used to determine the selenium adsorption ability of modified products. The high-resolution gamma spectroscopy system was used in the measurements.

Evaluation of the data obtained from the study showed that the usage of modified bentonite provided a significant increase of selenium adsorption capacity, depending on the production and experimental conditions. Therefore, the results of this study will contribute to scientific and technologic rehabilitation works by implementing land conservation measures.

Key words: Coal mining, sustainable land management, land conservation, selenium.

CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES THROUGH INTEGRATED WATERSHED MANAGEMENT PROGRAMME (IWMP) IN ODISHA-INDIA

Gala Bhaskar REDDY
Director, Odisha Watershed Development Mission
Email: bhaskar@worlp.com

Niranjan SAHU
Manager, GIS, Odisha Watershed Development Mission
Email: niranjan@worlp.com

Integrated Watershed Management Programme (IWMP) is under implementation in Odisha, India since 2009. It follows Common Watershed Guidelines for Watershed Development-2008 of the Ministry of Rural Development (MoRD) of the Government of India. India has 8.5 million hectares of rainfed areas out of the 142 million hectares of net cultivated area. An insight into the rainfed regions reveals a grim picture of poverty, water scarcity, rapid depletion of ground water table and fragile ecosystems. Land degradation due to soil erosion by wind and water, low rainwater use efficiency, high population pressure, acute fodder shortage, poor livestock productivity, underinvestment in water use efficiency, lack of assured and remunerative marketing opportunities and poor infrastructures are important concerns of these rainfed areas. The challenge in rainfed areas therefore is to improve rural livelihoods through participatory watershed development with a focus on Integrated Farming Systems enhancing income, productivity and livelihood security in a sustainable manner.

A close analysis of various types of rainfed situations would reveal that soil and water conservation, watershed development and efficient water management are the key to sustainable development of rainfed areas. The watershed approach has been accepted as a major theme for the development of rainfed areas, with a view to conserving natural resources of water, soil and vegetation by mobilising social capital. Various studies have pointed out the central preoccupation of watershed development projects with soil and water conservation and relative neglect of issues relating to balanced use of natural resources and livelihoods.

Integrated Watershed Management Programme (IWMP) puts emphasis on participatory watershed management in a cluster of about 5000 hectares to realise larger impacts with effective institutional delivery mechanisms. Inclusion of the livelihood component for the assetless and landless brings in inclusive development at the community level. Thus, conservation and management of natural resources through integrated watershed

management is looked at as a sustainable development process of rural development and poverty alleviation.

Key words: Integrated Watershed Management, Natural Resources, Sustainable Development, Poverty alleviation, Rural Development.

THE EFFECT OF RANGE MANAGEMENT ON ORGANIC CARBON CONTENT IN DEGRADED SOIL

İrfan OĞUZ[1], Rasim KOÇYİĞİT[1]

[1]Gaziosmanpasa University, Agricultural Faculty,
Department of Soil Science and Plant Nutrition, Tokat, Turkey,
irfan.oguz@gop.edu.tr
[2]Gaziosmanpasa University, Agricultural Faculty,
Department of Soil Science and Plant Nutrition, Tokat, Turkey,
rasim.kocyigit@gop.edu.tr

Degradation of soil and plant vegetation is a serious problem in grasslands at the Central Antolian Region of Turkey. Soils and plant vegetation in this region are highly degraded due to uncontrolled heavy grazing. Measures should be taken to restore the degraded grasslands to effectively prevent desertification in this region. This study was conducted to evaluate treatments; fertilized + planted + protected from grazing (A), Fertilized + protected from grazing (B), protected from grazing (C), and grazed (D) on soil organic carbon content between 2005-2008 years at Sivas, Turkey. The results showed that the total organic carbon content was affected by some rangeland management applications and this effect varied during the study period.

Key words: Grassland management, soil organic carbon, desertification.

EFFICIENCY OF EROSION CONTROL MEASURES IN THE LAND CONSOLIDATION PROCESS IN THE CZECH REPUBLIC

Jana KONEČNÁ, Jana PODHRÁZSKÁ,
Dagmar STEJSKALOVÁ, Petr KARÁSEK

Research Institute for Soil and Water Conservation,
Lidická 25/27, 602 00 Brno, Czech Republic,
e-mail: konecna.jana@vumop.cz

After the year 1989 state and cooperative farms were disbanded and the soil came back into private property in the Czech Republic. To stimulate agricultural business and farming in new political conditions it was necessary to clear up land ownership, consolidate fragmented and narrow parcels, and make blocks of accessible fields. The process of land consolidation started for this purpose. Complex land consolidation in a cadastre is initiated by land owners´ petition and it is managed by land offices. This process complies with the land consolidation act No. 139 of 2002. It states 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 implementation of protective and ecological measures. To judge efficiency of expended financial resources the Ministry of Agricultural supports research project No. QI92A012 aimed at evaluating the results of execution of erosion and flood control measures in the frame of rural countryside. Twenty five cadastres with at least one built erosion or flood protection measure have been chosen for this purpose. They are spread all over Bohemia and Moravia to represent various natural and anthropic conditions of the Czech Republic. The unified method is used for the evaluation of efficiency of those water and soil protective measures.

Key words: land consolidation, erosion control, protective measures, efficiency.

REGULATION OF GULLIES AND TORRENTS AND IMPACT OF E-75 HIGHWAY CONSTRUCTION ON EROSION PROCESSES IN THE GRDELICA GORGE

Jelena COTRIC[1], Irina MILOVANOVIC[1], Nikola ZLATANOVIC[1]

[1]Institute for Development of Water Resources Jaroslav Cerni,
Jaroslav Cerni st. 80, Belgrade
E-mail: jelenacotric@gmail.com

The section of E-75 Highway from Caričina Dolina to Vladičin Han is 14.5 *km* long. In the first part of the section which is 6 *km* long, the route passes through the Grdelica Gorge in the Južna Morava valley.

There are over 200 gullies registered in the area of the Grdelica Gorge. These gullies have been in the most part rehabilitated after catastrophic torrential floods with the implementation of various biological, biotechnical and technical works. The main focus of this particular design project were 25 torrential rivers and 40 gullies, all tributaries of the Južna Morava River. The Grdelica Gorge is well known for its problems with infrastructure protection. Heavy torrential rains that occurred in the past century have caused transportation disruption that even lasted for months at a time.

These specific problems forced the then governments of Yugoslavia and Serbia to enact a special law on the regulation of torrents in the Grdelica Gorge and the Vranje valley in 1952. A large number of works have been carried out until 1968. As a result, the problem has been addressed only to the extent that conformed with minimal requirements for protection from torrents. This approach was acceptable only in those sections where previous complex anti-erosion works existed over the whole catchment area.

The anti-erosion works carried out in this period were effective. A balance was accomplished and as a result, during the past decades no catastrophic torrential floods occurred that could cause disruption of traffic.

The Grdelica Gorge has always been viewed as an area of complex torrential and erosion problems. Although torrential and erosion rehabilitation has been carried out over the entire catchment area, this does not mean that erosion and torrents are “gone”, but rather that torrents of excessive categories have been reduced to medium intensity. In this way, problems of regulating the crossings of such torrents with railways and highways have been reduced.

The E-75 highway construction works will cause a new disturbance in the downstream sections of said torrents.

Key words: torrential flood, highway, erosion control.

SUSTAINABLE MANAGEMENT OF SOIL RESOURCES IN MOUNTAINOUS AREAS OF WESTERN SERBIA USING CONSERVATION MEASURES

Mirjana TODOSIJEVIĆ[1], Miodrag ZLATIĆ[1], Nada DRAGOVIĆ[1], Vukašin MILČANOVIĆ[1], Tijana ANDRIJANIĆ[1]

[1]University of Belgrade, Faculty of Forestry, Belgrade, Serbia
E-mail: mirjana.todosijevic@sfb.bg.ac.rs

Sustainable way of utilization of soil resources is a dynamic concept that provides the best solution for meeting future needs of food production, while maintaining environmental quality and productive capacity of soil resources. Soil resources as the basis of life on Earth are central to the strategy of sustainable management of the Republic of Serbia.

The mountainous region of western Serbia is exposed to the process of erosion as the dominant type of soil degradation. Hence, the soil losses are high, and productivity is decreased.

We studied soils characterized by different types of use in the watershed of the Trešnjica River. The threat of the process of soil erosion, prior to the application of conservation measures, is presented using the USLE soil loss model, as well as the degree of erosion hazard (DEH). Soil productivity is shown by the index after Pierce (Pierce, *et al*. 1983). The calculated soil losses were compared with soil loss tolerance. Tolerable soil loss is the loss that is assessed in relation to the depth of the soil profile. It amounts to 0.2 -1 *mm* per year after Wischmeier (Wischmeier and Smith, 1978). These losses correspond to the speed of creation of the new layers of soil in the process of pedogenesis (Kadović, R.1999).

After the application of conservation measures (contour planting of raspberry, blackberry, plum, blueberry and hazelnut) the soil losses were reduced by up to 20 times. On the basis of that, a new principle of economic activity, which is based on the principles of conservation of natural resources, was confirmed (Soil Management for Sustainability).

Key words: sustainable management, soil resources, erosion, losses of soil, conservation measures.

TORRENT CONTROL WORKS AT THE REGION OF PELOPONNESE (GREECE) AFTER A FOREST FIRE OF 2007

Panagiotis STEFANIDIS*, Marios SAPOUNTZIS, Fani Tziaftani, Stefanos STEFANIDIS

Institute of Mountainous Water Management and Control,
Faculty of Forestry and Natural Environment
Aristotle University of Thessaloniki, PO Box: 268, 54124, Greece. stefanid@for.auth.gr

In Greece forest fires are a permanent and always growing environmental problem that represents the greatest threat for Greek forests. This is primary due to the Mediterranean climate of our country with the dry and warm summers. Moreover the past 30 years due to socio-political conditions their devastating repercussions are aggravated exponentially.

During the last years the culmination were the fires at Sithonia 1985, Thasos 1986, Rhodes 1987, 1988, 1992 and 2008, Kassandra 1990, 2006, Thessaloniki 1997, Korinthos 1998 and at Peloponnese and Evia 2007. At Peloponnese the fire in August 2007 is a dreary record at the worldwide history of forest fires with almost 2.000.000 acres of burned area and the loss of 67 human lives.

One of the most important consequences of forest fires are the destruction of the protective mantle of forest vegetation. This contributes to an increase in flood risk and accelerated erosion because the drops of rain did not inhibit from the protective shield of forest vegetation, crash into the valuable forest soil which detached and was transported from the torrential streams and deposited at the plain areas.

Immediately after the fire which burst at Peloponnese the research group of the Laboratory of Mountainous Water Management and Control of the Faculty of Forestry and Natural Environment of Aristotle University of Thessaloniki studied and constructed anti-erosion and flood control works in two small torrents (Ekklisia and Gipedo) within the limits of fire-affected Figalias Municipality.

The works that have been constructed are the following: 2000 meters of log barriers in the watersheds of small torrential streams between the settlements of “Faskomilias” and “Neas Figalias” and specifically at the torrents “Ekklisias” and “Gipedo”. At the main stream of torrent “Gipedo” 2 wooden dams were constructed with a height of 1*m*, 1 concrete dam cover with dry masonry with the height of 1,5*m* and 1 beam dam was made of longitudinal and transverse steel bars with a height of 1*m* covered with dry masonry. At the stream “Ekklisia” 4 small beam dams were constructed, made of longitudinal and transverse steel bars at the main watercourse.

The purpose of the present paper is to assess the effectiveness of the torrent control works which were constructed after the fire for the protection of infrastructures after intense rainfalls.

From our study it can be concluded that the works which were constructed held a significant amount of sediments during the first rains of autumn. Moreover we have to mention that this is the first time dams were constructed from steel bars in Greece. These works seem to be effective and more economic, so we can use them in other similar studies with similar conditions.

Key words: forest fire, flood risk, torrent control

GROYNE EFFECTS ON DANUBE BANK EROSION CONTROL

Radovan SAVIC*, Atila BEZDAN*, Ljubomir LETIC**,
Gabrijel ONDRASEK***, Vesna NIKOLIC**

* Faculty of Agriculture, Department of Water Management ,
Trg D. Obradovića 8, 21000 Novi Sad, Serbia;
E-mail: rassa@polj.uns.ac.rs
** Faculty of Forestry, Belgrade, Serbia
*** Faculty of Agriculture, Zagreb, Croatia

The bed of alluvial lowland streams was formed in its own layers of sediment and is therefore highly erodible, subject to ongoing processes of fluvial erosion and morphological changes. In these processes, which occur under the influence of different factors, there is a shift in the alignment and contour of the river bed. These changes often take place in an undesirable direction, cause damage and are contrary to the intended use of watercourses or user's interests. Work on the regulation of watercourses and regulatory structures controls erosion processes, stabilizes riverbed and vulnerable river reaches receive planned features and bringing to purpose.

This paper analyzes the effects of groynes, river regulation structures, on the sector of the Danube from *km* 1255 (Novi Sad) to *km* 1433 (state borders of Serbia, Croatia and Hungary). Locations of over 70 groynes, grouped in 25 groyne systems, were found on the satellite maps, and the effects achieved by filling groyne fields were discussed. The size of sedimented areas in all groyne structures along the river has been shown. Areas of about 310 *ha* on the left, and 240 *ha* on the right bank (total of over 550 *ha*) have been formed by suspended deposite sedimentation in groyne fields. The percentage average fill-in of groyne fields is 58.7% on the left, and 39.9% on the right Danube bank. Most groyne fields are filled-in by 40-60% (8 of 25 systems), and by 60-80% (7 of 25 systems). On groyne fields with sedimentation greater than 40%, perennial vegetation has developed on newly-formed areas. On groyne fields with sedimentation greater than 50%, a connection of deposited areas with the existing bank has been formed, and a new bank has been developed.

Key words: Danube, groyne (groin), sedimentation.

LONG-TERM RESPONSE OF SOIL ORGANIC CARBON TO TILLAGE AND ORGANIC FERTILIZERS IN NORTHERN TURKEY

Rasim KOCYIGIT[1], İrfan OGUZ[2], Ömer Faruk NOYAN[3]

[1]Gaziosmanpasa University, Agricultural Faculty,
Department of Soil Science and Plant Nutrition, Tokat, Turkey,
rasim.kocyigit@gop.edu.tr
[2]Gaziosmanpasa University, Agricultural Faculty,
Department of Soil Science and Plant Nutrition, Tokat, Turkey,
irfan.oguz@gop.edu.tr
[3]Middle Black Sea Gateway Zone Agricultural Research Station, Tokat, Turkey

Tillage systems and type of organic fertilizer application can have significant effect on soil organic C content. The objective of this study was to determine the long-term effects of conventional and reduced tillage systems and animal and green manure applications on soil organic C content under the same plant rotation under semi arid conditions. In this study, some soil physical and chemical properties were analyzed after ten years of this study. Three plant rotations (Potato, Sugar beet, winter wheat) have been applied to the study plots. Tillage and organic fertilizers were applied as three replications and soil samples were taken from 0-20 and 20-40 *cm* depths in spring. Total carbon, soil organic C and inorganic C contents were determined. Greater total soil C content was observed under reduced tillage and animal manure applied to plots at 20-40 *cm* depths. However, greater total soil C in conventional tillage was obtained in plots where green manure was applied at 0-20 *cm* depths. Generally, conventional tillage produced lower soil organic C compared to reduced tillage. The plots where green manure was applied had greater soil organic C compared to ones with animal manure. The greatest soil organic C was determined under reduced tillage and plots with green manure. Overall, in the long run different tillage and organic fertilizers are applied to soils. Soil organic C content is significantly affected by the tillage system and type of organic fertilizer in semi arid conditions of Northern Turkey.

Key words: Organic carbon, tillage system, soil management.

LANDSCAPING AND RECLAMATION OF LANDFILL SITES TECHNICAL RECLAMATION OF LANDFILL SITES

Rossitsa Tsvetkova PETROVA[1]
Svetlana Viktorovna ANISIMOVA[2]

[1]University of Forestry, "Soil Science" Department,
e-mail: rpetrova_fri@yahoo.com
[2]University of Forestry, "Parks and Landscape Construction" Department,
e-mail: sanisimova@mail.bg

A large amount of urban solid waste, industrial non hazardous and construction waste materials has been disposed daily. Landfills are the only method for disposing urban solid waste in Bulgaria and the main method for treating other types of waste materials. According to data from the Ministry of Environment and Water of Bulgaria the amount of waste disposal for the period from 1999 to 2004 is estimated to 19,226 thousand tones. Negative terrains, gully slopes or river beds are used as landfill sites.

The case study presented investigates the Veliko Tarnovo Region in Bulgaria. Climatic, geological, hydrologycal, hydrogeological and pedological researches were conducted. A reference to the local vegetation community types was made. Reccomendations and practical solutions for technical landfill reclamation are given on the basis of the results.

Key words: landfill, damaged terrains, urban solid waste, reclamation.

THE QUARRIES – MANAGEMENT OF MINING INDUSTRY WASTE PRODUCTS

Rossitsa Tsvetkova PETROVA[1], Vladimir Metodiev ILINKIN[2]

[1]Department of Soil Science, University of Forestry, Sofia, Bulgaria,
rpetrova_fri@yahoo.com
[2]Department of Soil Science, University of Forestry, Sofia, Bulgaria,
ilinkin@mail.bg

Open mining requires integration of the approaches and techniques for recultivation with the future use of the restored terrains. Thus, the planned activities for decommissioning and recultivation of mining industry sites need to consider the structural integrity of the remaining mining infrastructure and the subsequent use of the land in an environmentally safe manner.

This report presents results from the analysis of „Chepintsi" quarry for mining of inert materials (sand and gravel).

The study investigated the possibilities for stabilizing the remaining bevels, waste sludge, as well as for the management of soil resources.

The results show that through partial utilization and through the application of technical methods for sludge consolidation, anti-erosion strengthening of the dry bevels of the non-functioning swaths of the quarry, and judicious management of soil resources, it is possible to mitigate significantly the negative impact of the mining activity and achieve physical stability of the beveled terrains in preparation for the subsequent landscape development.

Key words: quarries, physical stability, technical recultivation.

SOC AND AGGREGATE DYNAMICS IN NORTHWEST INDIA

S.S. KUKAL (sskukal@rediffmail.com)
Department of Soil Science
Punjab Agricultural University, Ludhiana-141004, India

The soil organic carbon (SOC) and its fractions are good indicators of soil quality and environmental stability. Among the factors affecting SOC pool and fluxes in a watershed, land use changes and soil erosion are of importance. The differences in SOC and its fractions among different land uses can help to understand the process of carbon sequestration. A study was conducted in Typic Ustochrepts of Northwest India to understand the impact of forest, grassland, agricultural and eroded lands on aggregate stability and SOC fractions. The undisturbed soil aggregates were sampled from different land uses in a watershed in Shiwaliks of lower Himalayas. The stability of these aggregates was determined by shaking under water and by single simulated raindrop technique. The SOC and its fractions were determined in aggregates of different sizes as well as in bulk soils.

The stability of aggregate as mean weight diameter (MWD) and SI_{SRT} (stability index) was highest in surface soils (0-15 *cm*) of grasslands followed by forest, agricultural and eroded lands. The WSA >2 *mm* (water stable aggregates > 2 *mm*) were highest (17.3%) in grasslands and lowest (0.85%) in eroded lands. The eroded soils had 2.2, 7.4 and 3.4 times higher amount of micro-aggregates (WSA < 0.25 *mm*) than agricultural, forest and grassland soils, respectively. The SOC significantly decreased by 20% in forest and 44% in agricultural lands from that in grasslands. In subsoil (15-30 *cm*), the SOC in eroded, agricultural and grasslands was statistically similar. The SOC stock in the subsoil (15-100 *cm*) was of significance. The grassland soils could store 41 Mg ha^{-1} SOC stock compared to 31 Mg ha^{-1} in the subsurface layer. This difference widened in forestland, where subsoil contained 73.4% of total SOC stock in a 100 *cm* soil profile. Among all the SOC fractions studied, labile carbon was mostly affected by erosion and was 91.6% lower in eroded lands than that in grasslands. The magnitude of aggregate associated organic carbon decreased with aggregate size in all the land uses. Among the SOC fractions, the aggregate stability under simulate raindrop impact could better be explained ($R^2 = 0.78$) by hot water soluble carbon whereas the water stability of aggregate could better be explained ($R^2 = 0.69$) by particulate organic carbon.

