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ENVIRO 2019

24th INTERNATIONAL SCIENTIFIC CONFERENCE

21st – 23th OCTOBER 2019

SUMMARY OF ABSTRACTS – ONLINE



Slovak University of Agriculture in Nitra
2019

SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA
Horticulture and Landscape Engineering Faculty
Department of Landscape Planning and Land Consolidation
Department of Water Resources and Environmental Engineering
Department of Biometeorology and Hydrology

UNIVERSITY OF AGRICULTURE IN KRAKOW
Faculty of Environmental Engineering and Land Surveying



ENVIRO 2019

24th INTERNATIONAL SCIENTIFIC CONFERENCE

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Recreation facility CROCUS, Kežmarské Žľaby, Slovakia

Summary of scientific abstracts – online
from the international scientific conference ENVIRO 2019,
held under the auspices of the dean of Horticulture and Landscape Engineering Faculty,
Slovak University of Agriculture in Nitra

prof. Ing. Dušan Igaz, PhD.

and

dean Faculty of Environmental Engineering and Land Surveying,
University of Agriculture in Krakow

prof. Krzysztof Gawroński, PhD, DSc.

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Topics of the conference:

24th edition of the International scientific conference ENVIRO 2019 set its goal to apprise the participants and scientists and professionals of the achievements of involved institutions in following fields:

- Effect of water management protection structures on landscape protection from drought and floods.
- Outlook and perspectives of landscape conservation and design.
- Climate change impacts, adaptation and mitigation.
- Current research and innovations in waste management.
- Biological, ecological, agricultural and technical measures in land consolidation.
- Use of geo-information technology applications in the landscape.
- Reflection of changing environmental conditions in horticultural production technologies.
- Modern approaches for designing and maintaining urban spaces.

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CONFERENCE PROGRAM

21st – 23th October 2019

Recreation facility CROCUS, Kežmarské Žľaby, Slovakia

21 October 2019 (Monday)

- 9:30** **Departure from Nitra (Hospodárska 7, Nitra) to Crocus recreation facility in Kežmarské Žľaby, Slovakia**
- 14:30 – 16:30** **Participant's registration**
- 17:00** **Official opening ceremony**
- 17:05 – 18:30** **Poster presentation:**

Effect of water management protection structures on landscape protection from drought and floods

- Tatijana KOTUŠ, Ján HORÁK, Tatiana KALETOVÁ: *Impact of agriculture on water quality.*
- Agnieszka POLICHT-LATAWIEC, Włodzimierz KANOWNIK: *Pollutants in sewage effluent and its impact on downstream water quality: A Case study of sewage plant, Upper Silesia Region.*
- Dušan HÚSKA, Lucia TÁTOŠOVÁ: *Climate change and remote sensing in town water management.*
- Martin MANINA, Peter HALAJ: *Optimization of pumping station's operational regime in drainage canal systems of the eastern Slovak lowland.*
- Piotr STACHOWSKI: *Characteristics of water management in open pit lignite post-mining grounds.*
- Marek TARNAWSKI, Agnieszka BARAN, Magdalena SZARA: *Assessment of trace elements leachability and ecotoxicity from bottom sediment.*
- Petr PELIKÁN, Jana MARKOVÁ, Věra HUBAČÍKOVÁ, Milosav ŠLEZINGR: *Characteristic wave height estimation in the fetch-limited conditions.*
- Lucia TOKOVÁ, Dušan IGAZ, Elena AYDIN, Natalya BUCHKINA, Ján ČIMO, Ján HORÁK: *The effect of N fertilizer on time domain reflectometry probe measurement accuracy in the field conditions.*
- Štefan REHÁK, Ľubica KOPČOVÁ, Peter STRADIOT, Karol KŇAVA, Bohumil KOVALČÍK: *Influence of Hanský drainage channel on environmental conditions.*

Outlook and perspectives of landscape conservation and design

- Denis BECHERA, Gabriel KUCZMAN: *Small Sacral Architecture in the Cultural Landscape of Požitavie.*
- Martina VEREŠOVÁ: *Characteristic features of traditional cultivated wine-growing landscape.*