Key words: carbon, indicator, soil qulity, environmental stability

EFFECTS OF DIVERSE AMELIORATIVE AFFORESTATION METHODS ON SOIL LOSS IN THE GRDELIČKA GORGE AND VRANJSKA VALLEY

Sara LUKIĆ, Stevan DOŽIĆ

University of Belgrade Faculty of Forestry, Kneza Višeslava 1, 11 030 Belgrade
sara.lukic@sfb.bg.ac.rs

Ameliorative afforestation is aimed at establishing forest vegetation on land degraded by erosion, and it is of importance in erosion control, conservation and protection of the environment.

This paper describes the effects of different ameliorative afforestation techniques on the level of soil loss decrease followings. The research was conducted on the soils of the Grdelička gorge and Vranjska valley in the watersheds of the Predejanska River, the Kalimanska River, Zla dolina 2, Lještarska valley and Momin kamen, which were afforested in the mid-1950s. The soil loss was estimated for soils afforestated by black pine (*Pinus nigra* Arnold) applying planting on bench terraces and pit planting methods. The method according to Gavrilović was applied for the estimation of the soil loss in 1967 and 2009. The comparison of soil loss obtained for the above mentioned afforestation methods showed that soil loss in 1967 was significantly lower on the pit planted soil then on the soil planted on bench terraces.

The effectiveness of each method was analyzed by comparing the soil losses in 1967 and 2009. Soil loss reduction on the sample plots planted on bench terraces in 2009 compared to 1967 year amounts to 12.65 $m^3yr^{-1}ha^{-1}$ and has statistical significance ($p<0.05$), in contrast to the reduction of soil loss (in the same period) on pit planted sample plots (5.26 $m^3yr^{-1}ha^{-1}$) that is evident, but statistically insignificant ($p>0.05$).

Key words: ameliorative afforestation, soil erosion, soil loss, plantation establishment.

SEDIMENT MANAGEMENT IN THE CATCHMENT OF THE IBAR RIVER IN SERBIA RELATED TO THE PROJECT OF HYDROPOWER SYSTEM

Prof. dr Slobodan PETKOVIĆ

Institut for Development of Water Resources "Jaroslav Černi",
Belgrade, Serbia, spetkovic@ikomline.net

The river Ibar is a medium-size river in Serbia, with the basin of about 7,000 km^2 . This river is characterized by a strong hydropower potential, based on water resources and steep slope of the river bed. The concept of utilization of the hydropower potential is determined by existing settlements and infrastructure in the river valley. As a result, a number of run-of-river hydropower plants, with a small head, have been proposed as viable solution. The planed system encompasses 10 dams and reservoirs.

Project of the hydropower system is related to several problems, which should be considered in preparatory phase of the master plan. One of the most important issues of the project is related to the sedimentation of future reservoirs. The catchment of the Ibar River is characterized by intensive erosion processes and excessive sediment yield. Thus, the sediment input from the main river and its tributaries to the future reservoirs is considerable and may cause a rapid filling of the reservoirs. This is the reason for application of sediment management measures in the watershed, which is directly related to the hydropower system.

The river streach which encompasses the future hydropower system is about 60 kilometers long, with a gross head of about 160 meters. The 10 reservoirs are located along this streach. The hydrographic network of the watershed area, which belongs to this streach, encompasses about 40 streams – direct tributaries of the future reservoirs. The catchment of the Ibar River, upstream of the streach of hydropower system, has an area of 5,500 km^2. On the other side, the watershed area, which belongs to this streach, has an area of 1,500 km^2. Thus, the main sediment input to the river streach which corresponds to the future hydropower system, belongs to the upstream part of the Ibar River basin. The sediment inflows from direct tributaries of the future reservoirs are smaller, but also important.

The concept of sediment management should take into consideration the relations between sediment input of the main river, upstream of the streach of hydropower system and input of direct tributaries of future reservoirs. The sediment transport of the Ibar River, in natural state, is known, by merasurements in the previous period. Unfortunatelly, there is no data on sediment transport of its tributaries . Thus, the sediment inflows of tributaries have to be estimated on the basis of given meteorological and geomorphic parameters, using some empirical formulas. After the comparison of annual sediment amounts of the main river and its tributaries, the concept of sediment control is proposed.

On the basis of assessement of sediment input of each tributary, the erosion control measures in the watersheds will be planned.

Key words: sediment management, catchment, hydropower system

ANALYSIS OF FORMULAS FOR THE CALCULATION OF THE SLOPE OF SILTATION OF DAM NO.5 IN THE VIDOVAČKA REKA

Svetlana L. BILIBAJKIĆ[1], Tomislav P. STEFANOVIĆ, Ružica B. BILIBAJKIĆ

[1]Institute of Forestry, Kneza Višeslava br.3, 11030 Belgrade, Serbia,
e-mail:svetlana.bilibajkic@hotmail.com

The oldest system applied for centuries is the classical European system based on the construction of transversal structures in torrent channels and the establishment of protective vegetation cover in all parts of the torrential catchment affected by strong erosion. The main role of transversal structures (dams) in torrent management is to retain bedload in siltation, migitate the longitudinal bed slope and protect torrent stream from further channel degradation. One of the most significant issues to be solved in the determination of the distance between the dams in the system is the forecast of the newly formed slope of sediment deposited behind the dam, known as the „slope of siltation" in torrent and erosion control theory and practice.

The formation of siltation is a complex process that is influenced by many factors, most significant being: natural bed slope, competent velocity, depth of flow, density of torrential water, sediment particle-size distribution and many others.

In torrent management, the designers determine the slope of siltation based on their experience, various formulas and analytical dependencies.

This paper compares the value of the slope of siltation calculated by the formulas by various authors, which are most commonly applied in practice, and the values obtained by geodetic surveying of the longitudinal profile of the slope of siltation of dam No.5 in the Vidovačka Reka.

The results of the slope of siltation calculated using the twenty formulas from different authors show that nearest value to the measured value of the slope of siltation resulted from formulas of regional analytic dependencies (Kostadinov, Biolčev) and calculation by Thiery's and Strikler's formulas. Kostadinov's regional analytic dependencies gave the results closest to the measured value. The other investigated formulas gave the result different from the measured value for slope of siltation.

Key words: dam, slope of siltation, natural bed slope, sediment particle-size distribution

Topic 2 - Land conservation

SOIL CONSERVATION MEASURES AND QUANTITATIVE ASSESSMENT OF THEIR EFFECTIVENESS

Valentin Golosov[1,2] & Vladimir Belyaev[1]

[1]Laboratory of Soil Erosion and Fluvial processes, Faculty of Geography,
Lomonosov Moscow State University, Moscow, Russia
e-mail: gollossov@rambler.ru
[2]Kazan (Volga Region) Federal University, Kazan. Russia

The problem of land degradation in different parts of the world is still very present in many countries around the world. Traditional and newly-elaborated soil conservation measures (SCM) are widely used to reduce soil losses because of soil erosion. However, in some cases it is difficult to evaluate the effectiveness of some conservation measures based on the quantitative methodology. It is in particular the problem if a SCM elaborated in one landscape is directly applied to another landscape zone, without special testing or improvements for geographical features of a given region. Some results of quantitative assessment of SCMs using integrated approach will be discussed. Advantages and disadvantages of different methods of quantitative assessment of erosion rates will be analyzed.

Analyses of the traditional and newly-elaborated SCMs applied in different countries are presented in this paper. Some aspects of on-site and of-site influence of different SCMs are discussed. River basin approach is recommended for the application of SCMs in different landscape zones of the world. Some information about the activity of UNESCO International Sediment Initiative will be presented.

Key words: Soil conservation measures, erosion, Sediment redistribution, International Sediment Initiative.

THE POSSIBILITY OF COMBINING GEO-SYNTHETICS AND PHYTO MATERIALS IN THE CONSTRUCTION AND PROTECTION OF FOREST ROADS

Vjaceslava MATIC, Bogdan STEFANOVIC

Faculty of Forestry, University of Belgrade,11030 Belgrad
e-mail: vjaceslava.matic@sfb.bg.ac.rs

The main destructive factor of decomposition construction of forest roads is water. The activities involved in the control of erosion processes forest roads are different, but are most commonly used combined methods of protection.

In this paper we analyze the possibility of combining herbal and synthetic materials in forest engineering construction and protection of forest roads. Geo-synthetics has a wide range of possible applications in construction industry, particularly in the construction of roads, but these materials had not been used in the construction of forest roads in Serbia.

A wide range allows the use of geo-synthetic materials and creates the possibility of their combining with the biological methods for the protection of forest roads. This paper provides an overview of geo-synthetic materials that can be used in the construction and protection of forest roads, as well as the analysis of possibilities of combining them with plants.

Practice shows that combined phyto and geo-synthetic materials can be used in the protection of forest roads, and the construction of structural elements of forest roads with a greater degree of risk.

Key words: geo-synthetic materials,forest engineering construction, plants materials, bioecological materials,bioengineering phyto materials,forest roads

Topic 2 - Land conservation

MODERN PHYTOENGINEERING MATERIALS FOR SOIL AND WATER PROTECTION

Vjačeslava MATIĆ, Gordana ĐUKANOVIĆ

Faculty of Forestry, University of Belgrade,11030 Belgrad
e-mail: vjaceslava.matic@sfb.bg.ac.rs

The priority of these materials is their efficiency, price, ready production and application, as well as the aesthetics and the rate of matching in the environment. This points to the necessity of their wider application in Serbia, because of the cost efficiency and supporting the world trends and achievements.The increased concern for ecology and environmental protection brought about the development in the application of vegetation materials, as well as their residues in the form of prefabricated elements in slope protection against erosion especially in urban regions.

Growing concern for ecology and environmental control encourages a wider use of vegetation as the only natural ecological and engineering protection of eroded regions which implies a wider use of willows and other tree species, as materials with remarkably good biological characteristics and wide distribution in our region. Therefore, they are used for the following living bioengineering structures: willow spiling, bundles, fascines, fascine mattresses, line planting, etc. Growing concern for ecology and environmental control encourages a wider use of vegetation as the only natural ecological and engineering protection of eroded regions which implies a wider use of willows and other tree species, as materials with remarkably good biological characteristics and wide distribution in our region. Therefore they are used for the following living bioengineering structures: willow spiling, bundles, fascines, fascine mattresses, line planting, etc.

Key words: bioengineering, biofixators, erosion, ecology, biomaterials, living structures, soil and water protection

THE QUARRIES – AN OPPORTUNITY FOR CREATING AREAS FOR RECREATION

Vladimir Metodiev ILINKIN[1], Rossitsa Tsvetkova PETROVA[2]

[1]Department of Soil Science, University of Forestry, Sofia, Bulgaria,
ilinkin@mail.bg
[2]Department of Soil Science, University of Forestry, Sofia, Bulgaria,
rpetrova_fri@yahoo.com

Studies of terrains affected by mining activity show that plant cover is restored over a long period of time, often lasting more than 25 years.

This report presents results from an analysis of climate and soil conditions in the area of an active quarry for mining of inert materials (sand and gravel). The waste product (sludge) is analyzed to determine the possibilities for its utilization for the purposes of biological recultivation.

The results show that the soil materials have moderate to poor levels of humus content, moderate to poor levels of nitrogen content, and moderate levels of absorbable phosphorus; the solution reaction varies from moderately to weakly acidic. The technological waste is characterized by unfavorable properties with respect to the overall content of organic compounds and basic nutrients. Levels of heavy metals above the maximum allowed concentrations were not detected.

The report offers recommendations for improving the conditions in the habitats and outlines the necessary ameliorative activities. Functional zoning is used to address the varying conditions by creating zones for active and passive recreation, as well as zones for different age groups. Plant species composition that corresponds to the requirements of the functional zoning is selected.

Key words: damaged terrains, biological recultivation, landscape development and public works.

CLIMATE-SMART AGRICULTURE: THE SUSTAINABLE LAND MANAGEMENT DIMENSION

William CRITCHLEY
willcritchley@hotmail.com
VU University, Amsterdam

Climate-smart agriculture is described by the World Bank as being a "triple-win"; assuring increased food production while at the same time addressing the twin climate change challenges of mitigation and adaptation. Thus, CSA is a form of farming that acknowledges the need to feed people, but simultaneously captures carbon, reduces emissions - and offers alternative forms of production that are adapted to the changing conditions. But where does sustainable land management fit in? It is argued here that SLM must be integrated into, and articulated within the discourse about, climate-smart agriculture. This is because sustainable land management is a sine qua non for any form of production (climate-smart or otherwise) in the long term. Because SLM increasingly stresses ecosystem function, its incorporation into the notion of CSA keeps an eye on the health of the landscape. But just as climate-smart agriculture is a departure from "business-as-usual" farming, should the SLM associated with CSA also change its emphasis?It is posited that sustainable land management already includes the key elements to support CSA – but some aspects, such as resilience and adaptability of systems need particular attention.

Key words: Sustainable land management; climate change; climate-smart agriculture; adaptation to climate change.

EFFECT OF ARTIFICIALLY ESTABLISHED STANDS OF LAWSON'S CYPRESS (Chamaecyparis lawsoniana (A. Murr.) Parl.) ON THE MONTANE BEECH (Fagetum moesiacae montanum, Jov. 1976) SITE ON SOIL ERODIBILITY

Zoran D. MILETIĆ D.Sc[1], Snežana A. STAJIĆ M.Sc[1],
Zlatan B. RADULOVIĆ M.Sc[1], Jelena S. MAKSIMOVIĆ B.Sc[1]

[1]Institute of Forestry, Kneza Viseslava 3, 11030 Belgrade, Serbia
Corresponding e-mail: zoranmil@ptt.rs

The effect of substitution of montane beech forest (*Fagetum moesiacae montanum* Jov. 1976) by Lawson's cypress (*Chamaecyparis lawsoniana* (A. Murr.)Parl.) on the soil properties affecting the erodibility factor was researched on four sample plots on Veliki Jastrebac mountain in south-eastern Serbia. The reserach was performed in an artificially established stand of Lawson's cypress, aged 40 years, and in the natural beech forests on dystric cambisol. Under the effect of Lawson's cypress and its dead organic residues, the content of total organic matter in the topsoil decreased by 10 *cm*, compared to that in the natural beech forest. This resulted in the decrease in stability of the soil micro-structural aggregates and the increase in soil erodibility factors.

Key words: Soil erodibility, beech forest, Lawson's cypress, artificially established stand.

Topic 3

IMPACT OF CLIMATE CHANGE ON ENVIRONMENT

Keynote papers

CONFLICTING ISSUES IN CONTROLLING LAND DEGRADATION AND GLOBAL CLIMATE CHANGES

Ildefonso Pla Sentís

Departament de Medi Ambient I Ciencies del Sol, Universitat de Lleida. Lleida (Spain)
ipla@macs.udl.es

There have been found and proposed many interactions between soil and water conservation and global climate changes. The main interactions have to do with land use and management, including aspects related to deforestations, agricultural developments and practices, cattle production and grazing, biofuel production, and other derived effects. In some of the cases contradictions appeared among their short and long term effects both in soil and water conservation and on global climate changes. The situations related to some commonly recommended land use and conservation practices and cropping systems were analyzed looking for controlling soil degradation and producing food and biofuels, with the purpose of attenuating global climate changes by reducing the emissions, or by "sequestering" greenhouse gases. Special consideration is given to some contradictions raised on the use of some practices related to land and soil cover, drainage, leveling, terracing, tillage, use of forest and crop residues and production of energy crops for biofuels. The contradictions are discussed in relation to the generalized past and present lack of integrated evaluations and predictions of the interrelated effects at short term, and particularly at long term projections, of the interactions of previewed global climate changes with soil and water conservation and food production, under different land use and management.

Key words: climate change, land use, agricultural practices, contradictory effects.

CLIMATE CHANGES AND INVASIVE PLANT SPECIES: RAISING AWARENESS OF THE PUBLIC TOWARDS ALIEN INVASIVE PLANT SPECIES IN THE CITY OF BELGRADE

Jelena TOMICEVIC[1], Ivana GUDURIC[2], Dragana SKOCAJIC[3]

[1]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia,
phone: +381 64 11 77 435, email: tomicevicj@yahoo.com
[2]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia,
e-mail: ivanag0906@hotmail.com
[3]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia,
e-mail: dragana.skocajic@sfb.bg.ac.rs

Climate change and invasive plant species pose extraordinary ecological challenges to the world today. In addition, global warming enables invasive plants to spread more widely. Biological invasions are seen as a major threat to biodiversity on a global level, while the number of new invasions is increasing at an alarming rate. Raising the awareness of the public, academic world and policy makers about the dangers caused by invasive species is essential for the creation of the support needed to implement and coordinate the policies necessary to address this problem. The aim of this study is to determine the level of local public awareness of the existence of these plant species, examine their attitudes towards alien invasive plant species and willingness to get involved in the prevention of their spreading. The survey was conducted in three nurseries and one garden center on the territory of the city of Belgrade. The population that visits the nurseries and garden center in order to buy plants were subject to the survey method. The results show that the local public is uninformed on the issue of invasive plant species. It is necessary to constantly and intensively raise their awareness of this issue, as well as the awareness of harmful consequences that may occur due to the uncontrolled spreading of alien invasive species.

Key words: climate change, awareness of the public, public attitude, alien invasive plant species, city of Belgrade.

Topic 3 - Impact of climate change on environment

EFFECTS OF CHANGES IN SELECTED CLIMATIC FACTORS ON WIND EROSION RISKS

Jana PODHRÁZSKÁ, [1]Josef KUČERA, [2]Filip CHUCHMA,
[2]Tomáš STŘEDA, [2]Hana STŘEDOVÁ, [3]Miroslav DUMBROVSKÝ

[1]Research institute for soil and water conservation, Dep. for landscape planning,
Lidická 25/27, 602 00 Brno, Czech Republic.
[2]Mendel University Brno, Zemědělská 1, Brno, 603 00 Brno, Czech Republic
[3]Technical University Brno, Veveří 331/95602 00 Brno
Corresponding author: podhrazska.jana@vumop.cz

In the context of varying values of the climatic factors, caused by changes of the climate, it can be assumed that differences in the extent of the area vulnerable to wind erosion will appear. This paper presents the results of the regionalization of areas affected by wind erosion according to the climatic and soil characteristics statistically processed for the 1901-1950 period and compared with the occurrence of erosion risk areas identified according to an updated set of climate data and their statistical treatment of the years from 1961 to 2008. The results are processed using GIS to map outputs.

Key words: wind erosion, climatic change, soil characteristics.

REGIONAL CLIMATE MODEL: IMPLICATIONS OF CLIMATE CHANGE FOR SOIL EROSION AND CONSERVATION STRATEGIES IN CENTRAL SERBIA

Ratko KADOVIĆ[1], Vladimir ĐURĐEVIĆ[2], Stanimir KOSTADINOV[1]

[1] University of Belgrade, Faculty of Forestry
e-mail: ratko.kadovic@sfb.bg.ac.rs
[2] University of Belgrade, Faculty of Physics

Climate models indicate that there will be an increase in annual temperature (+3,8°C) and a decrease (- 10-15%) in rainfall in the Central part of Serbia at the end of this century. These changes may result in warmer conditions, increasing the frequency of extreme weather events such as heavy precipitations, which emphasizes the extent to which extreme events under climate change raise special concerns about soil erosion, the late season of frost and droughts. These weather conditions will have an impact not only on agricultural production, but will also have implications on water and forest management. Warmer maximum and minimum temperatures, and particulary the drier, hotter summer, combined with heavy rainfall in spring and summer, will challenge this area to adapt. Without any adaptive strategies, biomass production and the preservation of soil quality and water resources are expected to decrease, and the impacts of soil erosion and droughts are expected to significantly increase under the future climate conditions.