Climate change impacts, adaptation and mitigation

- Elena AYDIN, Tatiana KALETOVÁ, Andrea BENKOVÁ, Jozef JOHANIK, Lisa HUMER, Ján ČIMO, Ronald E. PÖPLL: *Effects of initial soil moisture conditions on surface runoff and erosion rates – an experimental approach.*
- Justína VÍTKOVÁ, Peter ŠURDA, Peter RONČÁK, Viliam NAGY: *Differences in retention characteristics of soil after biochar amendment.*
- Ján HORÁK, Vladimír ŠIMANSKÝ, Elena AYDIN, Dušan IGAZ, Natalya BUCHKINA, Eugene BALASHOV: *Effects of Biochar and its combinations with N-fertilization on soil CO₂ emission, crop yields and relationships to soil.*
- Andrej TALL, Milan GOMBOŠ: *Results of water balance measurements in sandy and silty-loam soil profiles using lysimeters.*
- Branislav KANDRA, Dana PAVELKOVÁ: *The importance of volume changes in the determination of soil water retention curves on the Eastern Slovak Lowland.*
- Agnieszka BARAN, Tomasz CZEDH, Bożena ŁOZOWICKA, Piotr KACZYŃSKI, Monika MIERZWA - HERSZTEK, Marek TARNAWSKI, Krzysztof GONDEK, Magdalena SZARA: *The effect of the sediment organic matter on content and potential ecotoxicity of organochlorine pesticide residues in bottom sediments.*
- Zbigniew ZUŚKA, Alicja BARANOWSKA, Barbara SKOWERA: *Atmospheric air pollution with tropospheric ozone on the example of selected rural villages of the Lubelskie region.*
- Joanna KOPCIŃSKA, Barbara SKOWERA, Agnieszka ZIERNICKA-WOJTASZEK: *Circulation conditions determining high PM₁₀ concentrations in the Sącz Basin (Poland).*
- Sabina ANGRECKA, Piotr HERBUT, Dorota GODYŃ, Frederico MARCIO CORREA VIEIRA: *Development of microclimate conditions in two neighboring barns during winter.*
- Ján ČIMO, Karol ŠINKA, Andrej TÁRNÍK, Elena AYDIN, Beáta NOVOTNÁ, Jozefína POKRÝVKOVÁ, Lucia TOKOVÁ: *Change of Vegetation Period of Basic Species of Vegetables to Reference Period 1961-2010 and its Assumed Changes for Horizons 2011-2020, 2041-2050, 2071-2080 and 2091-2100 in Climate Change Condition.*
- Ján ČIMO, Karol ŠINKA, Beáta NOVOTNÁ, Andrej TÁRNÍK, Elena AYDIN, Lucia TOKOVÁ, Jozefína POKRÝVKOVÁ: *Selected Vegetable Species Vegetation Period Change to the Reference Period of Years 1961 – 2010 and its Expected Changes to the Time Horizons of 2011-2020, 2041-50, 2071-80 and 2091-2100 under Changing Climate Conditions.*
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- Vendula MORAVCOVÁ, Jana MORAVCOVÁ, Nikola NOVÁKOVÁ, Jakub POLENSKÝ: *Pectinatella magnifica: effect of the age of sample on the quality of DNA.*
- Viliam BÁREK, Anna BÁREKOVÁ, Vladimír KIŠŠ, Martina KOVÁČOVÁ: *Drought impact on dendrological changes and sap flow measurement in plants.*

Current research and innovations in waste management

- Anna BÁREKOVÁ, Lucia TÁTOŠOVÁ: *Biodegradable municipal waste composition in rural and urban area.*

Biological, ecological, agricultural and technical measures in land consolidation

- Jaroslav ANTAL, Elena AYDIN: *Suggestions for erosion control measures dimensioning.*
- Miloslav ŠLEZINGR: *Presentation of an Innovative Concept of Bank Stabilization.*

Use of geo-information technology applications in the landscape

- Jozef HALVA, Elena AYDIN, Andrej TÁRNÍK, Gisela M. EBERHARD, Ronald E. PÖPLL: *Detecting gully erosion features in agricultural catchments using photogrammetry.*
- Jozef HALVA: *Identification forest changes Primeval beech forests of the Carpathians with NDVI using.*

Reflection of changing environmental conditions in horticultural production technologies

- Ján MEZEY, Matej PETRÍK, Daniel BAJČAN, Luboš HARANGOZÓ, Tomáš TÓTH, Ivana MEZEYOVÁ, Jaroslav JEDLIČKA, Štefan AILER, Slavko BENÁTH, Oleg PAULEN, Eduard PINTÉR, Peter FLEISCHER: *Altitudinal zones influence on selected quantitative and qualitative attributes of lingonberry (*Vaccinium vitis-idaea*) in Tatra National Park.*
- Jakub POLENSKÝ, Pavel BOŽÁK, Jana MORAVCOVÁ, Pavel ONDR: *The use of unmanned aerial systems for detection of damage caused by game on agriculture fields.*

Modern approaches for designing and maintaining urban spaces

- Jozefína POKRÝVKOVÁ, Lenka LACKÓOVÁ, Jana KOZLOVSKY DUFKOVÁ, Ľuboš JURÍK: *Particle size changes in soil properties due to wind erosion in long term duration.*

18:30 – 19:30 **Conference dinner**

22 October 2019 (Tuesday)

8:30 **Breakfast**

9:30 – 11:00 **Plenary session (Part 1)**

Section head I.: prof. Ing. Jaroslav Antal, DrSc.