In this study, the dynamical downscaling approach was applied. The Coupled Regional Climate Model (CRCM) EBU–POM (Eta Belgrade University – Princeton Ocean Model) may generate useful regional climate scenarios for the part of Europe where Serbia is located. Three CRCM runs were considered:

• a climate simulation of the 1961–1990 period with realistic historical radiative forcing (experiment 20c3m);
• a climate simulation of the 2001–2030 period according to the SRES A1B emissions scenario;
• a climate simulation of the 2071–2100 period according to the SRES A2 emissions scenario.

Key words: Regional climate change, extreme events, soil erosion, adaptation, conservation strategies.

Papers

CLIMATE CHANGES IN LIBYA: CAUSES AND RESULTS

Ali JARAD

University of Belgrade - Faculty of Geography
e-mail: aligrad1972@yahoo.com

The present paper tried to discuss the causes and impacts of climate changes in Libya and their effect on the process of desertification as a case study, as well as other causes and manifestations of desertification in Libya.

In the late 20th century, natural sciences have increasingly focused on the problems and risks of modern societies. Climate is always changing and has always been a hot topic of discussion for Scientists. It is clearly identified that the 20th century was the warmest century during the past 1000 years. It was also shown that warming pronouncedly occurred over two periods: 1910-1945 and 1976-2000. The 1990s were experienced as the warmest decade, while 1998 was the warmest individual year during instrumental records. The expected impacts of climate change will be acute in different aspects, such as biodiversity, food security, water resources and human health. Libya is potentially one of the countries most at risk from the effects of climate change, because it has limited natural resources (water and soils). It is located in the arid and semi-arid lands and more than 95 % of its people live in the coastal zone which is threatened by sea level rise.

Key words: Desertification, human health, natural resources, food security, biodiversity, Libya.

URBANIZATION OF THE KUMODRAŽ STREAM WATERSHED IN BELGRADE IN THE CONTEXT OF CITES ADAPTATION TO CLIMATE CHANGE

Andreja TUTUNDŽIĆ, Jasminka CVEJIĆ, Aleksandar BOBIĆ, Stojanka RADULOVIĆ

University of Belgrade, Faculty of Forestry,
Department for Landscape Architecture and Horticulture, Kneza Višeslava 1.
E-mail: andreja.tutundzic@sfb.bc.ac.rs

Although undoubtedly unstoppable urbanization as a consequence of the global phenomenon of the 20th and 21st centuries is in many aspects positive, urbanization also brings many negative impacts on the environment. Irrational land consumption not only leads to complex changes in habitats under the direct influence of changes in land use, but these impacts are carried to surrounding areas as well. These changes lead to changes of local character, or to loss or modifications in biotic and abiotic factors of habitats. Moreover, they have broader impacts related to the overall pollution in urban and suburban environment, increased energy consumption, degradation of agricultural and forest land, changes in water regime and microclimate, and to the very climate change.

Particularly sensitive areas are small urban streams, which have for decades been treated as problems and barriers, and not as a unique value which would be able to contribute to the quality of the city life if treated in a sustainable manner. The examples of this approach could be found in most small streams of Belgrade, while the present situation of the Kumodraž stream watershed is one of the most visible ones. Located on the border between the outer and middle city zones, this area reflects the diversity of urban areas, from the continuously built urban tissue, through undeveloped free spaces, to the discontinuous tissue of suburbs, followed by spontaneous development.

In order to present the current state of land use the Kumodraž stream watershed, the existing data from mapping and assessment of Belgrade biotopes were used, along with the field verification of the current situation. Additional information on the percentage of porous, semi-porous and non-porous surfaces in the watershed was obtained. Comparing the above data with previous conditions, collected from significant archives of data from previous studies, changing trends in the basin and proposal for possible scenarios of further development were obtained. Finally, this paper presents those models and measures which are consistent with contemporary and sustainable models of urban planning and current efforts to mitigate the effects of urbanization in relation, above all to the urban adaptation to climate change as part of the responsibility for future generations.

Key words: urbanization, climate change, biotope mapping and assessment, small urban streams, Kumodraž stream, sustainable city planning, green infrastructure.

HYDROMETEOROLOGICAL ASSESMENT ON FLOODS IN MONTENEGRO AT THE END OF 2010

Dragan BURIC[1], Vladan DUCIC[2], Jelena LUKOVIC[2*],
Predrag MANOJLOVIC[2], Sanja MUSTAFIC[2]

[1]Hydrometeorological Service of Montenegro,
IV Proleterske 19, Podgorica, Montenegro
[2]Faculty of Geography University of Belgrade,
Studentski trg 3/3, 11000 Belgrade, Serbia

Floods are the most significant natural disasters in terms of damage and persons being affected. During 2010 floods occurred in Montenegro in January, November and December. The flood in December 2010 was the greatest ever recorded. This paper examines the causes of the flood in December 2010 in Montenegro. Meteorological conditions were particularly analysed, including water levels from several hydrological stations. The analysis has shown that heavy and prolonged rainfall, snows melting, as well as human activity are the main causes of such a great flood that affected Montenegro.

Key words: flood, rainfall, water level, Montenegro.

Topic 3 - Impact of climate change on environment

FORESTS AND CLIMATE CHANGES: POLITICAL AND STARTEGIC FRAMEWORKS IN SERBIA

Dragan NONIĆ[1], Nenad RANKOVIĆ[2], Jelena NEDELJKOVIĆ[3], Marko MARINKOVIĆ[4], Vladimir MANDIĆ[5]

[1] Dr. Dragan Nonić, Associate Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: dragan.nonic@sfb.bg.ac.rs
[2] Dr. Nenad Ranković, Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: nenad.rankovic@sfb.bg.ac.rs
[3] Jelena Nedeljković, PhD candidate, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: jelena.nedeljkovic@sfb.bg.ac.rs
[4] Marko Marinković, PE Vojvodinašume, 2 Preradovićeva street, Petrovaradin, Serbia. E-mail: marko.marinkovic@vojvodinasume.rs
[5] Vladimir Mandić, graduated forest engineer. E-mail: vladimir.mandic@sfb.bg.ac.rs

In order to support effective implementation of policies and programs related to mitigation of the effects of climate changes on forests, it is necessary to review and adapt existing forest policies, strategies and harmonize laws. Also, it is necessary to properly integrate the issues caused by climate change into the strategic and legal documents of the forestry sector, in order to achieve sustainable forest management. The objectives of national forest policy related to climate changes should support the implementation of strategy on climate change, which should be consistent with other forestry objectives and international commitments.

Policy relating to the climate change is not just the responsibility of the forestry sector, but also includes many other sectors and interest groups (environmental protection, sustainable development, energy etc.). Such a cross-sectoral approach often leads to the situations in which the climate change issues are neither fully addressed in the National Forest Policy, nor the impact of the forest to the adaptation and mitigation of climate change has been extensively discussed in the strategies related to the climate change. Therefore, in order to avoid the collision goals and, more often, collision of measures for their implementation, the role and impact of forestry should be recognized in all similar strategic and legislative documents.

In this regard, the aim of this paper is to identify the existing policies and strategies on forests and climate changes in Serbia and to analyze their linkages with other strategies on climate change and, also, to identify conflicts and common interests in policies of related sectors with strategies on climate changes and actions in the forestry sector, and, finally, to identify national forest commitments to international and regional agreements on climate change.

Key words: poltical and strategicframeworks, climate changes, forest.

THE BELGRADE WATERSCAPE AND THE CLIMATE CHANGE: LESSONS FROM THE 19th CENTURY URBAN HISTORY

Dragana T. ĆOROVIĆ, Ljiljana M. BLAGOJEVIĆ
University of Belgrade — the Faculty of Architecture,
Bulevar kralja Aleksandra 73/II, Beograd
dcorovic@EUnet.rs, ljblagojevic@arh.bg.ac.rs

The paper explores the multidimensional relationship between urbanization, water and society. It is an analysis of the spatiality of the changing relation of society to water, antagonisms and conflicts emerging from it, with the aim to underline the importance of water as a resource, with the view to contemporary environmental concerns. We will examine the urban history of Belgrade in the 19th century by focusing on transformation of the waterscape. Being geographically positioned on the confluence of two major rivers, the Sava and the Danube, Belgrade's geopolitical significance has historically been bound to the shifting relations to this waterscape. Furthermore, the historical waterscape consisted of a complex web of small rivers and streams which played a significant role in the urban life and functioning of the city, but have since disappeared in the process of urbanization. In this paper we will try to reconstruct the socio-spatial water network with an insight into its physical, geomorphologic, climatic, medical-hygienic, artistic and symbolic aspects. We will also outline the first modern public water supply system originating from the foundations of the Roman and the Ottoman waterworks, establishment of public baths on the river banks and public fountains in the parks, as well as water features and devices in the city. We will highlight, from a viewpoint of architectural and town planning, the changes in the urban landscape of Belgrade, by looking into evidence of spontaneous and controlled transformations of its waterscape.

Specifically, we will focus on the case study of the Topčider River, which flows into the Sava upstream from the confluence with the Danube. While in the 19th century this river and the area around it held central political, social, cultural and natural significance, today it is one of the most degraded and polluted watercourses in Belgrade. Can we envisage the new role for this river in the contemporary studies of the climate change and the ways to adapt to it and mitigate its impacts? Are there lessons to be learned from the urban history which can point to the methods of contemporary water management, as one of the principal aspects of urban sustainability? Could the restitution of the Topčider River be considered as a legacy of sustainability for future generations? In this sense, we aim to open a discussion on contemporary waterscape as key to sustainable town planning of Belgrade today.

Key words: waterscape, landscape, Belgrade, town planning, 19th century, ecology, climate change.

Topic 3 - Impact of climate change on environment

THE IMPACT OF CLIMATE CHANGE ON THE FOREST VEGETATION OF WETLANDS

Dragana, N, ČAVLOVIĆ[1], Dragica, D, OBRATOV-PETKOVIĆ[1],
Mirjana, R, OCOKOLJIĆ[1], Vladimir, S, DJURDJEVIĆ[2]

[1]University of Belgrade - Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade, Serbia;
Phone +381 11 3053 906; e-mail: dragica.obratov-petkovic@sfb.bg.ac.rs
[2]University of Belgrade- Faculty of Physics

About 1994 Wetlands of International Importance are designated all over the world, and they are all under protection of the *Ramsar Convention* (Ramsar sites). The goal of the *Ramsar Convention* is to preserve and protect wetlands as habitats and to provide the wise use of those areas. Nine Ramsar sites have been designated in Serbia so far, for the same purpose. Forest vegetation is a very important component of wetlands, especially riverine ones, because it preserves riverbanks from being eroded, and it prevents the intrusion of non-native plants through a "buffer" zone. Forests need to be stabile in order for wetlands to remain less fragile and vulnerable.

The main objective of this paper is to find out the impact of simulated climate change conditions on the floristic structure of wetland forest vegetation.

The research took place in three different riverine wetlands in Serbia: SNR Zasavica, Peštersko polje and Labudovo okno. The parameters that were taken into account are: mean monthly temperatures, mean monthly precipitations for these locations and indicator values for the plants.

The Coupled Regional Climate Model (CRCM), EBU-POM is used for climate simulations. Exact climatic variables for the sites are determined by the downscaling method. Climatic variables reference values were taken for the period from 1960 to 1991, and climate change simulations are for the period from 2071 to 2100 (A1B and A2).

Indicator values of forest plants that were taken into consideration are humidity and temperature. Therefore, ecological optimums were determined in scales of humidity and temperature.

The analyzed results show that temperature increase, along with low summer precipitations can cause some plants to retreat from wetlands, leaving the possibility for other, non-native, plants to inhabit their places, compromising wetland stability.

Key words: climate change, wetlands, forest vegetation, floristic structure.

LAND PROTECTION AND CLIMATE CHANGES IN THE REGULATIONS OF THE REPUBLIC OF SERBIA (HARMONIZATION OF THE NATIONAL LEGISLATION WITH EU LEGISLATION)

Dragoljub Cvijan TODIĆ[1],Mirjana TODOSIJEVIĆ[2], Ana Vladimir GRBIĆ[3]

[1]Graduate school of International Economics, Belgrade,
dtodic@ymail.com
[2]University of Belgrade Faculty of Forestry, Kneza Viseslava 1, 11000 Belgrade
[3]Graduate school of State Administration, Belgrade, agrbic@megatrend.edu.rs

Relations between land protection and climate changes may be seen through the interconnection of the regulations in these two areas. Essentially observed, common elements of the regulations in these two areas are determined by the criteria of relevance of the situation in one area compared to the situation in another area. In this sense, the basis of an analysis is presented in strategic determinations of the Republic of Serbia (RS) and national legislations in the field of protection and management of land whose direct relevance to the climate change is undoubtedly assumed and there is no particular need to be proven. Width of the possible analysis can be determined primarily by the various impacts that the state of land and the implementation of the appropriate legislations in this field, have or may have on climate changes. Accordingly, this starts with the status of various categories of land, with the subject of regulation of relevant legislations in this field and the objectives, measures and instruments that specific regulations establish and further on regulate in more detailed manner. On the other hand, this paper gives a review of the basic regulations of RS in the field of climate change that are potentially important for protecting land. Due to the width of possible links between climate change and land protection, the paper points to other provisions in the environmental field that are broadly relevant to the area of climate change and land protection. In the second part of this paper, there are indications on the current state of harmonisation of national legislations with those of the European Union (EU) in the field of land protection and climate change. It starts from the strategic determinations, the general objectives of EU policy and the current state of the legal regulation of land protection and climate changes in EU regulations. Finally, the paper gives basic indications of the possible directions in further activities in the Republic of Serbia. Status membership of RS and EU in the relevant international treaties in the field of the land protection and climate change is one of the criteria for reviewing the level of its mutual harmonization.

Key words: Land, Climate Change, Environment, Legislation, Republic of Serbia, European Union.

Topic 3 - Impact of climate change on environment

EFFECTS OF DROUGHT ON WATER SUPPLY IN BEECH FOREST SOILS IN EAST SERBIA

GALIĆ Z., MATOVIĆ B., ORLOVIĆ S., NOVČIĆ Z.

Institute of Lowland Forestry and Environment,
Antona Čehova 13, 21000 Novi Sad – SERBIA
galicz@uns.ac.rs

Climatic changes in Serbia, as well as at the global level are manifasted by the increase of mean annual air temperatures, and the decrease of annual precipitation. These changes will undeniably alter habitat conditions. The study of habitat conditions is a complex problem, and there are many different ways of approaching and solving it. Bearing that in mind, we can say that the main purpose of this paper was to show the data on availability of water in soil in relation to R_{vk} in beech forests at the end of the vegetation period in 2011.

Basic climate characteristics for the territory of Serbia in 2011 were pronounced drought period from the mid-year with pronounced precipitation deficit, and incresed average monthly air temperature during the studied period.

An analysis of soil water availability in relation to R_{vk} was performed at several localtions in the associations of mountain beech forests on the most common soil types. In most cases, the acid brown soil was determined.

Data analysis on water availability in soil in comparison to R_{vk} revealed that on average it differed from one locality to another. In the seven localities studied the average value ranged from 24,42 to 29,17 % in comparison to R_{vk}.

The above mentioned figures showed that the pronounced drought period during 2011 caused a significant reduction in soil water availability in comparison to R_{vk} i.e., only 1/4 to maximum 1/3 of the total amount of water was recorded in the soils compared to R_{vk}.

Key words: climate changes, habitat conditions, beech.

* This study is results of project III 43002 financed by Ministry of Education and Science of Republic Serbia

AWARENESS OF URBAN FOREST MANAGERS ABOUT CLIMATE CHANGE ADAPTATION ISSUES IN BELGRADE

Ivana GUDURIC[1], Bernhard WOLFSLEHNER[2], Jelena TOMICEVIC[3]

[1]Faculty of forestry, Department of Landscape Architecture and Horticulture, Kneza Viseslava str 1, Belgrade, phone: +381 64 2299801, email: ivanag0906@hotmail.com

[2]The European Forest Institute Central-East European Regional Office (EFICEEC), Feistmantelstr. 4, A-1180 Vienna, Austria, e-mail: bernhard.wolfslehner@efi.int

[3]Faculty of Forestry, Department of Landscape Architecture and Horticulture, Kneza Viseslava str 1, Belgrade, Serbia, e-mail: tomicevicj@yahoo.com

Climate change has become a main driver of environmental change and it is recognized as one of the most serious challenges facing the world. It has consequences on economic and natural systems and human health. Human influence on the change of environment is becoming more evident and obvious. It has a similar effect on the urban areas that have been drastically transformed and pressured. Last century can be described as the century of urbanization. The negative effects of all those influences are reflected on urban forest resources. Forest ecosystems, in general, are one of the most important means for combating climate change. In urban areas their significance is in addition seen through the improvement of social well-being. Therefore, adaptation and mitigation measures in urban forests are very important steps in the process of combating climate change.

Adaptation capacity consists of the adaptive capacity of trees and forests and of socio-economic factors that determine the capability to implement planned activities. The aim of this paper is the analysis of current and future adaptation strategies of urban forest managers in Belgrade toward the climate change issue. The analysis of urban forestry related documents showed a very weak integration of climate change issues. It can be noted that comprehensive and systematic approach to this challenge does not exist. The awareness of managers is present to a certain extent, nevertheless, institutional and human capacities are one of the most important factors that should be developed and strengthened in order to better adapt to climate change.

Key words: awareness, climate change, urban forest management, adaptation strategies, institutional and human capacity.

Topic 3 - Impact of climate change on environment

POSSIBLE IMPACTS OF GLOBAL WARMING ON FOREST TREE SPECIES COMPOSITION IN SLOVENIA

Lado KUTNAR[1], Andrej KOBLER[2]

[1]Slovenian Forestry Institute, Dept. of forest ecology, Ljubljana, Slovenia, lado.kutnar@gozdis.si;
[2]Slovenian Forestry Institute, Dept. of forest and landscape planning and monitoring, Ljubljana, Slovenia, andrej.kobler@gozdis.si

Global warming would lead to a readjustment of the forest and tree species composition, which would affect the ecological and economic sustainability of forests. The goal of this study was to study the potential decline of the main tree species' growing stock and dominant forest vegetation types in Slovenia due to the effects of climate change. Multi-target quantitative models of growing stock and vegetation have been calibrated at the spatial level of 1 × 1 *km* quadrants with machine-learning methods from empirical data based on previous climate data (monthly & yearly average temperatures T, precipitation R, evapotranspiration E), relief (elevation, slope, exposition) and soil data. Using the models and the existing predictions of the likely future climate warming, the simulations showed changes of forest site conditions, and consequently potential tree species decline and changes of the spatial pattern of vegetation types (groups of similar forest communities) in Slovenia until the year 2100 under three climate warming scenarios: the Middle Scenario (median predicted T, median predicted R, median predicted E), the Pessimistic Scenario (max T, min R, max E), and the Optimistic Scenario (min T, max R, min E).

We predict significant alteration in forest stand species composition and forest vegetation in Slovenia, even in the case of the Optimistic Scenario. At the end of the century, the abundance of the three structurally most important species (*Fagus sylvatica, Picea abies* and *Abies alba*) will potentially be reduced by 54% to 97%, depending on the scenario and species. The suitable areas for these species will be reduced to the mountainous parts of Slovenia. Under the Pessimistic scenario, an almost total decline of *Abies alba* and *Picea abies* is predicted, whereas suitable conditions for *Fagus sylvatica* will only remain available in the high mountain belt. Under different climate warming scenarios, the share of major vegetation types (e.g. acidophilic beech forests, sub-montane beech forests, (high-)montane beech and fir-beech forest in the Dinaric region) is likely to be reduced, and the area of warmth-tolerant forests and tree species, among them the invasive species of *Robinia pseudoacacia*, will significantly increase.