- 09:30 – 9:45** Jerzy JEZNACH, Agnieszka BOAS BERG: *Aktualne problemy nawodnień w Polsce w warunkach zmian klimatycznych.*
- 09:45 – 10:00** Zuzana ŠTEFUNKOVÁ, Viliam MACURA, Gréta DOLÁKOVÁ: *Hydroecological Quality Evaluation of the River Váh Aquatic Area.*
- 10:00 – 10:15** Ľuboš JURÍK: *The role of Small water reservoirs in changing climate.*
- 10:15 – 10:30** Andrzej STRUŽYŃSKI, Maciej WYRĘBEK, Krzysztof KULESZA, Adam NOWAK: *Changes to the intensity of erosion processes in mountain rivers under the influence of their training on the example of selected parts of Porębianka.*

- 10:30 – 10:45** Eva MAZANCOVÁ, Martina MAJOROŠOVÁ: *Stimulation surfaces in urban places.*
- 10:45 – 11:00** Karolina KRACZKOWSKA, Anna OLISKIEWICZ-KRZYWICKA, Piotr STACHOWSKI: *Analysis of changes in the structure of land use in the Poznań agglomeration on the example of the Rokietnica commune.*
- 10:00 – 11:15** **Coffee break**
- 11:15 – 12:45** **Plenary session (Part 2)**
- Section head I.: Dr.h.c. prof. Ing. Dušan Húska, PhD.**
- 11:15 – 11:30** Slavko BERNÁTH, Bernard ŠIŠKA, Oleg PAULEN, Veronika ZUZULOVÁ, Eduard PINTÉR, Matej ŽILINSKÝ, František TÓTH: *Drought Impact on Grape quality in Western Carpathian Region in Changing Climatic Conditions*
- 11:30 – 11:45** Andrej ŠKRINÁR, Jaroslav ANDREJI, Martina MAJOROŠOVÁ: *Assessment of functionality of the fish passage in Želiezovce small hydropower plant.*
- 11:45 – 12:00** Jana MORAVCOVÁ, Vendula MORAVCOVÁ, Nikola NOVÁKOVÁ, Jakub POLENSKÝ: *Land use changes through last 200 years in various production areas of South Bohemia.*
- 12:00 – 12:15** Kateryna ZHYKHAREVA, Roman ZHYKHAREV, Sergii ROGOVSKII: *Design Suggestions for the Organization of Landscape Space at the Renovation of the Ensemble of Postal Station in Bila Tserkva.*
- 12:15 – 12:30** Tõnis TEPPAND, Merrit SHANSKIY, Jüri LIIV: *Horizontal and vertical gardening on 3D printed natural composites supported on prefabricated timber structures.*
- 12:30 – 12:45** Tomasz STACHURA: *Analysis of the possibilities of using solar energy by an innovative solar power plant.*
- 13:00 – 14:00** **Lunch**
- 14:15 – 17:30** **Excursion**
- 18:30** **Social evening**

23 October 2019 (Wednesday)

- 8:30** **Breakfast**
- 10:00** **Departure to Nitra**

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Suggestions for erosion control measures dimensioning

Jaroslav ANTAL, Elena AYDIN

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Water erosion is the most significant form of physical soil degradation in Slovakia. It is estimated that approximately 55% of agricultural land is moderately vulnerable to water erosion, while 37% of agricultural land is severely or extremely vulnerable to water erosion. According to §5 of Act no. 220/2004 Coll. on agricultural land protection, the owner or user of agricultural land is obligated to perform permanent and effective erosion protection primarily by applying conservation cropping practices, such as contour ploughing and zero tillage practices. If necessary these practices can be supplemented with additional structural measures. Erosion control measures should be applied always when the calculated intensity of water erosion exceeds the permissible soil loss. Generally, the dimensioning of erosion control measures for the purposes of soil protection means in particular defining their location in the area of interest, design (determination) of their dimensions, and very often their material, constructional, architectural, aesthetic and other properties characterization. This contribution highlights some specifications that should be taken into account in the process of the dimensioning, but are in some cases omitted because of various reasons. In the case of soil protection from the negative effects of water erosion, hydrological and hydraulic properties of the proposed erosion control measures as well as hydrological and hydraulic characteristics of the area of interest should not be disregarded. This recommendation implies especially in case of dimensioning of permanent structures such as terraces and erosion ditches. Liquid precipitation (rainfall) is the most important source of water in Slovakia. Considering that precipitation characteristics have random (stochastic) character, probability theory should be applied also in erosion control not only to the characteristics of the design rainfall (e.g. the rainfall intensity, rainfall erosivity, rainfall depth), but also to the design parameters of erosion control measures (e.g. design discharge, design rainfall volume, rate of surface runoff). It is needed to apply the probability theory in many cases of determination of the permissible soil loss (e.g. in the protection of the urban area from mud floods). A special case is dimensioning of erosion control measures in situations, when natural characteristics of area of interest or dimensioning principles and current regulations are limiting and the proposed dimensions have to be reduced. In such cases, the effect of the proposed erosion control measure with limited dimensions on soil loss reduction has to be calculated and then the maximal distance between two erosion control measures on protected area set accordingly.