Key words: forest site, tree species, vegetation, climate-change scenario, global warming, Slovenia

CLIMATE CHANGE AND FOREST ECOSYSTEMS DIVERSITY IN SERBIA

Mihailo B. RATKNIĆ, Sonja Z. BRAUNOVIĆ

Institute of Forestry, Kneza Višeslava 3, 11030 Belgrade, Serbia
mihailoratknic@yahoo.com sonjabraunovic@yahoo.com,

The current global climate models were based on the data, which prevents detailed spatial structure of the variables, mainly temperature and precipitation above the homogenous areas. In the aim of reduction of the disadvantages of the current global climate projections, it is necessary to use the regional models and models of influnce in the forecasts in the aim of quantification, accuracy and uncertainties. It is necessary to incorpate the results of these models in the activities which enable timely adaptation to the climate change and their alleviation (if possible). On the basis of models and scenarios, it can be concluded that over a relatively short period drastic change in the number and structure of the forest ecosystems in Serbia will occur. The previous concept of the multi-purpose planning system in each individual goal (general or specific) and methods for achivement must be analyzed separately in regard to the climate change as one of the basic factors of risks. Given the above warning facts and the adverse effects of climate change in the forest ecosystems and the environment in general, these are not future goals, but the obligations of the present time. The guides to forest management planning should determine the desirable characteristics of the management system at the operational level, and the guidelines for the forest management in great detail determine the activities which should be used in forestry.

Key words: ecosystem diversity, cllimate models, biotope, climatic scenarios, forest management.

Topic 3 - Impact of climate change on environment

MASS CLONAL PROPAGATION OF ELMS FOR USE IN CLIMATE CHANGED ENVIRONMENTS

Mihailo GRBIC, Matilda DJUKIC, Dragana SKOCAJIC,
Danijela DJUNISIJEVIC-BOJOVIC

University of Belgrade, Faculty of Forestry, Kneza Viseslava 1,
RS-11030 Belgrade, Serbia E-mail: mihailo.grbic @sfb.bg.ac.rs

Due to the increasing use of intraspecies and allochthonous (mainly Asiatic) taxa of elms, caused by Dutch elm disease (DED), the study of the most suitable methods of IN VITRO propagation has been imposed. DED is itself a product of a changed environment which was a trigger for a virulence of fungus ***(Ophiostoma ulmi (Buisman) Melin & Nannf. (1934). Ophiostoma*** devastated elms throughout Europe and much of North America in the second half of the 20th century.

The lack of elms in Serbia has been generally compensated by the introduction of Siberian elm (*Ulmus pumila* L.) and its application in shelter belts. Recent investigations, however, show its invasive nature in Serbia. In Europe and the United States the problem has been rectified by use of resistant elm cultivars synthesized, as the only correct solution. Advocating for such a solution, a series of experiments were performed with explants of four elm clones: ***Ulmus 'Dodoens', Ulmus 'Lobel', U. 'Regal',*** and ***U. 'Sapporo Autumn Gold***' in three growing media- Hellers, Murashige and Skoog, and Woody plant. The concentration of auxin and cytokinin was also altered.

In selecting clones account is taken of their adaptability to climate change, which is highly customizable in Siberian elm. However, its aggressiveness is usually the reason for restricted application in the world. Its climate tolerance, on the other hand, is evident in clones in which it is one of the parents, such as U. 'Sapporo Autumn Gold' (U. pumila h U. japonica) and U. 'Regal' U. 'COMELIN'N274 (U. x HOLLANDICA' VEGETA 'x carpinifolia # 1) and U. N215 (U. pumila x carpinifolia 'HOERSHOLMIENSIS'). One of the parents of two other clones is U. wallichiana which is also known for its resistance to DED.

For all four clones an optimal medium was found that allows fast and efficient production of identical copies that unite resistance to the pathogen and broad ecological range, guarantees for survival in altered environments. The applied methods can produce more than 200,000 identical virus free copies in less than a year, in each variant.

Key words: Elm cultivars, IN VITRO propagation, nursery stock for altered environments.

LAND USE IN TRANSITION-DRIVEN URBAN DEVELOPMENT AND CLIMATE CHANGE: CONFRONTING THE DESIRED AND ACHIEVED

Mladen PEŠIĆ, PhD Student - Faculty of Architecture, University of Belgrade
e-mail: mladmix@gmail.com, tel.064-269-2100
Aleksandar KUŠIĆ, PhD Student - Faculty of Architecture, University of Belgrade
e-mail: aleksandar.kusic@gmail, tel. 0600357720

The spaces of cities once considered (or planned) as socialist areas are today being rapidly re-urbanized as part of a wide-range offensive of post-socialist development. Criticized in the times of socialism, these cities were resented for their mono-functionality, austerity of design, inhumane urban structure and an overall lack of urban atmosphere. Nowadays, it is just these issues that shape the discourse of the post-socialist city, from shopping malls to new business communities, emerging in the spaces of settlements such as New Belgrade.

This paper deals with the issues of recent, post-socialist development of New Belgrade, in the context of climate-friendly city-building. We will examine the different aspects of urban density changes occurring today in the spaces of the ex-socialist city and their influence on the sustainability of the settlement.

Starting with the theories of *Eco-City* (Richard Register, Tai-Chee Wong and Belinda Yuen) and *Compact-City* (Michael Jenks and Rod Burgess) we will investigate several aspects of the contemporary New Belgrade urban development – changes in the overall density; the presence/absence of green spaces; and changes in the traffic infrastructure. We will look into these aspects through two urban events, typical of post-socialist development of Belgrade – the rebuilding of empty areas of modernist housing blocks (New Belgrade blocks 21 and 22) and the re-use of areas dedicated to functions other than housing (Airport City Belgrade and West 65). This investigative work will confront three issues - the main points of criticism directed at modernist settlements during the socialist period, their post-socialist re-building, and the requirements of the climate-friendly (compact- and eco-city) development.

Having in mind that the compact-city ad eco-city paradigms have received increased attention worldwide this research will try to investigate the extent to which we can consider the contemporary re-use of New Belgrade land potential as climate-friendly, and the relation of this development toward the issues of social sustainability.

This paper proposes a stance which sees the recent development as contradictory - in the sense that it represents a natural outcome of the desired transformation of modernist spaces during the period of socialism, but also represents a negation of these initial demands for urban reconstruction. These relations are demonstrated through the premises of ecological and climate-friendly building, which are shown to be simultaneously integrated

and ignored by the post-socialist Capital – the driving force behind the attempts aiming to control the whole of New Belgrade's land potential.

Key words: post-socialist city, New Belgrade, Eco- City, Compact- City, density, climate change.

THE IMPACT OF CLIMATE CHANGE ON WATER AVAILABILITY AND USE IN THE MEDITERRANEAN REGION

Mladen TODOROVIĆ[1,2], Piero LIONELLO[2,3]

[1]CIHEAM – Mediterranean Agronomic Institute of Bari, Land and Water Dept.,
Via Ceglie 9, 70110 Valenzano (BA), Italy; E-mail: mladen@iamb.it
[2]Euro-Mediterranean Centre for Climate Change, Lecce, Italy
[3]University of Salento, Dept. of Scienze dei Materiali, Lecce, Italy;
E-mail: piero.lionello@unisalento.it

This work focuses on the achievements of the WASSERMed project (EC-FP7-ENV) on the "Water availability and security in Southern Europe and the Mediterranean region". The project analyses analyse, in a multi-disciplinary way, the ongoing and future climate induced changes in hydrological budgets and extremes in southern Europe, North Africa and the Middle East under the frame of threats to national and human security. The impacts on key strategic sectors, such as agriculture and tourism, are considered, as well as the macroeconomic implications of water availability in terms of regional income, consumption, investment, trade flows, industrial structure and competitiveness. WASSERMed is an interdisciplinary project which, through the integration of climate change scenarios, promotes holistic water system modelling and interdisciplinary impact assessment. The project runs on both regional and local scale considering five case study areas.

In this work, a particular emphasis is given to the impact of climate change on crop water and irrigation requirements in the countries located in the Balkan Peninsula. The analysis is based on the climate change simulations based on the A1B SRES scenario and database referring to the actual situation (year 2000) and future climate (year 2050). The study uses a full set of weather parameters for the estimation of reference evapotranspiration by the Penman-Monteith equation and considers air temperature data for the determination of both the areas suitable for cultivation and the starting day and duration of growing cycle (the later by means of accumulation of heat units).

On a country level, the average temperature could increase from 1.3°C in Slovenia to 1.7°C in the FYROM. Precipitation would likely decrease from 30-40 *mm/year* in Bosnia and Herzegovina and Serbia to about 80 *mm/year* in Montenegro and the FYROM.

In Croatia, the precipitation would remain at the same level as nowadays whereas in Slovenia an increase of about 10 *mm/year* is expected. Reference evapotranspiration could increase from 35 *mm/year* in Slovenia to 84 *mm/year* in the FYROM.

By the middle of this century, the average water requirements of agricultural sector could be slightly lower or remain almost the same as today because the shortening of the growing season would likely counterbalance the increase of evaporative demand and decrease of precipitation in the region. The benefits could be distributed in a dissimilar way throughout the region due to spatial and temporal variation of future precipitation pattern and air temperature trend.

Key words: evapotranspiration; irrigation; A1B SRES scenario; 2000 vs. 2050.

THE RELATIONSHIP BETWEEN SOME CLIMATE ELEMENTS AND COLLECTED VOLUME OF NON WOOD FOREST PRODUCTS IN SERBIA

Nenad RANKOVIĆ[1], Dragan NONIĆ[2], Jelena NEDELJKOVIĆ[3], Saša STAMATOVIĆ[4]
[1]Dr. Nenad Ranković, Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: nenad.rankovic@sfb.bg.ac.rs
[2]Dr. Dragan Nonić, Associate Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: dragan.nonic@sfb.bg.ac.rs
[3]Jelena Nedeljković, PhD candidate, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: jelena.nedeljkovic@sfb.bg.ac.rs
[4] Saša Stamatović, PhD candidate, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: sasa.stamatovic@minpolj.gov.rs

Climate changes may be a consequence of various human activities and they can cause many social and economic problems, as well as problems related to environmental protection. Considering forests as complex and climate sensible ecosystems, the changes in growth conditions, triggered by climate changes, may lead to a disturbance in their functioning. Besides the influence on the spatial distribution of different plant species, forest increment, insect calamities and epiphytotics of plant diseases, climate changes can as well, influence biodiversity to a large extent.

Multifunctional forest management, whose important aspect is utilization of non-wood forest products (NWFPs), is necessary for the mitigation of climate changes and adaptation to them. Air temperature and the amount of precipitation, among other things, are environmental factors that have an important role in the distribution, abundance and sustainability of mushrooms, berries and herbs, which are some of the most significant NWFPs in Serbia.

For that reason, this research carried out the analysis of changes in the average annual air temperatures and the amount of precipitation, as well as changes in the collected volume of selected NWFPs in the period from 1993 to 2010.

The aim of this research is gaining the knowledge of the observed values' trends over time and their mutual influence. The purpose of this research is to, based on the acquired knowledge, assess measures and activities that would enable improvement of the production and trade in NWFPs in Serbia. In that sense, the subject of this research are temperature and precipitation, as indicators of climate changes, and collected amounts of porcini, chanterelles, blueberry and wild strawberry, as the most significant NWFPs in Serbia.

Key words: climate elements, non wood forest products, collecting.

Topic 4

SOCIO ECONOMIC ASPECTS OF LAND DEGRADATION AND LAND CONSERVATION

Keynote papers

Topic 4 - Socio economic aspects of land degradation and land conservation

DESERTIFICATION, CONFLICTS AND WARS IN THE TWENTY-FIRST CENTURY-NEW GLOBAL ENVIRONMENTAL THREATS

Jose. L. RUBIO

Past President of European Society for Soil Conservation (ESSC)
Centro de Investigaciones sobre Desertificación-CIDE (Consejo Superior de Investigaciones Científicas, Generalidad Valenciana, Universitad de Valencia), Carretera Moncada-Naquera km 4,5 Apartado Oficial, 46113 Moncada(Valencia), Spain

The effects of climate change and other global crises such as population growth, food insecurity, economic recession, lack of basic resources and forced population displacement in the coming decades foresee a serious socioeconomic impact of unprecedented and unpredictable consequences. The soil/land degradation, desertification, floods, water shortages, the impact of drought and the effects of extreme weather events exacerbated by the tendency of climate change represent a serious threat to the welfare state in both environmental and economic terms. The conditions for the survival of societies of agrarian structure are already limited. A worsening trend as a result of climate change can lead to catastrophic situations without the responding capacity and resources. The collapse of social structures and the scarcity or degradation of resources can increase subsistence crises, conflicts and violence. The history shows that the use of violence is always an option that has been used in the past. Currently, there is a constellation of serious conflict situations directly or indirectly related to land degradation, climate change and socio-economic aspects. The Darfur crisis represents a real example of this situation. The paper analyzes the most important factors related to aspects of environmental uncertainty that may represent an increase in conflicts and wars in the XXI century as a result of depletion or degradation of the base of natural resources paying particular attention to land degradation aspects.

Key words: climate change, global crises, land degradation

SUSTAINABILITY IN THE CONTEXT OF STAKEHOLDERS NECCESSITY AND LONG-TERM ECOLOGICAL AND ECONOMIC EFFECTS

Miodrag ZLATIC[1], Mirjana TODOSIJEVIC[1], Zaklina STOJANOVIC[2], Emilija MANIC[2], Gordana VUKELIC[3]
[1]University of Belgrade, Faculty of Forestry, Kneza Viseslava 1, 11030 Belgrade
[2]University of Belgrade, Faculty of Economics, Kamenicka 6, 11000 Belgrade

Land degradation is a „a cross cutting issue“ that intersects with biodiversity, climate change, hazardous waste and other issues of global change. „*Natural resources such as soils, water and ecosystems have been seriosly degraded throughout the history of agriculture and at an accelerated scale in the past century, thereby threatening food security in the medium to long term, given continuing population growth*“ (Hurni, H., 2009).

The loss and degradation of land resources need to be seen in the context of policy, socio-economic conditions and the environment. Today it is recognised that maintained integrity and restoration of land resources are a critical factor in achieving economic and ecological sustainability. To meet these challenges, new and innovative approaches are required.

In this paper strategies and intended actions for land use management and soil conservation are presented and discussed, as well as models of sustainable land management for hilly regions and a conceptual model of SLM for mountainous regions in Serbia. These models are planned, designed and investigated in the field regarding the neccessity of local people, conservation of soil resources and possible profitability. They involved a spatial scale (macro,medium and micro level), a management scale through international agencies, national agencies and village and household level and finally the time scale.

According to the long term effects based on benefit – cost analysis and the analysis of risk and uncertainty, it can be said that it is cost-effective to invest in these purposes. At the same time, soil, as the one of the most important natural resources, is preserved. Parts of these models can be seen occasionally in some parts of hilly mountainous regions in Serbia. They could be the contribution to the revival of degraded regions which should be based on people remaining in the area and being able to have decent livelihoods.

Key words: land degradation, soil conservation, sustainable land management, conceptual model, efficiency.

Papers

ECONOMIC JUSTIFICATION OF THE MODEL OF ANTI HAIL PROTECTION OF MULTI-YEAR PLANTS

Phd Gordana VUKELIC[1], Phd Miodrag ZLATIC[2], Phd Mirjana TODOSIJEVIC[2]

[1]Belgrade Banking Academy, Faculty for banking, insurance and finance,
Zmaj Jovina 12, 11 000 Belgrade, Serbia.
[2]University of Belgrade, Faculty of Forestry, Belgrade, Serbia

Agriculture has significant potential and plays an important role in the economic structure of Serbia, regardless of the threat to agricultural soil, water and biodiversity imposed by various processes requiring certain actions and increasing efficiency of functioning of all segments in order to improve conditions of production on farms and in companies.

Fruit growing is a branch of agriculture which studies various features of fruits, environmental factors affecting their growth, the ways of dissemination as well as application of agritechnical and pomotechnical measures so as to achieve the highest possible yield. Fruit growing is based on research and theoretical grounds, but changes in science are integrated into practice and encourage good results in the industry. The results which are achieved in fruit production are significant, but still below potential. Inconsistency in agricultural policy in the past negatively affected agriculture, that is, it reduced investments in agriculture in general, thus reducing investments in developing fruit growing as well.

The general crisis forces Serbian economy to re-industrialize. It implies supporting development so as to encourage the production of agricultural machinery, activate domestic industry for manufacturing elements of the anti hail protection, increase production of fruit, vegetable and other crops, increase trade and transport of produces. One of the incentives in terms of enlargement of production under networks with efficient anti hail protection would promote development of fruit growing and other agricultural branches. Agricultural production under the very sky should be protected from elements, which implies good modes of protection. This paper deals with hail as an element and analyzes protection and consequences which affect the producers, that is, it analyzes the relationship among the insurance, producer and the state.

Key words: economic feasibility, multi-year plants, production, yield rate, anti hail protection, modes, efficiency.

AN EXAMPLE OF AHP APPLICATION IN FORESTRY

Ivaylo VELICHKOV[1], Bojan SRDJEVIC[2], Milena LAKICEVIC[2]

[1]Forest Research Institute - Sofia, 132 „St. Kliment Ohridski" blvd.,
1756 Sofia, Bulgaria
[2]University of Novi Sad, Faculty of Agriculture, Trg D. Obradovica 8,
21000 Novi Sad, Serbia

The paper presents an example of AHP application in addressing a forestry decision problem stated as: identifying the best multifunctional stand in the Rila Monastery, Bulgaria. The problem was evaluated by three forestry experts. The chief monastery forester (the first author of the paper) developed a hierarchy of the decision making problem and evaluated all its elements i.e. criteria, sub criteria and alternatives. Two other decision makers evaluated criteria and sub criteria, according to their competences.

This paper presents one of the possible ways to aggregate decision makers' preferences within AHP framework, in cases in which some group members did not evaluate all hierarchy elements. The proposed aggregation procedure was supported by the geometric mean method and applied on a selected case study example. As a result, the best multifunctional stand is recognized. These results were compared to the previous researches.

Key words: multiple criteria decision making, group decision making, AHP, forest stand.

LANDSCAPE MODIFICATION AND LANDSCAPE PERCEPTION BY LOCAL PEOPLE IN THE VILLAGE OF KUPINOVO WITHIN A PROTECTED AREA

Jelena TOMICEVIC[1], Ana KOSTIC[2], Werner KONOLD[3], Ivana GUDURIC[4]

[1]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia,
phone: +381 64 11 77 435, email: tomicevicj@yahoo.com
[2]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia, e-mail: anakostic@yahoo.com
[3]Institut for Landscape Management, Albert-Ludwigs-Universität Freiburg,
Tennenbacher Str. 4, D-79106 Freiburg, Germany,
e-mail: werner.konold@landespflege.uni-freiburg.de
[4]Faculty of Forestry, Department of Landscape Architecture and Horticulture,
Kneza Viseslava str 1, Belgrade, Serbia, e-mail: ivanag0906@hotmail.com

Landscape modifications have been caused by human activities over time. They consist of: arable land expansion (through deforestation, land consolidation, wetland drainage etc.) grazing land, development of infrastructure, settlements, etc. All of these changes have been done in order to adapt the landscape to meet the needs of population. Some of these activities can be identified in the village of Kupinovo, situated within the protected area of the“Obedska Bara”Special Nature Reserve.

The village of Kupinovo dates back to medieval times, when the Kupinik fortress was built. For centuries, this village and its local population have influenced the marginal zone of the protected area, in different periods of time. Anthropogenic landscape modification in the village was determined on the basis of a complex historical analysis of the study area from various perspectives (social, economic, cultural) combined with a survey. Socio - empirical research was carried out in order to explore and describe the ways local population use the landscape within the village, with the emphasis on lifestyle in the protected area. Furthermore, the aim of this research was to identify their expectations regarding the development of the village.