Key words: *agricultural land, water erosion, structural erosion measures, hydrological and hydraulic properties of erosion control measures*

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Effects of initial soil moisture conditions on surface runoff and erosion rates – an experimental approach

Elena AYDIN¹, Tatiana KALETOVÁ², Andrea BENKOVÁ², Jozef JOHANIK¹, Lisa HUMER³,
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Soil erosion caused by water causes several problems in agriculture and water resources management. In the Danubian Lowland Region of Slovakia, from late autumn to the beginning of spring (i.e. between the cropping seasons), many agricultural soils are left bare without protective vegetation cover. Due to changing climate patterns, in the south of Slovakia winters tend to become warmer and wetter, potentially leading to increasing surface runoff and soil erosion. The aim of this research is to determine the effect of changing soil moisture on soil erosion intensity. The research was conducted on a bare loamy Stagni-Haplic Luvisol located in an experimental area in the cadastral area of Kolíňany (Nitra district) applying rainfall simulator experiments (November 2017, March and April 2018). The volume of surface runoff from simulations at initial soil moisture ranged from 1.6 up to 3.5 dm³ and sediment concentration from 6 up to 105 g l⁻¹. After repeated simulation the volume of surface runoff rose from 2.3 up to 4.5 dm³ and sediment concentration became lower, ranging from 5 to 71 g l⁻¹. Variability in observed ponding and concentrated flow formation times can be explained by differences in antecedent soil moisture conditions. However, no relationship has been found between sediment yield and surface runoff volume, suggesting that further factors such as soil compaction, soil surface roughness might influence runoff-induced soil detachment processes.

Key words: *soil erosion, agriculture, rainfall simulation, concentrated flow properties, Stagni-Haplic Luvisols*

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The effect of the sediment organic matter on content and potential ecotoxicity of organochlorine pesticide residues in bottom sediments

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Organochlorine pesticides belong to a group of compounds known as Persistent Organic Pollutants (POPs). The highly persistent, hydrophobic properties and resistance to degradation make them a significant ecotoxicological problem and a challenge to control. Bottom sediments are known to be an important sink for organic contaminants. Among factors potentially influencing the fate of organochlorine pesticides in bottom sediments, organic matter is cited among the key ones. However, the qualitative and quantitative composition of organic matter plays a very important role in the assessment of organic pollution behaviour in the aquatic environment.

The aims of the study were to evaluate the content of organochlorine pesticides residues in bottom sediments from two dammed reservoirs: Rożnów (the Dunajec River, agricultural catchment) and Rybnik (the Ruda River, industrial catchment), South Poland, and to investigate the relationship between the fraction of organic matter and the content of organochlorine pesticides in bottom sediments. GC-MS/MS were used to the identification and quantification of the content of 39 organochlorine pesticides residues in the surface of sediments.

The most frequently detected pesticides were the DDT group compounds and dicofol. The commonly occurring pesticide residues in the sediments were (range, ng/10g) p,p'-DDD 2.99±0.52; p,p'-DDE 2.45±1.05; o,p'-DDT 3.06± 0.70; HCB 1.21±0.54; α-HCH 1.25 ±1.29; β-HCH 1.88±2.33; γ-HCH 2.08±2.13; dicofol 3.40 ±1.90 (Rożnów reservoir) and p,p'-DDD 11.89±11.04; p,p'-DDE 4.88±3.92; o,p'-DDT 14.13±16.61; HCB 6.00±1.70; HCH-α 1.30 ±1.30; dicofol 12.28 ±11.26 (Rybnik reservoir). The higher significant positive correlations between organochlorine pesticides residues content and TOC were found in bottom sediments form Rybnik reservoir. Moreover, we demonstrated that these pollutants have a strong affinity for stable fractions (black carbon, non-hydrolysing carbon) of organic matter in the studied sediments. The identification of above interactions is useful for the prediction of the fate of organochlorine pesticides in the sediments as well as the assessment of pollution risk.