The results show that the changes that have occurred in the study area are the result of a series of historical and cultural events in the past. Apart from cultural elements that should be preserved for future generations, this area is very important for its renewal of traditional ways of land-use practices within the landscape. The renewal of traditional activities, the involvement of the local people and their identification with these activities will contribute to the economic stability of the area. Moreover, the research results will raise general public awareness, by emphasizing the special qualities of the area. They will further increase the level of awareness among experts about the importance and role of

alandscape character assessment as a basis for environmental planning in the context of sustainable development.

Key words: landscape modification, human influence, traditional land use practice, perception, awareness, protected areas, local population

INVESTMENT APPRAISAL IN POPLAR PLANTATIONS IN SERBIA AND ITS RELATIONS WITH SUSTAINABLE LAND MANAGEMENT

Ljiljana M. KEČA, Nenad Đ. KEČA
Corresponding author: University of Belgrade - Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade, SERBIA
ljiljana.keca@sfb.bg.ac.rs

Production processes in forestry last longer than similar ones in other industries. The investment process in poplar wood production includes financial investments in present to achieve economic benefits in the future, and have seasonal characteristics. Therefore, it is possible that some problems can arise, mainly in the framework of forecasts, calculation of investments in poplar production, engagement of human labor, mechanical work, etc.

Poplar plantations are a category of fixed assets in forestry, i.e. the assets with a biological character. They are related to their site, they are cultivated for a relatively long time and they have a relatively long utilization cycle, with the yield development determined by the plantation growth and age. Plantations transfer their value gradually to the obtained products during the period of their harvesting, and, by the realization of the products, the means invested in the plantation establishment are reproduced. The period of investments in poplar growing can be relatively long, and so is the period of harvesting.

Poplar wood production in plantations of different characteristics is one of the shortest rotations in our circumstances. Production of poplar wood requires rational and planned management, so that the site and the species potentials are maximally utilized, on the one hand, and on the other hand also to realize the favorable financial effects. In this sense, costs and receipts of wood production of poplar will be analyzed and four dynamic methods of investment appraisal will be applied to prove some of the hypotheses in the article. On the basis of application of these methods the intention is to advise the practice and government on how to proceed and improve the position of plantation producers in this way and influence sustainable land management (SLM) in Serbia.

The purpose of this research was to examine ways in which large- and small-scale private sector enterprises in poplar plantation production can work together with communities, so that both get what they need out of forest resources.

Specifically, that corporate access to land and profits from wood production can be accompanied both by the production of public benefits from forests, and by improved possibilities for communities to engage in commercial forestry for profit themselves. The research aimed to test two main linked hypotheses: (a) Partnerships between companies and communities can produce environmental and social forest goods and services as well as wood. (b) The conditions can be identified under which partnerships are, and are not, efficient, equitable and sustainable in a framework of SLM.

Key words: investment appraisal, poplar plantations, Serbia, sustainability, land management.

AN ANALYSIS OF THE PERCEPTIONS OF LOCAL POPULATION ON THE ROLE OF VODNO URBAN FOREST IN THE PROTECTION AGAINST EROSION AND TORRENTS

M. STOJANOVSKA, A. BLAZEVSKA, V. STOJANOVSKI,
V. NEDANOVSKA, B. STOJANOVA

Ss.Ciryl and Methodius University, Faculty of forestry – Skopje,
bul."Alexandar Makedonski "bb. 1000 Skopje, Republic of Macedonia;
e-mail:makedonkast@yahoo.com, makedonka@sf.ukim.edu.mk

The Vodno urban forest was established after a high erosion processes that occurred in 1951 in Skopje, permanently endangering citizens by torrents. The undertaken measures to control soil erosion decreased negative consequences, although in the south, south-east and eastern parts of the forest there is permanent occurrence of floods after heavy rains. The local population of settlements Sopiste and Kisela Voda are permanently facing this problem.

This paper examines the perception of the local population from Sopiste and Kisela Voda on the protective role of the urban forest" Vodno" against erosion and torrents. The qualitative methodology was adopted and the snowball sampling technique was used to identify interviewees' perception. Semi-structured interviews were conducted with the local population until the point of saturation was obtained. The interviews, which were audio-taped and transcribed verbatim, were evaluated by thematic content analysis and further verified by other authors' analyses.

Results showed that the term erosion and torrents is very familiar to respondents from the newspapers and TV. About 90% responded that they are permanently facing problems in time of precipitations. One half of the interviewees have not heard that urban forest Vodno also has a protective role against erosion and torrents. Most of them (86%) think that the local government is responsible for the management of this forest and 75% think that lack of willingness of the local government is the main reason why this issue still exists in such a big city.

Most of the respondents recommended the improvement of regulating erosion canals as the most appropriate activity, as well as afforestation of bare land, which will minimize the negative consequences.

Key words: perception, soil erosion, torrents, land degradation, urban forest.

LEGISLATIVE, PLANNING AND INSTITUTIONAL FRAMEWORK FOR THE PROTECTION OF FOREST SOILS IN SERBIA

Milan MEDAREVIĆ, Staniša BANKOVIĆ,
Biljana ŠLJUKIĆ, Snežana OBRADOVIĆ

University of Belgrade - Faculty of Forestry, Kneza Višeslava 1,
11030 Belgrade, SERBIA

The first records of realistic ideas concerning the establishment of erodible areas in Yugoslavia date back to 1929, when the Forest Law recognized the partly problematic state regarding vulnerability and poor quality of the soil in the former Yugoslavia, establishing the category of permanently protective forests. This was the first attempt to create a network of soil areas in the local conditions, in terms of quality and need for a more serious attitude towards the problem of soil depletion.

The legislative framework for a rational management of forest soils can be found in the applicable Forest Law, i.e. in the definition of sustainable management in Article 3 of this law, which provides the conditions for sustainable management of forests and forest soils. This article defines the way and scope of activities that maintain and provide the productive capacity of forests and promote their vitality, improving their potential to mitigate climate changes and provide environmental, economic and social functions...

The Law on Nature Protection (Official Gazette of the Republic of Serbia br.36/2009) elaborates on this issue, defining the obligation to meet the following objectives:

1) Protection, preservation and improvement of biodiversity (genetic, special and ecosystem biodiversity), as well as geological and landscape diversity;

2) Harmonization of human activities, economic and social development plans, programs, plans and projects that include sustainable use of renewable and non-renewable natural resources and long-term conservation of natural ecosystems and the balance of nature;

3) Sustainable use and/or management of natural resources and areas, provision of their functions while preserving natural values and the balance of natural ecosystems;

4) Timely prevention of human activities and actions that can lead to a permanent impoverishment of biological, geological and landscape diversity and nature disorders with negative consequences;

5) Determination and monitoring of the state of nature;

6) Improvement of the damaged parts of natural areas and landscapes.

In addition to these two laws, some other laws contain provisions pertaining to the above mentioned that are most often complementary to them.

Plan framework aimed at the operationalization of these goals can be found in strategic and operational plans, which are one of the prerequisites for sustainable forest management.

The polyfunctional approach to forest management planning, among other objectives, involves: the protection of soil from water and wind erosion and balancing of water inflows and runoff and the prevention of torrents and flood waves using biological measures. In this regard, it can be added that about 1/5 of the forests and forest soils are of permanently protective nature.

In institutional terms, public enterprises entrusted to forest management are directly in charge of the achievement of these goals, and the control mechanism is the responsibility of the state or the ministries whose services exercise the control function.

The problem regarding all these issues is the provision of funding for the measures and works that ensure the longevity of forests and forest soils in Serbia, and particularly of those whose character is primarily protective.

Key words: management of forest soils, legal, institutional and plan framework.

THE POTENTIAL DECREASE IN PRICES OF AGRICULTURAL LAND DUE TO THE EFFECT OF WATER EROSION – ANALYSIS OF THE HUSTOPEČE REGION (CZECH REPUBLIC)

Mgr. Petr KARÁSEK, Ing. Jana PODHRÁZSKÁ, Ph.D., Ing. Jana KONEČNÁ

Research Institute for Soil and Water Conservation, dep. for Land Use Planning Brno
Lidicka 25/27, 602 00, Brno, Czech Republic
karasek.petr@vumop.cz

Mapping of evaluated soil ecological units passed on all agricultural land of the Czech Republic in the 1973 – 1980 period. These units are indexes of soil quality, productive potential, ecological properties and also its value. They are used as a basis for soil and environmental protection and for the evaluation of plots prices. Every unit has clearly determined boundaries in special maps and it is signed by a code, which includes information about the climatic region, main soil type, soil depth, the content of gravel and stones, steepness and exposition of a habitat. Since 1990 the system of evaluated soil ecological units has been updated in the Czech Republic. New soil survey and mapping has been running. Comparing primal and new results, we can see significant degradation of soils, locally caused by water and wind erosion. This situation was mainly evoked by improper intensive soil management on large blocks of arable land. Soil degradation is reflected in the decrease of plot prices. The poster presents analyses of changes of soil quality and prices in the primal (1978) and recent (2008) evaluations of soil ecological units in the region of Hustopeče (Southern Moravia, Czech Republic).

Key words: water erosion, soil degradation, price of agricultural land.

IMPROVEMENT OF ENVIRONMENTAL PROTECTION BY INCREASING SOCIAL RESPONSIBILITY FOR OPERATIONS MANAGEMENT IN THE WOOD PROCESSING IN SERBIA

Milan Ž. NEŠIĆ[1], Branko GLAVONJIĆ[1], Dragoljub IVKOVIĆ[1], Nevena M. ČULE[2]

[1]University of Belgrade - Faculty of Forestry, Serbia, Kneza Višeslava 1,
milan.nesic@sfb.bg.ac.rs
[2]Institute of Forestry, Belgrade, Serbia, Kneza Višeslava 3

Achieving sustainability means reducing or stabilizing the environmental burden. To achieve this, the only realistic option is to change the way goods and services are being produced. The aim of this paper is to investigate pollutants in wood processing and to point to their harmful effects on the environment. Further, options to eliminate or reduce these hazards with corresponding changes in production and operations management were examined. In order to obtain a general picture of the situation of social responsibility in environmental protection in the wood industry of Serbia, the inductive method was used. The methods of comparing the data to the EU standards and the benchmarking were applied. The results show that the wood industry is not paying due attention to environmental protection, especially in small companies, whose share is around 98% of the total enterprises in wood processing in Serbia. This study has shown that, with the proposed changes in technology and related operations management, social responsibility towards the environment can be significantly improved, with no consequences to the economy of companies.

Key words: environmental protection, wood processing, social responsibility, operations management.

SOCIO-ECONOMIC IMPACT OF RECULTIVATION ACTIVITIES IN THE KOLUBARA REGION

Radmilo PESIC

University of Belgrade - Faculty of Agriculture, Agricultural Econs. Dept.
www.policy.hu/pesic, radmilo@sbb.rs

The Kolubara opencast lignite mines are part of the Serbian Electricity Company (EPS), and are located in what has always been a heavily used cultivated landscape. Annual production in Kolubara mines is about 28 million tons of lignite coal, and about 70 million tons of barren soil. The post-mining landscape recultivation in the Kolubara region started in1958, covering 110 *ha* area with acacia trees. In 1971 first attempts were made by introducing medical plants on 33 *ha* area, and the first agricultural plantations (corn and sunflower) were initiated in 1974. By 2010 total covered area was 1,197 *ha* (agricultural plantations 298 *ha*, orchards 17 *ha*. seed-plots 12 *ha*, and forests 870 *ha*). It is expected that by 2020 the total reactivated area will be about 2000 *ha*.

In opposition to the successfully implemented agro-technical measures, socio-economic effects of the undertaken projects were quite modest. Among the most striking problems of the region are demographic decline, maturing population, growing unemployment, nonfunctional and outdated industrial structure, government sector predominance and heterogeneous and uneven social standard. The article is focused not only on explanations of the unsatisfactory socio-economic performance, but it offers a set of policy recommendations for socio-economic rehabilitation, including private sector (family businesses) growth, broad inclusion of local communities, human resource development etc. Sustainable economic growth of the Kolubara region is expected to be based on environmentally friendly technologies, better water resource utilization and renewable energy production using forest biomass.

Key words: socio-economic impact, recultivation, demographic decline

Topic 4 - Socio economic aspects of land degradation and land conservation

RECENT CHANGES OF EROSION INTENSITY CAUSED BY SOCIO-GEOGRAPHIC AND LAND USE CHANGES (CASE STUDY: KNJAŽEVAC MUNICIPALITY, SERBIA)

Slavoljub S. DRAGIĆEVIĆ[1], Marija P. MARTINOVIĆ[1], Mikica Z. SIBINOVIĆ[1], Ivan D. NOVKOVIĆ[1], Radislav S. TOŠIĆ[2], Stefana Lj. BABOVIĆ[3]

[1]University of Belgrade, Faculty of Geography, Belgrade, Serbia
e-mail: slavoljubdragicevic@eunet.rs
[2]Faculty of Natural Sciences, Banja Luka, Republic of Srpska
e-mail: rtosic@blic.net
[3]University of Belgrade, Faculty of Forestry, Belgrade, Serbia
e-mail: stefana_babovic@yahoo.co.uk

Soil erosion is dominantly determined by four main factors: lithological and pedological structure, climate, topography and land use. Although all of these factors interact with human activity to a certain extent, land use is the most 'changeable' and a very important factor of soil erosion processes. The main aim of this research is to assess the influence of demographic, socioeconomic and land use changes as very important factors of the erosional processes in the Knjaževac Municipality.

The amount of eroded material on the teritorry of Serbia has decreased in the last decades. For the purpose of quantifying the erosion intensity changes in the Municipality of Knjaževac using GIS, overlapping of the territory has been done with the soil erosion maps from 1971 and the recent state in 2010. With digitalization of the area affected by different categories of erosion of these two maps, it was made possibile to determine those changes in the last 40 years. Based on previous analysis of the area affected by different categories of erosion in the Knjaževac Municipality, it is clear that there is a decrease in the intensity of soil erosion. Significant reduction is expressed in the medium category (with 44.6% in 1971 to 26.9 in 2006) and the increase in the weak erosion (from 30% to 53.03%).

The Knjaževac region has been characterized by a decline in population size. As the result of population decrease since the end of the 1960s, with the exception of the city of Knjaževac, this region has been classified among the heavily demographic shrinking regions in Serbia. The total municipal population of 59,345 inhabitants in 1961 decreased to 38,248 inhabitants in 2002. Changes in average population settlement size are especially expressed in rural settlements. The average size of rural settlements was 610 inhabitants in 1961, 378 in 1981, and 215 inhabitants in 2002. This population decrease in the Knjaževac region is just one symptom of the overall process of shrinking that needs to be put in context, not only in terms of demographic changes, but in socioeconomic

changes as well. Depopulation had a huge influence in agliculture as well, but it still has great importance for this region, and this was confirmed by the data from the year 2002, which suggest that the economic structure has the largest share in agriculture with 43.6% of national income of the region.

Therefore, the transformation of agricultural production and land use, especially from the beginning of the transition period, needs to be considered with the soil erosion aspect.

Key words: soil erosion, demographic and land use changes, depopulation, agricultural production, Serbia.

SOIL, SOCIETY AND GLOBAL CHANGE

Winfried E.H. BLUM

University of Natural Resources and Life Sciences (BOKU) Vienna, Austria
E-mail: winfried.blum@boku.ac.at

Soils have six main functions, delivering goods and services to society. The three ecological functions are:

- production of biomass in agriculture and forestry;
- filtering, buffering and transformation activities between the atmosphere and the ground water, protecting the food chain and the drinking water resources;
- gene reserve and biodiversity, with more biota in number and biomass than above ground.

The three other functions linked to technical, social, cultural and economic developments are

- physical base for urbanisation, industrialisation and transport;
- source of raw materials, delivering clay, sand, gravel and other materials;
- memory of time, protecting archaeological and palaeontological remnants.

The main problem for the sustainable use of soils is the competition in the use of these different functions in space and time.

Because the production of biomass in agriculture and forestry is the basis of all animal and human life, in the following, the impact of global change on soils and biomass production will be discussed. In this context, global change comprises the increase of world population and migration from rural into urban areas, the increasing human demands with regard to the goods and services provided by soil, e.g. the new demands for bioenergy in the form of biofuels and the problems caused by the continuing use of fossil energy inducing climate change and other adverse impacts. All these impacts on the capacity of soils to produce biomass and to sustain food security will be discussed in detail, showing that we are moving into severe constraints in the near to medium future.

Key words: soil functions, population increase and migration, changes in lifestyle, urbanisation, demands for bioenergy, economic changes, climate change.

MODIFICATION OF LANDSCAPE STABILITY AS RESPONSE ON RURAL DEPOPULATION: EXAMPLE OF WATERSHED OF KUPINOVAČKA RIVER, SERBIA

Boris P. RADIĆ, Ratko U. RISTIĆ, Nevena B. VASILJEVIĆ, Ivan Đ. MALUŠEVIĆ

University of Belgrade Faculty of Forestry, Kneza Višeslava 1, Belgrade,
boris.radic@gmail.com

Human activities in agriculture, forestry and natural landscapes in general, have caused disturbances in land cover stability. Change in vegetation cover and original soil structure, cause erosion processes at multiple scales. The character and the intensity of erosive processes have a dependent relationship between not only with natural and historical, but also with social and economic factors. This is especially relevant for hilly and mountainous regions where natural hazards and population decline are more emphasized. The area of Kupinovačka river is good example of hilly watershed that suffered from type of changes. Demographic decline with intensive migration and changes in land use, contributed to the reduction of erosion intensity in the investigated area. Further reduction of agrarian pressure, which was on the highest level in the fifties and sixties of last century, is to be expected in the future. Lost of demographic volume of investigated area contribute to preservation of natural resources. But this shouldn't be a land use model change for achieving stable watershed and sustainable local development. Land management should link preservation of natural resources with enhancing circumstances for local people communities.

Key words: land use, demographic decline, erosion processes, local development

Topic 5

IMPLEMENTED GLOBAL/REGIONAL/NATIONAL PROJECTS

Keynote papers

Topic 5 - Implemented global/regional/national projects

INDIA ABROAD: INTERNATIONAL DEVELOPMENT PROJECTS OF INDIA'S NGOS.

Martin J. HAIGH

Department of Social Sciences (Geography), Oxford Brookes University,
mhaigh@brookes.ac.uk

This paper explores the International Agricultural Development and educational work of some of the Indian NGOs that operate, internationally, outside India. Its foci are the ideas, ideals and works of the followers of the Gandhian political economy of Sarvodaya (especially its application in Sri Lanka), the Ananda Marg's Progressive Utilisation Theory (PROUT) (especially its development of agricultural cooperatives in Venezuela, ISKCON), the International Society for Krishna Consciousness (especially its model farm-based rural communities in Europe, and ISKCON's GLOVESCO (Global Vanasrama Educational, Social and Cultural Organisation) offshoot with its roots in village Indonesia), the Ramakrishna Order and, briefly, groups associated with the Hindu contribution to the UNDP/ARC's multi-faith sustainability initiative "*Many Heavens, One Earth*", namely the "*Bhumi Project*". Each of these initiatives emphasises different aspects of the Hindu worldview. Gandhian Sarvodaya emphasises self-reliance, non-harming (ahimsa), and personal ethics (dharma), while P.R. Sarkar's Ananda Marg, emphasises cooperative enterprise and the institution of a new more spiritually-socialist social order; in fact, the Tantric body re-imagined at the social scale. ISKCON emphasises devotional service (bhakti yoga) within a model for a self-sufficient, self-sustainable, post-hydrocarbon farming future, GLOVESCO aims to establish new village-based agricultural communities according to strict Vedic ideals while Swami Vivekananda's Sri Ramakrishna Order emphasises spiritual development through service to the God in each human (karma yoga). Finally, the Bhumi Project, a product of the emerging self-awareness of the global Hindu diaspora, aims to unite the work of a range of Hindu organisations working according to dharmic principles. These movements share a development agenda that emphasises self-sustainability, a low ecological footprint, social justice (variously defined), and a greater emphasis on the development of spiritual rather than economic capital.