Key words: *air temperature and humidity, vegetation, Orawsko-Nowotarska Basin...*

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Biodegradable municipal waste composition in rural and urban area

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In order to meet the EU recycling target, it was introduced an obligation for municipalities to separate and recover biodegradable municipal waste (BDMW) from the gardens of family houses in Slovakia. The collection of these wastes is being realized in brown bio-bins, those are usually emptied at two-week intervals. BDMWs are then processed in the municipal composting plants to compost. The composition and purity of arrived BDMW affect the quality of the output compost. The aim of our research was to evaluate the composition of BDMW coming from the family houses in rural and urban areas. Quantitative composition analyzes of the separated BDMW were carried out in the premises of two composting plants in the Nitra district in the southwest of Slovakia. BDMW at the plant of the municipal association in the village of Výčapy-Opatovce represented samples of waste from rural area and the BDMW at the composting plant of Nitra city served as samples of waste from the urban area. Our task was to compare the composition of BDMW in these composting plants and to find out if it is influenced by the different lifestyles of the inhabitants of village and town. In each composting plant, we performed 6 analyzes over 9 months during 3 seasons (spring, summer and autumn). Each analyzed sample weighed about 100 kg and we determined the weight fraction of garden waste, kitchen waste and the weight and type of impurities. In the BDMW from the inhabitants of Nitra, impurities accounted for 3.14% of the total amount of 623.8 kg of analyzed waste. From the rural area a total of 615.9 kg of BDMW was analyzed and the proportion of impurities in them was only about 1.58%. The pollution rate of sorted BDMW was the lowest in both areas in autumn (0.68% in Nitra and 0.95% in Výčapy-Opatovce). Waste samples in both composting plants during the summer analyzes were the most polluted (up to 5.72% in Nitra and 2.36% in Výčapy-Opatovce). The most common impurities were plastic, metal, glass and animal by-products. Kitchen waste suitable for composting represented only a negligible proportion (1.14%) in urban area samples. The rural population used bio-bins for kitchen waste to a greater extent (3.81%), but the proportion of kitchen waste is insignificant compared to garden waste. The results of the research show that the residents of the urban areas family houses are less disciplined in adhering to the rules of BDMW classification, what is especially evident in the summer months. Surprising there was the low proportion of compostable kitchen waste in the investigated samples of BDMW. This implies that these residents throw this waste into mixed municipal waste, which is determined for landfill.

Key words: *green waste, undesirable impurities content, household waste, municipal composting plant*

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Drought Impact on Grape quality in Western Carpathian Region in Changing Climatic Conditions

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Western Carpathians are historically the northern range traditional grapevine growing areas since Middle Age. Mean annual temperature has increased by about 1,1 °C during last century in Slovakia. Rised temperature impacted growing conditions of grapevine. Together with the rised temperatures higher frequency of draught periods and parameters are evident. Traditional grape producing areas are facing new challenges. Except of accelerated grapevine phenology, pathogene infection pressure and occurrence of pests including new ones, also the quality of grapes influencing wine quality is changing. For evaluation of draught impact on quality paramters of grapes there was chosen locality of Cultivar Testing Station in Dolné Plachtince which belongs to the Central Slovakian grape producing region. Potential impact of climate change on phenology was evaluated based on RCP 4.5. To describe water availability under changing climate the climatic water balance was used. Interannual variability of draught impact on grape quality was evaluated according to Palmer draught severity index (PDSI). Drought was categorised and emphasis was put on the most severe drought. 1990 – 2014 period was used as a base for evaluation. Period with the phenological phase crucial for grape quality formation was determined. As a model cultivars two groups of cultivars were selected with different ripening periods. Pinot Gris, Muscat Ottonel Weiss, Müller Thurgau representing early ripening cultivars (OIV earliness code 4 and 5), Grüner Veltliner, Riesling, Welschriesling representing late ripening cultivars (OIV code 8 and 9) were used. Cumulative values of PDSI for the crucial periods were calculated. PDSI values and sugar and acid contents which are the most important quality parameters of grape used for wine production were correlated to find correlation levels between them. Short drought periods did not influence grape quality significantly while long drought periods caused decrease of acid content and increase of sugar content. Though the tendency was clear, correlation level was very low. The most sensitive period in this sense was July – September period, however it was influenced by ripening term of individual cultivars. The results suggest necessity of thorough approach to cultivar selection taking into account its vitality and ability to preserve satisfactory acid content. This paper was made with support of grant project VEGA 1/0767/17: Response of ecosystem services of grape growing country to climate change regional impact - change of functions to adaptation potential.