Key words: Indian NGOs, Sustainable Development Theory, Sarvodaya, Ananda Marg, ISKCON, GLOVESCO, Bhumi Project.

A SURVEY OF EROSION PROBLEMS & PROPOSED SOLUTIONS FOR AN INDIGINOUS ANDEAN COMMUNITY IN ECUADOR

William B. MAHONEY

Environmental Services International LLC
8353 E. Kenyon Drive, Denver, CO 80237 USA
wbmahoney@gmail.com

MalinguaPamba(population approximately 720) is a rural agricultural community in the Western Cordillera of the Andes. It is located at 0°50'south latitude, approximately 115*km* south-southwest of Quito (Ecuador's capital) and 30*km* west-northwest of Latacunga (the provincial capital). Elevations range from 2900 meters along the Rio Toachi to 4100 meters at the local drainage divide. The steep, generally westward-sloping land surface is sharply dissected by a number of gullies. The community has a humid tropical highland climate.

Hundreds of years of clearing the native cloud forest and paramo grasslands for settlement, cultivation, livestock grazing, fuel and building materials have resulted in a loss of much of the original rich organic topsoil. The remaining soils are less productive subsoils with a thin or non-existent organic surface horizon. These sandy volcanic soils are very susceptible to surface water erosion, especially when stripped of protective vegetation.

The Denver Professional Chapter of Engineers Without Borders (EWB) has been engaged in volunteer work in MalinguaPamba since 2006. EWB has assisted with development of potable and irrigation water systems which rely on natural springs. During site visits, EWB engineers have noticed erosion problems associated with water lines, community access roads, and agricultural practices. The International Erosion Control Association (IECA) has been asked to provide support to EWB in assessing the nature and causes of erosion and sedimentation and evaluating possible low-technology solutions to these problems which concern both EWB and the indigenous community.

With the support of IECA and EWB, I spent eight days in the community in July 2011 evaluating approximately 75 eroded sites many of which had been identified by members of the community. I documented and photographed around 40 of these sites, recording GPS locations, slope anglesand aspects, and measurements of the size of erosion features. Causes of erosion were evaluated and possible mitigation measures were considered.

This presentation will highlight several sites with relatively serious erosion problems. Mitigation measures being considered for these sites include planting native tree, shrub, and grass species; use of locally-woven erosion control netting; construction of check dams using locally available materials; excavation of diversion ditches; use of

slotted pipe to spread overflow from water holding tanks; improvements in road drainage; and agricultural terraces.

Key words: erosion control, Ecuador, volcanic soils, tropical highlands.

Papers

Topic 5 - Implemented global/regional/national projects

THE VISITING CENTER AS AN ALTERNATIVE FOR CULTURAL LANDSCAPE

Assistant professor Ana Z. NIKEZIĆ, PhD, Dragan N. MARKOVIĆ, PhD student

Faculty of Archietcture, University of Belgrade
Bulevar Kralja Aleksandra 73/2, kab.346a
ana.nikezic@gmail.com +381637278915

Over the past decade, the theme of land and water conservation shifted from theoretical to practical discourse focussing on the effects of climate change. One of the ways in which architecture can engage itself in the process of sustainable development is finding new possibilities in negotiating between the values of natural landscapes and historical heritage through a typology of a Visiting center. The visiting center is seen as a frame for specific place character being able to engage the local community and involve general public in raising awareness and education on climate change and effects it has on the cultural landscape.

This article presents results of a Master students' research on positioning a Visiting center as cultural and economic infrastructure, a natural resource that can protect and develop water and land quality, a place that engages man and nature in finding possible solutions for affirming history and culture into contemporary everyday life.

A group of 12 students have had the task to examine the positioning of a visiting center in the context of protected remains of the Trajan Bridge on the Danube River near Kladovo. During the semester, students dealt with the physical and program review of the relationship of the inherited structures and natural landscape through finding principles on which the visiting center was to be based. Students were expected to find new possibilities and limitations of networking nature and architecture by researching the impact and prospect that the socio-economic aspect has on degradation of the natural environment in the age of climate change and explore how various architectural approaches harmonized with the natural environment can contribute to sustainable development and use of management strategies to minimize the negative impact of built structures on erosion, pollution and soil fertility.

The aim of this paper is not to describe how architecture can be incorporated into the natural environment, but to examine the relationship between man and nature via architecture. As architecture has the ability to communicate with the environment, the article concludes that sustainable design means reaching a higher quality of life and active involvement of people and their heritage through natural landscapes in which changes in their relations are adaptive and transparent. This type of research contributes not only to the solving of problems concerning the lakeshore, water, cultural heritage and contemporary architectural intervention, but it also participates in raising appropriate general

awareness on the subject of adaptive quality of places seen in the prospect of global climate change.

Key words: climate change, natural landscape, historical heritage, visiting center, sustainable development.

IMPACTS OF THE GRAIN FOR GREEN PROJECT (GGP) ON SOIL EROSION IN CHINA

LI Rui, DENG Lei, SHANGGUA Zhouping, WANG Fei,

Institute of Soil and Water Conservation (ISWC), Northwest A & F University, CAS/MWR, Yangling, Shaanxi 712100, China

Since 1999, the Grain for Green Project (GGP) has been launched as one of the most important projects for ecological restoration in China. The GGP aims to change land use on slope land. The government is carrying out subsidy policy to encourage farmers to convert cropping to tree or grass planting on slope land. This paper quantitatively analyzed the impacts of the GGP on soil erosion in the study area. According to the observation data of 11 rivers of China, the runoff and soil erosion significantly decreased. Compared to the 1998-2002 period, the runoff and sediment yield in the 2003-2007 period were decreased by 18% and 45.4% respectively. Herein, the runoff of the Yangtze River basin decreased as the farmland converted forestland area of its basin increased, while the runoff of the Yellow River basin increased. The results show that the grain-crop planting area and grain yields of China significantly decreased as its farmland converted forestland area increased ($P<0.05$). However, the farmers' per capita net income is significantly increased ($P<0.05$) .Therefore, the China's Grain for Green Project reduces its soil erosion, thus having very good ecological and economic benefits.

Key words: The China's Grain for Green Project, soil erosion, ecological restoration.

INTEGRATED IMPACTS ASSESSMENT OF SOIL AND WATER CONSERVATION AT REGIONAL SCALE: COOPERATION AND PROGRESS

Wang Fei*, Li Rui, Mu Xingminand, Liu Guobin
Miodrag Zlatic**, Stanimir Kostadinov, Nada Dragovic, Mirjana Todosijevic

*Institute of Soil and Water Conservation, Northwest A&F University, Yangling 712100, Shaanxi, China; b Institute of Soil and Water Conservation, Chinese Academy of Sciences and Ministry of water Resources, Yangling 712100, Shaanxi, China,
*wafe@ms.iswc.ac.cn
** Belgrade University, Faculty of Forestry, Serbia,
**miodrag.zlatic@sfb.bg.ac.rs

The China-Serbia Inter-Governmental S&T Cooperation Program on Integrated Impacts Assessment of Soil and Water Conservation at Regional Scale has been implemented by the Institute of Soil and Water Conservation, Northwest A&F University, CAS and MWR and Belgrade University, Faculty of Forestry (Dept. of Ecological Engineering in Soil and Water Resources Protection) since 2011. The main aim of this project is knowledge exchange regarding the development and integrated assessment in soil and water conservation on the basis of a bilateral research. The costs, inter-basin relationship and data feasibility should in an integrated assessment be considered from three aspects of ecological, economic and social impacts. A draft framework of assessment indicator system was developed including 5 aspects, including general context, soil and water conservation, ecological, economic and social impacts. However, there are some remaining questions, e.g. (1) What are the proper boundaries of integrated assessment? (2) How should possible duplications be dealt with? (3) What is the best short list of indicators or core indicator system? (4) Which is better: multi-indicators for a single objective or multi-indicators for complex objectives? Careful further discussions on the above topic should be held among multi-stakeholders.

There is a possibility to write textbook(s), scientific papers, etc.

The young master and doctoral students can participate in the analysis, discussion, and workshops in both countries. The results from this cooperation will be shared with colleges, universities and institutes with an interest in soil erosion control and its impacts.

Key words: indicator system, soil & water conservation, impact assesment, stakeholders, cooperation.

Topic 5 - Implemented global/regional/national projects

DEVELOPMENT OF A PRESPA LAKE WATERSHED MANAGEMENT PLAN (Main findings)

Ivan BLINKOV (on behalf of the project team)

1 Ss.Ciryl and Methodius University, Faculty of forestry – Skopje, , bul."Alexandar Makedonski "bb. 1000 Skopje, Republic of Macedonia;
E-mail: ivanblinkov@yahoo.com

The transboundary Prespa Lake basin, situated in the Balkan Peninsula, is considered to be an ecosystem of global significance and has been identified as one of Europe's major trans-boundary "ecological bricks". The entire Prespa Region hosts unique habitats and species that are important from both European and global conservation perspective. However, unsustainable agricultural, fisheries, water and forest management practices are causing stresses on the ecosystem health of the Prespa Basin. There is limited knowledge on environmental protection/conservation issues among the decision makers and the general population, and the lack of streamlined information available to the interested parties. The aim of the project was to prepare an 'ecosystem oriented' watershed management plan for the Prespa Lake's basin in the Republic of Macedonia and this is the first plan prepared according to the WFD needs. The project team consists of more than 20 various experts-scientists. The most significant thing is shifting from the traditional approach in the preparation of watershed management plan, where the main objective was optimization of water use to integrated management planning, where dominant objective is protection of the water ecosystem. The project was carried out in 5 phases. The project team faced some barriers during the period of implementation especially because of the lack of available data. There is no: delineation and typology of water bodies at the national level; GIS data is poor and very often unavailable; the existing data about water quality are according to the former rules (only basic physical-chemical and microbiological parameters needed for defining the usage of water for drinking) while according to WFD needs these parameters are only supportive characteristics for biological elements, and the most important is quality of the water ecosystem. In the defining of reference conditions for the lake, there is no measuring of pollutant income from the main point source of pollution. There isn't enough regulation related to water quality. There are no operational plans for flood control, and there is a lack of data on economic conditions at municipality level etc. Besides, the principle of public participation holds that those who are affected by a decision have the right to be involved in the decision-making process and all main results as well as the programme of measures and the choice of a scenario for the development of the plan, which should be done together with relevant stakeholders.

Key words: WFD, river basin management plan, Prespa Lake

Acknowledgment: This project was a part of integral project: Integrated Ecosystem Management in the Prespa Lakes Basin (Project No. 00051409) carried out by UNDP and supported by GEF.

Topic 6

EDUCATION IN LAND CONSERVATION

Papers

Topic 6 - Education in land conservation

MODELLING THE IMPACT OF MAHONIA AQUIFOLIUM STRIPS ON HILLSLOPE EROSION

Csilla HUDEK*, Geert STERK, Rens L.P.H. van BEEK, Steven M. de JONG

Utrecht University, Faculty of Geosciences, Department of Physical Geography, Utrecht, Netherlands, Address : P.O. Box 80.115, 3508 TC Utrecht, Netherlands.
E-mail:csilla.hudek@gmail.com

Farmers' choice of cultivation (plant selection and cultivation techniques) is often driven by economic forces and only secondarily by environmental conditions. As a result, cultivated hillslopes can often be exposed to increased erosion processes. Erosion models are valuable tools for both farmers and soil conservationists in the prediction of soil loss and surface runoff where experimental data is not often available. The use of permanent vegetation strips on cultivated slopes is an effective way to trap sediment and reduce the risk of agro-chemicals and soil escaping from farmlands and polluting the off-site environment. As the earlier field results confirmed, cultivated *Mahonia aquifolium* is an effective plant on water erosion control on the hillslopes of Hungary. Therefore our hypothesis was that contour strips of *M. aquifolium* in sloping agricultural fields could be an effective method to control surface runoff and soil loss. Modelling should be applied for providing information under various bio-physical conditions. The Revised Morgan-Morgan-Finney model (RMMF) is a well known erosion model requires little input data and has already effectively used in different environments. However there is a limitation of the RMMF model, it does not include the impact of plant roots on soil erodibility. Since a previous root study provided detailed information on the root system of *M. aquifolium* we incorporated the effects of *M. aquifolium* roots on soil hydrology, sediment detachment and soil erosion in the RMMF model. With the use of measured soil loss and surface runoff data from the *M. aquifolium* plots the study also calibrated the adapted RMMF model.

Finally, the study computed the surface runoff and soil loss reductions caused by the strips of *M. aquifolium* on a variety of agricultural hillslopes in Hungary.

The RMMF model was found to be a useful tool predicting the affect of *M. aquifolium* strips on soil loss and runoff on a range of agricultural hillslopes.

Key words: Mahonia aquifolium, RMMF model, soil erosion, strip cropping.

STATE OF EROSION AND PROBLEMS IN TORRENTIAL FLOWS MANAGEMENT IN THE JABLANICA DISTRICT

Jasmina B. RADONJIĆ, PhD student

Faculty of Forestry, University of Belgrade
jasmina.jass.radonjic @ gmail.com

State of erosion and torrential flows management are the most important segments in the management, rational usage and improvement of a water flow. Specifically, this paper dealt with the issues mentioned in the territory of the Jablanica District. The research methodology included the collection of technical documents, flooding records, anti-erosion works done, terrain research and the analysis of erosion.

The study looks at the direction of the effects of anti-erosion regulation, protection projects against floods and opportunities to advance this work in order to achieve the integral effects that include protection, conservation and improvement.

This research includes seven largest torrential flows. In the period since 1980 there have been many technical works in the river basins of the Jablanica, the Veternica, the Vlasina, the Pusta River, the Jelasnicka River, the Bara Canal and the Tulovska River. Works are related to the organization of river beds, training works, river training, stabilization sill, check dam and embankments.

Biology projects were carried out on three of the seven basins. These works included the afforestation and grassing locations in the basin that are most threatened by erosion. The most widely used species for afforestation include the coniferous species *Pinus nigra* and *Pinus sylvestris*, and the broadleaved species *Robinia pseudoacacia, Alnus glutinosa* and *Populus x canadensis*. For grassing a mixture grass species is used.

Flooding has previously threatened several towns and villages. Farms and rural households were the most vulnerable to most of the flooding that took place. Minor damage to infrastructure and housing in cities is also recorded. On several occasions there were casualties.

Based on the analysis of the erosion maps from 1983 and 2002, the state of erosion in the area of the Jablanica district was moving in a positive direction only in the river basin of the Vlasina. On other basins lesser or greater worsening of erosion occurred.

The state of erosion which is shown on the map has changed a lot, although one may not immediately notice some major changes. This area requires a lot of attention in terms of biological and technical projects, including a large financial investment. Given that no investment in construction of greater regulation of these flows is planned in the

coming period, it is necessary to consider options for the maintenance of existing facilities. Water regime of this area could be improved with minimal investment.

Key words: state of erosion, torrential flows, floods, water regime, biological works.

COLLECTION OF NON-WOOD FOREST PRODUCTS AND BIODIVERSITY CONSERVATION: ATTITUDES OF COLLECTORS IN THE AREA OF KOPAONIK AND BELJANICA

Jelena NEDELJKOVIĆ[1], Dragan NONIĆ[2], Nenad RANKOVIĆ[3], Marina NONIĆ[4], Vladimir MANDIĆ[5]

[1]Jelena Nedeljković, PhD candidate, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: jelena.nedeljkovic@sfb.bg.ac.rs
[2]Dr. Dragan Nonić, Associate Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: dragan.nonic@sfb.bg.ac.rs
[3]Dr. Nenad Ranković, Professor, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: nenad.rankovic@sfb.bg.ac.rs
[4]Marina Nonić, PhD candidate, University of Belgrade, Faculty of Forestry, Belgrade, Serbia. E-mail: marina.nonic@sfb.bg.ac.rs
[5]Vladimir Mandić, graduated forest engineer. E-mail: vladimir.mandic@sfb.bg.ac.rs

The loss of biodiversity and land degradation are the most common consequences of climate change in forest ecosystems. In contrast, biodiversity conservation may be important for the mitigation of negative effects of climate changes.

In recent decades more attention is paid to the use of non-wood forest products (NWFPs), as an integral part of forest ecosystems. The NWFPs include, among other products, mushrooms, berries and medicinal and aromatic plants. A significant presence of these species in Serbia allows their use for commercial purposes, but, at the same time, there is a need for their sustainable collection. Inadequate collection of NWFPs may have negative consequences on biodiversity conservation, through land degradation, which can lead to degradation of forest ecosystems.

This paper presents the results of socio-economic research of the attitudes of NWFPs collectors in some areas of Serbia, which was conducted within the international EFI FOPER project "*Entrepreneurship, markets and marketing of non-timber forest products in South-Eastern Europe*". The survey was conducted in the second half of 2011 and it included 50 collectors of mushrooms, berries and medicinal plants from Brzeće, Brus

and Strmosten, in the area of mountains Kopaonik and Beljanica. This paper presents the analysis of the responses to questions related to the sustainable collection of NWFPs.

The goal of this paper is an analysis of the attitudes of NWFPs collectors towards the vulnerability of biodiversity, as a consequence of NWFPs collecting in the research area. In that sense, the purpose of this paper is to give recommendations for further research, which will allow more precise determination of actions to ensure sustainable collection of NWFPs.

Key words: non-wood forest products, sustainable collection, biodiversity.

IMPACTS OF THE INVASIVE SPECIES ASTER LANCEOLATUS WILLD. ON SOIL PROPERTIES

Marija M. NEŠIĆ, Dragica D. OBRATOV-PETKOVIĆ, Ivana R. BJEDOV, Snežana R. BELANOVIĆ, Matilda Š. ĐUKIĆ, Danijela M. ĐUNISIJEVIĆ-BOJOVIĆ, Dragana M. SKOČAJIĆ

University of Belgrade - Faculty of Forestry, Serbia, Kneza Višeslava 1, marijanesic79@yahoo.com

The introduction of exotic species to the ecosystem is one of the main threats to biodiversity. Changes in the environment, such as increasing concentration of carbon dioxide, nitrogen and sulfur are the result of human activity. These changes directly and indirectly affect plants, soils and their interrelationships. In response to the growing problem of invasive plants, many studies are being conducted in an attempt to understand the mechanisms that make invasive plants so successful. Invasive plants are capable of modifying soil properties, thus to promote their own growth. The purpose of this research was to investigate whether the species *Aster lenceolatus* Willd. causes changes in the soil and thus becomes the dominant species on the invaded sites. The correlation between *Aster lanceolatus* Willd. and soil was analyzed on nine sites. Invaded and adjacent uninvaded plots with native vegetation were compared on each location. Soil parameters such as pH value, electrical conductivity (EC), cation exchange capacity (CEC), C:N ratio, clay content and heavy metals were analyzed. The results showed differences in soil properties among areas affected by the invasion and areas with native vegetation. However, the differences were not equally expressed in all locations. Corresponding parameters resembled in some locations, but in other sites the results were variable. This study raises

the possibility that invasive species change soil characteristics. Although further studies are necessary, results offer evidence that the invasive plant *Aster lanceolatus* Willd. alters soil properties, possibly creating conditions that favor *Aster lanceolatus* Willd. over native plants.

Key words: *Aster lanceolatus* Willd., invasive plants, plant-soil interaction, soil modification.

CLIMATE CHANGES IN SERBIA AND THEIR IMPACT ON SOIL

Milena, Anđelko, ANĐELIĆ

University of Belgrade, Faculty of Forestry. Department:
Ecological Engineering in Soil and Water Resources Protection, Republic Serbia.
e-mail: milenaandjelic911@hotmail.rs

Increasingly evident effort of the community to connect the prosperity of society with evolutionism has led to enormous pressures on natural resources. We entered the period of consequences. Human activities lead to drastic changes at almost all possible levels with potentially major consequences for our future life.