Key words: *drought, grape, acid content, sugar content*

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Change of Vegetation Period of Basic Species of Vegetables to Reference Period 1961-2010 and its Assumed Changes for Horizons 2011-2020, 2041-2050, 2071-2080 and 2091-2100 in Climate Change Condition

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The aim of this study is to clarify a theory of climate changes and creation of map outputs of these changes for researchers in biology, agriculture, genetics and agricultural practice. This study has also an objective to provide fundamental climate data for basic elements and characteristics of energy balance from current and also future trends point of view in the Slovakia.

One hundred climatologist stations were chosen for agro-climate analysis in the Slovakia. These stations were chosen as representatives to cover all agricultural regions to 800 meters above sea level. Primary agro-climatic analyses were applied to time period 1961-2010 due to its homogeneity in measurements and observations. Trends and assumed map outputs of future climate changes were obtained by mathematical-statistical methods for horizons of years 2011-20, 2041-50, 2071-80 and 2091-2100.

This study brings significant benefits and detailed view to climate changes and their impact on temperature conditions in the Slovakia. Historical (from 1961), present and future (to year 2100) analyses of occurrence of ice, frost, summer and tropical days; and summer and tropical nights were described in this study. Vegetation period changes of selected fruit vegetables, *Brassica* vegetables and root vegetable in field conditions with prediction to year 2100 were analysed.

Agro-climatic analyses shown that start of vegetation period is getting earlier in a spring and continue longer to an autumn in last 30 years. The increase of the long vegetation period length 25-30 days in average is supposed with compare nowadays situation and years 2091-2100 (20-25 days for *Solanum lycopersicum*; 15-20 days for *Brassica oleracea var. capitata*; 10-15 days for *Daucus carota*).

Key words: *climate change; vegetation period; average temperature; map outputs; changes of temperature*

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Selected Vegetable Species Vegetation Period Change to the Reference Period of Years 1961-2010 and its Expected Changes to the Time Horizons of 2011-2020, 2041-50, 2071-80 and 2091-2100 under Changing Climate Conditions

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The aim of the paper is to bring scientists in the field of biological and agricultural sciences, geneticists, plants breeder and agricultural workers and other interested persons the knowledge from the theory of climate change, the map outputs creation of these changes and mainly to provide climate data from basic elements and characteristics of the energy balance in terms of the current state and also in terms of trends and assumptions of their future changes in Slovakia.

For the agroclimatic analyses, 100 climatic stations have been selected in Slovakia spread out so to cover all agricultural regions, i.e. up to 800 m above sea level. The basic agroclimatic analyses were related to the time series 1961 - 2010, which ranks among the most homogeneous in terms of measurements and observations. Trends and projected map outputs of future climate change were determined by the mathematic-statistical methods to the 2035, 2050, 2075 and 2100 year horizons.

This paper presents a significant contribution and detailed view on climate change and its impact on the temperature conditions in Slovakia. The work analyses in detail temperature changes (average, maximum and minimum temperature) with forecasts up to year 2100.

Agro-climatic analyses shown that start of vegetation period is getting earlier in a spring and continue longer to an autumn in last 30 years. The increase of the main vegetation period length 20 days in average is supposed with compare nowadays situation and years 2091-2100 (15-20 days for *Capsicum annum*; 15-20 days for *Brassica oleracea* var. *capitata*; 10-15 days for *Beta vulgaris* subsp. *vulgaris*).

Key words: *climate change; vegetation period; average temperature; map outputs; changes of temperature*

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Temperature Slovakia Conditions Change to the reference period of 1961 - 2010 and their expected changes to the time horizons of 2035, 2050, 2075 and 2100 in conditions of changing climate

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The aim of the paper is to bring knowledge from the theory of climate change. The map outputs creation of these changes provide climate data from basic elements and characteristics of the energy balance in terms of the current state as well as trends and assumptions of their future changes in Slovakia. For the agroclimatic analyses, 100 climatic stations have been selected in Slovakia spread out so to cover all agricultural regions, up to 800 m above sea level. These analyses are related to the period of years 1961 - 2010, when measurements and observations were the most homogeneous. Trends and projected map outputs of future climate change were determined by the mathematic-statistical methods to the 2035, 2050, 2075 and 2100 year horizons.

This paper presents view on climate change and its impact on the temperature conditions in Slovakia. There are analysed the temperature changes (average, maximum and minimum temperature) with forecasts up to year 2100.