In Serbia the spatial distribution of climate parameters is conditioned by the relief, geographic location and local influence and according to Köppen the climate of Serbia is between oceanic (Cfb), humid subtropical (Cfa) and humid continental (Dfa) with an average air temperature for the 1961-90 period of 10.9 °C. Serbia has already experienced a change in climate conditions. The acute illness of the climate of Serbia are two antagonistic natural phenomena: floods and droughts. With changed climatic conditions Serbia faces intensive precipitation events during winter and spring and that affects the watersheds, and the consequence is sudden appearance of floods with a lot of eroded material (material suspend and pulled by rivers) with high destructive effect. On the other hand, droughts are more dominant in summer and autumn. However, in the future reduction of precipitation during summer and autumn will be larger than the increase in winter and spring in Serbia so frequency, intensity and duration of drought will continue to happen as a consequence of changed air temperatures, cumulative deficit of precipitation and frequent heat waves. The appearance of heat waves occurs as a consequence of intense evaporation and changed conditions of soil moisture, and it will be more frequent in the future period. A scenario by PRUDENCE was developed for Serbia for future trends of temperature and it is expected that an increase of mean winter temperatures for the 2011-2040 period will be 2°C and summer temperatures will increase by about 5-6 °C.

Changing precipitation patterns are more complex and for the territory of Serbia decreasing amounts are expected, ranging from -10 to -3 millimeters per month.

Changed climatic conditions combined with other factors, such as inappropriate land use practices, represent a potentially high risk for agriculture. Climate changes, especially higher temperatures in future, will have a major impact on soil processes, and they will change the number of soil properties, which will have consequences on the entire ecosystem.

Key words: climate change, precipitation pattern, floods, soil.

MULTI-CRITERIA ANALYSIS IN DETERMINING THE CARRYING CAPACITY OF NATIONAL PARKS

Milena LAKICEVIC[1], Miodrag ZLATIC[2], Bojan SRDJEVIC[1], Zorica SRDJEVIC[1]

[1] University of Novi Sad, Faculty of Agriculture, Trg D. Obradovica 8, 21000 Novi Sad, Serbia
[2] University of Belgrade, Faculty of Forestry, Kneza Viseslava 1, 11000 Belgrade, Serbia, lakicevic.milena@gmail.com

National Parks are designated for three equally important primary management objectives, including the preservation of species and genetic diversity, the maintenance of environmental services, and tourism and recreation. Visitors enter National parks for different purposes and, in order to achieve multiple management objectives, it is essential to properly determine the carrying capacity of the Park, that is *the maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic and socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction* (WTO, 1997). If both nature protection and tourism development are set as management goals, we propose to determine the carrying capacity through an assessment of environmental criteria and sub criteria (indicators) within the multi-criteria analysis framework.

Key words: national park, carrying capacity, environmental indicators, multi-criteria analysis.

Topic 6 - Education in land conservation

APPLICATION OF TELEDETECTION METHODS TO ENVIRONMENTAL PROTECTION ON THE EXAMPLE OF RB „KOLUBARA"

Milisav TOMIĆ

PhD, student, Faculty of Forestry, University of Belgrade, Serbia
Тел: 063-8685712; e-mail: tomic.milisav@gmail.com

Kolubara basin is of particular socio-economic and ecological importance for the Republic of Serbia. Its position in the natural and social terms, as well as the quantity and quality of natural resources requires special treatment in terms of environmental management. The specific need for constant environmental monitoring of the Kolubara basin is related to the continuous dynamics, due to anthropogenic influence expressed through surface mining and coal processing. Remote sensing methods offer the possibility of creating a system for monitoring environmental changes in the Kolubara basin, including the possibility of predicting using various methods of spatial changes modelling.

Key words: remote sensing, Kolubara basin, environmental protection, natural resources, water, land, processing coal, RB „Kolubara".

THE SOCIO-ECONOMIC AND ECOLOGICAL VALUE OF THE PRINCIPLE „THE POLLUTER PAYS"

Nataša PAVLOVIĆ, Marina ILIĆ
natasa@ti-soft.net , mrnilic@yahoo.com

Since 2002, when the UN project of monitoring environmental conditions in Serbia was started a set of laws were passed to apply the principle "The polluter pays". However, in practice there has been little progress. Enforcing this principle requires organization and technical approaches that have the aim of creating a positive economic, ecological and social effect. Until recently, the organizational principles of dealing with waste were the product of socialist government owned institutions that did not contribute to decreasing the annual amount of waste being disposed of at dumps. The reason for this is the lack of incentive on the side of the producer as well as the waste management company to change anything. On the basis of an extensive terrain research in 10 municipal companies in Serbia, the opportunity to apply the principle of "The polluter pays" to communal waste was assessed. In order to explore options for dealing with non-communal waste, it would be possible to apply the same methodology used in this study. The aim of this paper is to establish that by adopting the principle "The polluter pays", on the example of communal waste, there are economic and social advantages for the population to separate its communal waste. In this way there would be a reduction of communal waste that is being disposed of at dumps that are generally not built up to the standards required.

Key word: principle "the polluter pays", communal waste, charge for communal waste.

Topic 7

Keynote papers

Topic 7 - Environmental issus

SOIL DIVERSITY OF SOUTH URAL RIDGES IN THE BASHKIRIYA RED SOIL DATA BOOK

Ruslan SULEYMANOV[1], Evgeniy ABAKUMOV[2], Roman HALITOV[2]

[1]Institute of Biology, Ufa Research Centre, Russian Academy of Sciences
[2]St-Petersburg State University, Department of Soil Science and Soil Ecology
1rusoils@rambler.ru, 2e_abakumov@mail.ru

Soil protection is one of the most important objectives of nature protection in Russia. The Federal law on Nature preservation says that "rare and endangered soils need to be preserved". The data on such soils that need the protection measures should be collected in special Red soil data books of the Regions of Russia. The list of soils in general includes the following categories of protection: rare, unequal, endangered, etalon and monitoring soils. All these categories were revealed and described in southern parts of Ural ridges on the territory of Bashkiriya. The data collected show that in broadleaf forests situated on etalon Umbric Luvisols – zonal type of forest-steppe soils, the endangered soils are Rendzic Leptosols and Lithosols, affected by tourism and wildfires. Umbric Luvisols, formed of red-colored loams of the preural deflection are considered as unequal ones, while rare soils are described on the example of mountain Sod-Alluvial soils in Pleistocene valleys. Monitoring of soils was used for the investigation of soil erosion processes, as well as other trends of soil degradation. Detailed data on soil categories are discussed in the presentation as well as a structure and organization of the Red soil data book of Bashkiriya.

This work is the contribution to the pr. No 11-05-97017 regional project of Russian foundation for basic research.

Key words: Soil degradation, Soil protection, Red soil data books.

Topic 7 - Environmental issus

IMPACT OF INVASIVE PLANT SPECIES ON SPECIES RICHNESS IN VARIOUS HABITATS IN SERBIA

Dragica D. OBRATOV-PETKOVIĆ*[1], Ivana R. BJEDOV[1], Branislav B. JURIŠIĆ[2], Marija M. NEŠIĆ[1], Verica B. STOJANOVIĆ[3]

[1]University of Belgrade-Faculty of Forestry,
[2]University of Novi Sad-Faculty of Agriculture,
[3]Institut for Nature conservation of Serbia
*dragica.obratov-petkovic@sfb.bg.ac.rs

Invasive plant species share the same habitats with native species. The influence of invasive plants to native species and habitats is one of the most important indices used for evaluating the sustainability of a habitat. Usually those habitats are characterized by the domination of invasive species. However, some of them have high floristic diversity. Some authors have emphasized that species richness and diversity are assumed to be negatively correlated to invasive success, while others found that invasion resistance and compositional stability increase with diversity.

Cities and other settlements are most commonly situated near the waterways, so for quite some time urban, suburban and rural areas have been recognized as centers from which the invasive species start to spread.

The investigations were carried out in central, western and northern parts of Serbia as well as in Belgrade (capital of Serbia) and its surroundings.

This study aims to identify and compare the plant species diversity in the study area and characterize the communities where the invasive species are dominant or subdominant or are the cenobiont of various communities.

For this purpose, 15 relevés were sampled by a randomized-systematic method, using the Braun-Blanquet scale. Data on the community edificator representation were obtained on the basis of previous research in these sites, and are shown to form „CPS SKEW" Schwarze Liste und Watch List gebietsfremde Invasive Pflanzen on-line (2009), as amended and adapted to the conditions in Belgrade and its surroundings (Obratov-Petković et al., 2009).

Classification of the vegetation was conducted using the EUNIS habitat classification. Species richness was applied to quantify the diversity of different communities.

The studied habitats are characterized by the presence of a large number of plant species. The analysis has shown differentiation of floristic composition at 15 localities into five separate groups which completely correspond to the studied habitats determined according to the international classification key. The floristic composition turned out to be sufficiently homogenous for the observed level of each habitat. The highest number of species

was recorded at the devastated and degraded habitats, where both diversity and invasiveness were at their maximum.

Keywords: invasive plant species, Shannon and Simpson indices of species richness, habitats.

Papers

Topic 7 - Environmental issus

ENVIRONMENTAL ASPECTS OF CHARCOAL PRODUCTION IN SERBIA: CURRENT SITUATION AND ASSESSMENT OF HARMONIZATION WITH THE ISO14025 DECLARATION

Branko D. GLAVONJIĆ, Milan Ž. NEŠIĆ,
Slavica PETROVIĆ, Snežana BELANOVIĆ

University of Belgrade Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade
Republic of Serbia, tel.+381 11 30 53 863
branko.glavonjic@sfb.bg.ac.rs
milan.nesic@sfb.bg.ac.rs
slavica.petrovic@sfb.bg.ac.rs
snezana.belanovic@sfb.bg.ac.rs

Charcoal is produced in about 1,500 charcoal kilns in Serbia with the highest geographic density in South, East, South West and West Serbia. So called traditional manner of wood carbonization is most present in the production process where certain amounts of the so called coal dust appear apart from charcoal as the main product. 240,849 m^3 of wood was used for the production of 34,086 tonnes of charcoal in Serbia in 2010. The amount of about 5,000 tonnes of coal dust appeared in this process as well, which is in most cases disposed in an irregular manner thus polluting soil and waters.

This paper presents the results of implemented researches of environmental aspects of charcoal production in Serbia by means of indicators of its impact on soil and water acidification. Based on the obtained indicators, the assessment of its harmonisation with the ISO14025 declaration was performed.

Key words: charcoal, coal dust, indicators, environmental.

Topic 7 - Environmental issus

POTENTIAL OF THE BEECH IN THE ''DJERDAP'' NATIONAL PARK FOR DENDROCLIMATOLOGICAL STUDIES

Branko STAJIĆ

University of Belgrade, Faculty of Forestry, Belgrade, Serbia
branko.stajic@sfb.bg.ac.rs

The radial growth of beech trees from three mixed beech stands (localities A, B and C) in a National park of Serbia (north-eastern Serbia) was analyzed in order to assess the potential of beech for dendroclimatological investigations. The total number of initially measured beech tree ring width series was: 26 (A), 32 (B) и 35 (C). The Cofecha program was used to evaluate the quality of visual crossdating. The ring width series in the final sample (reduced by all ring width series that presented any kind of problem in the visual and statistical crossdating), show a satisfactory level of interrelationship within each locality. The obtained values of the average coefficients of the series intercorrelation of ring widths (r_A=0.67, r_B=0.69 and r_C=0.66) are within the same scope of values of these series intercorrelation parameters in the majority of chronologies (0.55-0.75). The average mean sensitivity values (MS_A=0.33, MS_B=0.31 and MS_C=0.37) show that, according to Grissino-Mayer criteria (2001), the series of the empirical beech tree ring width, taken at all three localities, can be classified as sensitive. The average ''first order'' autocorrelation coefficient values of the empirical ring width are below (AC_A=0.55), on the margin (AC_C=0.60) or within (AC_B=0.65) the category of the most common values of this coefficient, determined in numerous dendrochronological investigations (0.600-0.800).

Prior to detrending, transformation of tree ring width was applied to remove bias caused by so-called heteroscedasticity. The raw ring width data was detrended to remove age trend. For this purpose a cubic smoothing 32-year spline with a 50% of frequency response was fitted to the raw ring width series. Master standard chronology was constructed as biweight robust means. Finally, the chronologies were prewhitened by autoregressive modelling.

After all of these dendrochronological procedures had been applied it was concluded that the obtained local beech chronologies were of a satisfactory quality and reliability and that they contain a sufficient ''signal'' in their growth ring width, which was common to all analyzed trees. Beech trees in the analyzed region have expressed a sensitive reaction to the modifications of environmental conditions in the last 100 years and they have been able to register climatic ''signals'' on a regional scale.

Key words: radial growth, dendrochronolgy, beech, Serbia

Topic 7 - Environmental issus

RADIAL GROWTH OF ARTIFICIALLY ESTABLISHED SESSILE OAK AND ITS RELATIONSHIP WITH TEMPERATURE AND PRECIPITATION

Branko STAJIĆ[1], Milivoj VUČKOVIĆ[1], Siniša ANDRAŠEV[2], Marko SMILJANIĆ[3], Živan JANJATOVIĆ[4]

[1]University of Belgrade, Faculty of Forestry, Belgrade, Serbia
[2]Institute of Lowland Forestry and Environment, Novi Sad, Serbia
[3]University Greifswald, Institute of Botany and Landscape Ecology, Germany
[4]Public Company ''Vojvodinašume'', Forest holding ''Banat'' Pančevo, Serbia
branko.stajic@sfb.bg.ac.rs

The radial growth of artificially established sessile oak (*Quercus petraea* (Matt.) Liebl.) in the area of the ''Fruška gora'' National Park and its dependence on precipitation and temperature was studied using dendrochronological methods. The relationship between tree growth and seasonalized (January-Mart, April-October, April-September, April-May, June-July, July-August, June-August, September-October) precipitation and temperature in the period from 1966 to 1987 (precipitation) and from 1965 to 1990 (temperature) was analyzed using the Pearson's correlation coefficients. In order to determine whether the conditions of the previous growing season affected the growth during the current season, the values of the studied climate elements were lagged and seasonalized precipitation and temperature (April-Mart, June-August, September-October, November-December) of the previous year were also used.

After the visual and statistical synchronization, one oak tree ring width series (out of 18 trees bored in total) was rejected due to poor matching in some sections of the oak master chronology. The cross-dated radial growth series were standardised with a cubic smoothing spline. The standard master oak chronology was built as biweight robust means. Mean sensitivity (0,160) and first-order autocorrelation (0,63) are low and series intercorrelation (0,569) is similar to the majority of other chronologies. In order to remove autocorrelation, chronology was prewhitened by autoregressive modelling and the residual chronology was constructed. The residual chronology has a somewhat higher mean sensitivity (0,177) and eliminated autocorrelation. The chronologies span a period of 92 years, from 1919 to 2010. The obtained chronologies were used to be compared with climatic variables.

Only a few of the obtained results of the growth-climate correlations reached satisfactorily significant level, although there was a weak tendency towards positive response to rainfall and negative response to summer temperature. Namely, oak tree growth correlated significantly and positively ($r = 0,46$, $p < 0,05$) with precipitations only during

the summer (June-August) of the previous year. Temperatures from the current summer (June-August) and the late summer (July-August) are both significantly and negatively correlated ($r = 0,51$, $p < 0.001$; $r = 0,48$, $p < 0,05$) to the radial growth.

These dendrochronological and dendroclimatological studies of oak were performed for the first time in Serbia. Future studies should be undertaken in order to expand the data base and the knowledge of the climate influences on oak growth in the studied region as well as in many other regions.

Key words: radial growth, dendroclimatology, sessile oak, temperature and precipitation, Serbia.

ESTIMATION OF THE INVASIVENESS DEGREE OF ASTER LANCEOLATUS WILLD. IN SOME HABITATS IN BELGRADE

Ivana R. BJEDOV*, Dragica D. OBRATOV-PETKOVIĆ, Marija M. NEŠIĆ

[1]University of Belgrade-Faculty of Forestry, Kneza Višeslava 1, 11000 Belgrade, Serbia
*e-mail address: ivana.bjedov@sfb.bg.ac.rs

The invasion of non-natives into intact ecosystems is recognized by scientists and land managers as one of the primary causes of biodiversity loss, ranking second only to outright habitat loss (Pimm and Gilpin, 1989; Myers, 1997; Stein *et al*. 2000). Invasive plants can affect the composition, structure, and function of native ecosystems and reduce plant diversity. In many countries, invasive plants have become a major ecological, social and economic problem despite the existence of legal measures and substantial funding to control them. Invasive alien species are a problem in diverse ecosystems. However, some ecosystems are more favourable for invasion than others. Also, not all non-native plants are equally harmful. Invasive plants establishment is highly dependent on ecological and climatic conditions.

In this paper the analysis of the degree of invasiveness of *Aster lanceolatus* in the chosen sites in Belgrade was done. *Aster lanceolatus* is one of the most important riverside invasive plant species (Fehér, 2007; Obratov-Petković *et al*., 2009). Its spreading potential is conditioned by the species biology and the expansiveness by climate changes, anthropogenic impacts and the competitive interrelationships. To estimate the invasiveness degree of *Aster lanceolatus* invasiveness assessment models are applied (Morse *et al*., 2004; Carlson, 2008). These models are composed of a series of questions evaluating spatial characteristics, known or potential impacts on the resources of value (e.g., biodiversity), biological characteristics, and the ease of control. Scores are given for each question and totaled to produce a final evaluation.

According to the results, it can be concluded that *Aster lanceolatus* is characterized by a high invasiveness degree.

Key words: *Aster lanceolatus*, invasiveness degree, invasiveness assessment models, Belgrade.

TRANSPIRATION OF WHITE AND EURAMERICAN POPLAR ON ADA CIGANLIJA RIVER ISLAND AND ITS POSSIBLE IMPACT ON MICROCLIMATE

Matilda DJUKIC, Danijela DJUNISIJEVIC BOJOVIC,
Mihailo GRBIC, Dragana SKOCAJIC

University of Belgrade, Faculty of Forestry, Kneza Viseslava 1, Serbia
matilda.djukic@sfb.bg.ac.sr

Increasing air temperature is an important manifestation of evident global climate change. The influence of vegetation on microclimate, especially in urban areas, is a significant factor in mitigating the consequences of this warming. The most important physiological process in plants, transpiration, is a major consumer of solar energy on Earth. Through transpiration plants reduce summer air temperature indirectly, by increasing its relative humidity. Because it is known that the total leaves surface of woody plants can be several tens of times larger than the area of land on which they grow, it is clear that the air in the surrounding area has higher moisture content than the areas without vegetation.

This paper analyzes the intensity of leaves transpiration of *Populus alba* L. and *Populus x euramericana* (*Populus deltoides* × *P. nigra*) I-214 clon populations at (1) flooded (wetter) and (2) non-flooded (drier) habitats on Ada Ciganlija river island during the growing season. Nine trees of each species were selected from both habitats, of similar height, the same age and physiological condition. It was found that the intensity of transpiration of euramerican poplar trees had higher average values (0,730 $gH_2Odm^{-2}h^{-1}$) than white poplar (0,385 $gH_2Odm^{-2}h^{-1}$). The transpiration of both species was more intensive in the drier than in the flooded habitats. By analyzing the number and size of stomata on leaves of the investigated euramerican poplar trees, it was found that stomata are more numerous but smaller in size on the leaves from drier habitats.

It can be concluded that *Populus x euramericana* clone I-214 may have a greater impact on microclimate conditions by increasing air moisture content.

Key words: transpiration, *Populus alba, Populus x euramericana* I-214, microclimate.