The forecasts for the 2100 year horizon indicate that predicted average annual temperature will increase in average about 2.0 °C, maximum temperature will increase in average about 2.0 °C and minimum temperature will increase in average about 2.5 – 3 °C compared to the present.

Key words: *climate change; average temperature; map outputs; temperature change*

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Hydro-ecological Quality Evaluation of the River Váh Aquatic Area

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Understanding the impact of human activity on the aquatic habitat structure remains one of the most neglected areas of water research. The assessment of habitat quality is a good input for various water management decisions and planning, for example in determining minimum (ecological) discharge. Such evaluation was carried out on the lower section of the Váh River. A cascade of hydroelectric power plants has been built on the Váh River, and a natural stream channel is used to drain extreme discharges. Discharges in the old Váh channel are regulated by water structures for the most part of the year. These flows are not used for energy purposes, so it is important to determine the optimum discharge that will not negatively impact the flow ecosystem. Specifically, the article presents the results of research aimed at determining the minimum discharge below the weir in Trenčianske Biskupice. The minimal - remediation flow was determined by decision-making modelling IFIM methodology, specifically by the RHABSIM model (Riverine Habitat Simulation System). Input data were obtained by direct measurement on three reference sections in the Piešťany - Nové Mesto nad Váhom area. The flow characteristics were derived from three measurements in various water states. Habitat quality was represented by ichthyofauna. Data for the determination of appropriate fish curves were determined by the original method using divers video recording, resulting in a quantification of the discharge effect on ichthyofauna as a bioindicator of habitat quality resulting in design of a minimum summer discharge balance. The outcomes are suggesting that relationship between fish population and characteristics of the habitat are well defined by the discharge and structure of the riverbed. The main advantage of IFIM models is the fact that they quantify the biological changes in the water course, based on the discharge. Therefore, a cumulative suitability curve can be used. From the results of the minimum flow rates simulation, the optimal interval of water states is concluded for the preservation of biota in the flow. In particular, it is necessary to ensure the supply of water from the weir of Trenčianske Biskupice to the old channel of the discharge rate of $20 \text{ m}^3 \cdot \text{s}^{-1}$. Even at a discharge rate of $10 \text{ m}^3 \cdot \text{s}^{-1}$ there is no significant deterioration in the quality of the aquatic habitat. By increasing the rate over $20 \text{ m}^3 \cdot \text{s}^{-1}$, the fish population can be flushed out. This phenomenon occurs because the riverbed is not rugged and does not provide enough shelter options. Therefore, it would be advisable to improve the quality of the aquatic habitat not only by increasing the discharge rate, but also by revitalisation aimed at supporting the ruggedness of the riverbed.

Key words: *aquatic ecosystem, discharge, habitat quality, water management, fish population, IFIM methodology, RHABSIM model*

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Detecting gully erosion features in agricultural catchments using photogrammetry

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The use of photogrammetry in erosion research in agricultural catchments is a non-destructive method which combines remote sensing and image postprocessing. It allows contactless measurement, and provides topographic data with high spatial and temporal resolution. The advantages of photogrammetry over conventional methods, such as field-based measurements, include saving of time and avoidance of ground disturbance. This conference contribution presents the application of low-cost terrestrial photogrammetry in gully erosion monitoring. The gully is located in an agricultural catchment in Kolíňany, a municipality located in the Nitra region (Slovakia). Soil management includes mostly conventional agricultural practices, while contour ploughing has been applied upslope of the studied gully. The gully is located in the middle of an 850 m long slope. The gully itself is 37 m long, with an average depth of 1 m and started to develop in 2015. During field campaigns in November 2018 and July 2019, overlapping imagery of the gully features was performed by using a conventional digital camera. Point clouds obtained from the processed photographs, digital elevation models of the gully were computed and compared to detect geomorphic changes. First results revealed that the gully gradually deepened by 17% on average. We conclude that photogrammetry is a suitable alternative to conventional field-based approaches. The following limitations have been identified: i) presence of vegetation cover or other obstructions limits data accuracy; ii) high computational demand for image processing.

Key words: *photogrammetry, soil erosion monitoring, agricultural land, erosion gully*

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Identification forest changes Primeval beech forests of the Carpathians with NDVI using

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The report presents the use of spectral data from the images Sentinel-2 for the purpose of determining changes in land cover in the Primeval Beech Forests of the Carpathians in Slovakia. In the sites designated by UNESCO, the commission of the World heritage expressed by the suspect and unauthorized interventions and management in forests, mainly grub felling way of mining. For identifying suspicious interventions in the country in large areas, we decided to use methods of remote sensing of the earth using satellite images of the mission Sentinel-2, providing data in different spectral bands. The methodology consisted in the calculation of the vegetation index (NDVI) in selected sites and one test locality. For this use case have been selected data from the vegetation season in 2016, 2017 and 2018. After verification of the accuracy of the methodology on the test locality and calculating on the considered locality, we have not experienced significant changes in the way of forest management across the territory.