Topic 7 - Environmental issus

PROSPECTS OF PAULOWNIA PLANTATION ESTABLISHMENT IN THE DANUBE BASIN IN SERBIA

Mirjana OCOKOLJIĆ[1], Dragica VILOTIĆ[1], Mirjana ŠIJAČIĆ-NIKOLIĆ[1], Đurđa STOJIČIĆ[1], Mirjana MILENKOVIĆ[2]

[1]University of Belgrade - Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade, SerbiaTel. +381 11 3053 898, Fax. +381 11 2545 485
mirjana.ocokoljic@sfb.bg.ac.rs,dragica.vilotic@sfb.bg.ac.rs, mirjana.sijacic-nikolic@sfb.bg.ac.rs, djurdja.stojicic@sfb.bg.ac.rs,
[2]Republic Hydrometeorological Service of Serbia, Kneza Višeslava 66, 11030 Belgrade, Serbia
mirjana.milenkovic@rhmz.rs

Flora of the Danube Basin is realised in spatial and temporal continuity at three inter-related levels: species, genetic and ecosystem. The species level includes the total number of species in the Danube Basin flora. The genetic level includes the determination of functional genes comprised in individual plant species, as a result of evolution processes whose expression is an individual phenotype, i.e., a directly recognisable functional form. The ecosystem level includes the recording of the total number of species, the specificity of their populations and the biocoenoses in which the functionality is realised at the level of natural and cultural ecosystems. In this sense, detailed analysis requires precise species, intraspecies and ecological studies.

Taking into account the above, the Danube Basin was divided into zones based on the comparative and SWAT analyses of Paulownia ecological requirements, climate and other site conditions, by which suitable zones for the establishment of short rotation plantations on alluvial sites were selected in the Republic of Serbia. Namely, the success of each introduction depends on the ecological valence of individuals to environmental factors within which their survival is possible.

The species for plantation establishment were selected based on Paulownia commercial and bio-reclamation significance. The yield of biomass produced by Paulownia in East Asian countries is from 36 to 53 m^3/ha per year, its wood is of good technical quality, the species is significant in bee keeping, and it is characterised by a wide ecological range thanks to which it belongs to "pioneer" species. Paulownia is readily adaptable to devastated sites, after wildfires or defoliation caused by insect attacks. It can grow on different soil types, even on very poor and acid soil. Still, the most vital trees are observed on alluvial soils. A limiting factor for the application of Paulownia are low temperatures and light conditions. Juvenile trees freeze to the ground at low temperatures, but older trees can survive at low temperature to -20 °C. Paulownia is an obligative heliophilous species.

The study also presents the methods and rules of plantation establishment with the recommendations for plant spacing to achieve the maximal biomass yield in different development stages. Mechanical and chemical methods are recommended for the control of spreading in the favourable conditions, in which the species reproduces spontaneously and invades, because of which in such areas it is a highly invasive species and has to be suppressed.

Key words: *Paulownia tomentosa* (Thunb.) Steud., forest plantations, alluvial soils, devastated sites, biomass.

INFLUENCE OF ECOLOGICAL CONDITIONS AND ROOT ROT DISEASES ON THE REGENERATION AND SUCCESSION OF SPRUCE IN A MOUNTAINOUS AREA OF SERBIA

Nenad Đ. KEČA, Ljiljana M. KEČA

Corresponding author: University of Belgrade - Faculty of Forestry,
Kneza Višeslava 1, 11030 Belgrade, SERBIA
nenad.keca@sfb.bg.ac.rs

Root and butt rot caused by *Heterobasidion* and *Armillaria* species are, in economic terms, the most important diseases of conifers in the forests of northern temperate regions. The history of study of root and butt rot diseases dates back to 1963, when a severe attack of *Fomes annosus* (former name for *Heterobasidion annosum*) was reported on Kopaonik mountain. At the same time, the disease was found in natural forests of spruce throughout former Yugoslavia (Marinković *et al*., 1990).

Three sites in Norway spruce stands with different management and ecological conditions were chosen for stand characteristic evaluation. One site was inside a Nature Reserve, the second one in a managed spruce stand and the third one was on a slope unsuitable for spruce growth. The changes in stand structure were driven by the presence of *Heterobasidion parviporum*, but also the Armillaria species.

The sizes of genets differed depending on site conditions. Also, the process of regeneration was different in the sites studied. In site no. 1 small clusters of spruce trees filled the gaps formed by root rot diseases. Site no. 2 was devastated because of the presence of large gaps caused by the disease, while in site no. 3 other broadleaved trees, like *Sorbus aucuparia*, started to settle the empty space.

Key words: Norway spruce, Root rot disease, *Heterobasidion parviporum*, site condition, regeneration.

Topic 7 - Environmental issus

ANALYSIS OF TREATMENT TECHNOLOGIES FOR SOILS CONTAMINATED BY EXPLOSIVE RESIDUES

Predrag B. JOVANIĆ[1], Dragica STANKOVIĆ[2], Ana BORISAVLJEVIĆ[2]

[1]University of Belgrade, Institute for Multidisciplinary Research,
1 Kneza Višeslava St., Belgrade, Serbia;
jovanicp@ikomline.net
[2]University of Belgrade, Faculty of Forestry, 1 Kneza Višeslava St., Belgrade, Serbia

Most explosive compounds or explosive related compounds in soil have unique physical and chemical properties that make them unsuitable for analysis by the conventional gas chromatography (GC) methods. They have a low vapor pressure, but tend to be heat labile, i.e., they tend to breakdown at temperatures typically used in GC injectors. Liquid chromatography (LC) methods are well suited to the analysis of polar, nonvolatile, and heat sensitive compounds. In general, LC can be used for the analysis of a much wider range of compounds that is possible by classical GC methods. As a result, the standard method for the analysis of explosives has been the EPA Method 8330, which uses dual column high pressure liquid chromatography (HPLC) with an ultraviolet (UV) detector. The samples taken from the specific land filed could be analyzed by the classical chemical methods or as the base for the specific plant which will react to the presence of explosives. This research is dedicated to the modelling of TNT degradation and finding of a possible remediation technique. The analysis of the amino and nitroso degrades of explosives as markers for contaminant plumes is one application we are pursuing. Obviously the older field methods and the conventional HPLC/UV method will continue to play a key role. However, our own experience has shown that GC/MS and GC/MS/MS analysis using the newer instruments are the only established techniques for difficult real-world samples requiring both a high degree of sensitivity and accuracy.

Key words: explosive residue, soil, GC/MS, GC/MS/MS, TNT.

Topic 7 - Environmental issus

CHANGES OF SOIL CHARACTERISTICS AS A RESULT OF POPULUS ALBA FORESTS SUBSTITUTION WITH PLANTATIONS OF TAXODIUM DISTICHUM

Vladan M POPOVIĆ M.Sc[1], Zoran D MILETIĆ D.Sc[1],
Vesna V GOLUBOVIĆ-ĆURGUZ D.Sc[2]

[1]Institute of Forestry, Kneza Višeslava 3, Belgrade
[2]Faculty of Forestry, Kneza Višeslava 1, Belgrade
Corespodence e-mail vladanpop79@gmail.com

These researches were conducted on a 70-year-old seed plantation of *Taxodium distichum* that was established on the habitat of *Populus alba*. As a result of chemical changes of organic material that comes to the land surface as leaf waste, there are many changes in the number of microorganisms, and that caused some changes in their relations with the land in the natural forest of *Populus alba*. It affected the changes in soil characteristics with the increased relation between carbon und nitrogen, the increased content of humus, decreased acidity of the soil, and the increased content of available forms of phosphorus and potassium.

Key words: *Populus alba, Taxodium distichum*, substitution of species, soil microorganisms, properties of soil.

WATER RUNOFF REGIME IN CONDITIONS OF BEECH-FIR HABITAT ON THE MOUNTAIN GOČ

Lubomir LETIĆ[1], Vojislav ĐEKOVIĆ[1], Vesna NIKOLIĆ[1],
Aleksandar ANĐELKOVIĆ[1], Neđo MILOŠEVIĆ[1]

[1]Faculty of Forestry - University of Belgrade,
ljubomir.letic@sfb.bg.ac.rs

One of the main tasks of water management planning in hilly and mountainous areas in Serbia is the research of water runoff in habitats of different types of forests. This paper presents a perennial research of the catchment of Gvozdačka River on the mountain Goc. The analyzed data concerning the effect of forest vegetation on water runoff regime in forest basins refer to the Abieto-fagetum plant community which dominates in the study area. Analyzes were carried out on 30 hydrological units. Retention and runoff conditions, as well as their effect on the formation of Gvozdacka river mainstream were the subjects of this research.

Key words: type of forest, habitat, hydrologic unit, retention, runoff, etc.

Topic 7 - Environmental issus

FORESTS WATER POTENTIALS IN THE CATCHMENT OF THE PORECKA RIVER

Vesna NIKOLIĆ[1], Zoran NIKIĆ[1], Radovan SAVIĆ[2], Ljubomir LETIĆ[1]

[1]Faculty of Forestry - University of Belgrade,
vesna.nikolic@sfb.bg.ac.rs
[2]Faculty of Agriculture, Department of Water Menagment,
Novi Sad, Serbia

This paper presents a study of water runoff from the catchment of the PoreckaRiver that flows into the Danube near DonjiMilanovac and is located in the area managed by SE „ Srbijasume" and NP „Djerdap". Forests and forest lands dominate the area, over 70% of its surface, and have a key role inregulating waterrunoff and water retention in this catchment area. Beech, Sessile oak, Hungarian oak and Turkeyoak forests of pure ormixed stands cover this area.The following the ecological production units have been distinguished: Quercetummontanum; FagetumsubmontanumserbicumiFagetummontanumserbicum.

Key words: Forest type, water potential, runoff, retentionetc.

ANALYSIS OF LEGISLATION AND CERTIFICATION SYSTEM FOR THE PURPOSE OF ASSESSING THE COMPLIANCE OF QUALITY OF WOOD FUELS IN SERBIA AND THEIR CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

Slavica PETROVIĆ, Predrag SRETENOVIĆ

University of Belgrade, Faculty of Forestry
Kneza Viseslava 1, 11030 Belgrade, Republic of Serbia
e-mail: slavica.petrovic@sfb.bg.ac.rs
e-mail: p.sretenovic@yahoo.com

Results presented in this paper are obtained from the analysis of Serbian wood fuels market that was performed with the aim to assess the compliance of wood fuel quality with the requirements laid down in the new European standard EN14961. Following the adoption of this standard, on January 1, 2012, national quality standards for wood fuels ceased to be effective in all European countries. Given that the wood pellets are the most prominent Serbian export product in this industry, the adoption of the new European standard has the strongest impact on the producers of this type of wood fuel. For this reason, the conducted research is primarily focused on the quality requirements for wood pellets laid down by the said standard. In addition to the quality standard, the paper analyses the most important certification schemes applied for wood pellets - ENplus, DINplus and DIN-Geprüf.

Key words: wood fuels, wood pellets, quality standards, certification schemes, certificates

The paper is financially supported by the Ministry of Science and Technological Development of the Republic Serbia within the project ref.43007: „Research of climate changes and their environmental impact – monitoring of impacts, adaptation and mitigation“.

Topic 7 - Environmental issus

INVESTIGATION OF CHECK DAMS PERFORMANCE :CASE STUDY (SPIDAN CITY)

Fariba JAFARI[1], Majid SOUFI[2], Nasser TALEB BEYDOKHTI[3]

[1]Student B.SC. Watershed, Islamic Azad University, Arsanjan Branch, Dabiri_somayeh@yahoo.com
[2]Ph. D, Member Faculty, Fars Research center for Agriculture and Natural Resources, Soufi@farsagres.ir
[3]Ph. D, Member Faculty, Shiraz University, taleb@shirazu.ac.ir

Aim of improving watersheds, clean water to the rivers and to obtain better results should be in addition to soil conservation operations such as the biological (litter, pile work, enriching the forest, regenerating forest, etc.) and biomechanical (Banket, terrace, etc) attempted to reform the floods. Of correction the floods should main ducts distinguished from the subsidiary ducts and proposed separately method for each. The main ducts reform is extremely important in terms of floods damage. If you do not take such action, flood dig self bed and the sides of it are falling. A struggle to prevent carried particles by the flow of water into rivers and dams reservoirs, and precipitation of shipment material, correct the path by build check dams.

For this purpose 159 check dams in the basin Jubkhaleh of Sepidan city were evaluated. In this study, the data were collected from check dams that constructed.Then, during field operations, the location of all structures built in the area was determined using GPS and general characteristics of each of them was controlled and finally sedimentation volume behind the dam by using numbers, sedimentation area and height of the dam was calculated.

Key word: Check dams, Jubkhaleh basin, Sepidan city

DETERMININD THE CAUSE OF SUCCES AND/OR FAILURE OF CHECK DAMS (CASE STUDY: TAVILEH-BAND WATERSHED, EQLID SITY, SOUTHWEST OF IRAN)

Majid SOUFI[1], Seyede Somayeh DABIRI[2], Nasser TALEB BEYDOKHTI[3]

[1]Ph. D, Member Faculty, Fars Research center for Agriculture and Natural Resources, Watershed management and Soil conservation, Soufi@farsagres.ir
[2]Student B.SC. Watershed, Islamic Azad University, Arsanjan Branch, Dabiri_somayeh@yahoo.com (Responsible author)
[3]Ph. D, Member Faculty, Shiraz University, taleb@shirazu.ac.ir

Check dams are one of the most common alternatives for reducing watershed's sediment production, controlling erosion, stabilizing stream long profile and recharging water tables. 70% of recent watershed measures for erosion and flood control in Fars province consisted of check dams. This research has been carried out to determine the technical function of check dams in Fars province. In this research, 267 check dams were investigated in Tavileh-Band watershed located in Eqlid of Fars province. At first the basic data about the watershed including topographic map and background researches was gathered. Then to determine the number and type of constructed dams, all the streams were investigated during field studies and the locations of all the check dams were recorded by GPS. The technical features of check dams like the effective height, the height and length of the spillway, the height of sediments behind the dams and the distance between check dams and stream width were measured in the field. Meanwhile a number of qualitative parameters such as dam type, construction date, the amount of dam's function, plunge pool situation, presence of any damage to dams and the location of the damage were also determined. Other quantitative parameters including gradient of long profile and total length of the steam, drainage area and the order of each stream were estimated by GIS software and empirical methods. Finally dams were classified into damaged and undamaged dams, type of function and reasons for destruction and/or success were determined. The results indicated that out of 267 constructed check dams including 190 loose rock dams and 77 gabion check dams, 10 percent were completely damaged. This was due to the lack of adequate experience in designing and construction. 6 percent of them were slightly damaged but still were stable and efficient and 84 percent were undamaged.

Key word: Check dam, success, failure, function of check dams, damage, Iran.

Topic 7 - Environmental issus

LONG TERM IMPACTS OF CONSERVATION AGRICULTURE ON SOIL AND WATER CONSERVATION AND ECONOMIC PRODUCTIVITY IN NORTHERN ETHIOPIAN HIGHLANDS

Tesfay ARAYA[1,2], Wim M. CORNELIS[2], Jan NYSSEN[3],
Bram GOVAERTS[4], Jozef DECKERS[5]

[1]Mekelle University, Department of Crop and Horticultural Science,
POBox 231, Mekelle, Ethiopia.
[2]Ghent University, Department of Soil Management,
Coupure Links 653, B-9000 Gent, Belgium
[3]Ghent University, Department of Geography,
Krijgslaan 281 (S8), B-9000 Gent, Belgium
[4]International Maize and Wheat Improvement Centre (CIMMYT),
A.P. 6-641, Mexico D.F. 06600, México.
[5]K.U.Leuven, Department of Earth and Environmental Sciences,
Celestijnenlaan 200E, B-3001 Heverlee, Belgium
*Corresponding author: Tesfay Araya, Tel. +251914720426,
e-mail: tesfayaraya@yahoo.com

Conservation Agriculture (CA) can appreciably reduces runoff and soil erosion from croplands, thereby curb the sediment load in the rivers. Also CA can increase rainwater infiltration and in situ moisture conservation that can increase economic productivity of a land. A long-term tillage experiment was carried out (2005 to 2011) on a vertisol to quantify changes in runoff, soil loss, nutrient loss, crop yield and economic benefits due to CA on plain farmers' field in Adigudem, northern Ethiopian highlands. The experimental layout was implemented in a randomized complete block design with three replications on permanent plots of 5 *m* by 19 *m*. The tillage treatments were (i) *derdero*+ (DER+) with a furrow and permanent raised bed planting system, 30% standing crop residue retention and no-tillage on top of the bed, (ii) *terwah*+ planting system (TER+) with ploughing once at sowing, 30% standing crop residue retention and fresh broad beds, and (iii) conventional tillage (CT) with a minimum of three tillage operations and removal of crop residues. Data on soil loss, runoff, nutrient loss, soil moisture, crop yield, NDVI and economic benefits were collected. Significantly different ($p<0.05$) mean soil losses and runoff of 4.4 and 458, 12.5 and 706 and 18 and 925 *t/ha/y* and *m*^{3}*/ha/y* were recorded for DER+, TER+ and CT, respectively. In addition to the reduction on runoff, soil loss and nutrient loss and improve crop yield and economic profits, we argue that the reduction in draught power requirement will enable a reduction in oxen density with further natural resource benefits.

Key words: Conservation agriculture, runoff, soil loss, wheat, teff, grass pea, barley

ANALYSIS OF GROUNDWATER RECHARGE OF THE BASIN OF KOLUBARA RIVER IN SERBIA

Vesna Đukić

University of Belgrade, Faculty of Forestry, Department of Ecological Engineering for Soil and Water Resources Protection, Kneza Višeslava street 1, Belgrade, Serbia
e-mail: vesna.djukic@sfb.bg.ac.rs

Groundwater is an important water resource of Serbia that accounts for close to 90% in water supply of the territory of Serbia. It is very important to estimate the retention characteristics of basin and the amount of groundwater recharge when planning and managing water resources. The purpose of this paper is to estimate intensities of groundwater recharge from different parts of the basin basing on the known physical characteristics of the basin (climatic, paedological, geological and vegetational) on the example of 340 km2 Kolubara River basin up to "Valjevo" water level monitoring station in Serbia. This is done using the physically based model, established in this paper, which describes the vertical exchange of water between the atmosphere, unsaturated media and ground water. It is assumed that groundwater recharge is approximately equal to base flow. Taking into consideration that the amount of base flow of a basin is impossible to measure at the catchment outlet, the hydrograph of the base flow values obtained by separating from the streamflow hydrograph registered at the outlet of a drainage basin was used for checking the model's functioning. Results of the simulations show a good agreement between the calculated values of total groundwater recharge from the whole basin and the base flow values at the outlet point of the basin so that this model can be used to forecast intensities of groundwater recharge in a basin as a result of different rainfall intensities and different meteorological conditions at the soil surface.

Key words: groundwater recharge, base flow, physical characteristics of catchment

ACKNOWLEDGEMENT

Belgrade University - Faculty of Forestry expresses its appreciation to all the organizations that have assisted financially or otherwise in the organization of the International Conference "LAND CONSERVATION" - LANDCON 1209, as follows:

- Ministry of Education, Science and Technological Development of the Republic of Serbia
- Serbian Chamber of Engineers
- National park "Djerdap"
- City of Belgrade - Municipality of Čukarica
- Foundation of Environmental Protection of the Republic of Serbia
- Institute for Nature Conservation of Serbia
- RB „Kolubara" d.o.o. Lazarevac

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

502.521(048)
551.311.2(048)
627.4/.5(048)
630*116(048)
631.4(048)
551.583(048)

INTERNATIONAL Conference "Land Conservation" (2012 ; Donji Milanovac)
Sustainable Land Management and Climate Changes : conference abstracts / International Conference "Land Conservation" - LANDCON 1209, September 17-21, 2012., Danube Region, Republic of Serbia ; editors Miodrag Zlatić, Stanimir Kostadinov. - Belgrade : #University, #Faculty of Forestry, 2012 (Belgrade : Planeta print). - 188 str. ; 24 cm

Tiraž 300. - Str. 15: Preface / Miodrag Zlatic.

ISBN 978-86-7299-205-2

a) Земљиште - Заштита - Апстракти b) Ерозија земљишта - Апстракти c) Заштита од ерозије - Апстракти d) Педологија - Апстракти e) Клима - Промене - Апстракти

COBISS.SR-ID 193311500