Key words, *Sentinel, Land cover, NDVI, Primeval Beech Forests of the Carpathians in Slovakia*

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Effects of Biochar and its combinations with N-fertilization on soil CO₂ emission, crop yields and relationships to soil properties

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As a result of the projected increase in atmospheric CO₂, the interest of the environmentalists is rising to reduce CO₂ emissions from soil and increase soil carbon (C) reserves, because the soil organic carbon (C_{org}) is one of the most important factors affecting soil fertility. The objective of this study was to evaluate the effect of biochar application alone and in combination with nitrogen N-fertilizers during 2014 - 2016 on (1) CO₂ emissions from soil and (2) to evaluate the influence of selected soil physical and chemical properties on these emissions. Further the effect of soil amendment application on crop development and crop yields (3) was evaluated during the vegetation season as well as after harvest. A field experiment was conducted with different biochar application rates: B0 control (0 t ha⁻¹), B10 (10 t ha⁻¹) and B20 (20 t ha⁻¹) and 0 (no N), 1st and 2nd level of nitrogen fertilization. The doses of level 1 were calculated on required average crop production using the balance method. The level 2 included an application of additional 100% of N in 2014 and additional 50% of N in the years 2015–2016 on silty loam Haplic Luvisol at the study site located at Dolná Malanta (Slovakia). The application of biochar alone or with N-fertilizer decreased (not significantly; $P > 0.05$) the cumulative CO₂ emissions during the first two years (2014-2015) by 1-25% when compared to their respective controls. There was one exception in 2015 where B10N1 treatment showed higher cumulative CO₂ by % 25 in comparison to the control without biochar (B0N1). Opposite was found in 2016 where treatments with biochar achieved a higher cumulative emission (insignificantly, $P > 0.05$) by 11% - 16% when compared to their controls. A positive effect of biochar application on cumulative CO₂ emissions in 2016 was observed in treatments B10N1 (12% reduction) and B20N2 (5% reduction) when compared to their controls (B0N1 and B0N2). The Pearson correlation showed that soil temperature ($r = 0.34-0.50$; $P < 0.001$) and soil moisture ($r = 0.20-0.34$; $P < 0.05$; $P < 0.01$; $P < 0.001$) are the key factors influencing CO₂ production from soil to the atmosphere. Biochar potential to increase crop yields was also observed only in the first two years of the experiment (2014 and 2015) and this effect was almost eliminated in the last year (2016). Nearly none of the differences in the crop evaluated crop yield parameters were statistically significant ($P < 0.05$). Based on these results we conclude that the addition of biochar alone or in combination with N-fertilizer could be an effective management practice for reduction of soil CO₂ emissions and increase of crop yields. However this positive effect is short-term and to maintain its positive effect would require its reapplication every two years, however field studies should confirm this suggestion.

Key words: biochar, N fertilizer, CO₂ emission, crop yields

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Some problems of irrigation in poland in climate change conditions

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Water is essential for sustaining life and providing ecosystem services for different human needs. In 2000, the European Union Water Framework Directive (WFD) was adopted against the background of increasing pressure on the waters of Europe. With the WFD, a new approach to governing water resources within the Union was introduced, aimed at facilitating a shift from fragmented and sectoral water policies to a more holistic, integrated and adaptive governance system at the hydrological scale of river basins.

It was found out that continuous growth in urbanization keeps creating challenges for implementing strategies that require additional space. In Poland there is a need for rainwater management practices to be implemented in dense urban cores. In this case, a combination of technologies and methods would need to be considered to effectively address space requirements on the ground needed for the installation of bioretention systems; (water sensitive urban design WSUD, examples; ditches collecting water, green roofs, green walls, rain garden and retention of water)

Climate changes should therefore be addressed and incorporated into plans that regulate the change of land use, namely, municipal and local plans, wastewater plans, water plans and municipal risk management plans. These plans constitute the future administrative basis for this area and are binding on the authorities. WSUD does not become a reality until the concept and techniques have been incorporated into all relevant plans.

Furthermore, successful implementation of rainwater technologies demonstrates the need for an integrative approach and utilization of combined methods. That is, a single technology will more likely not solve issues concerning excessive runoff and flooding. To be effective, an inclusive approach and mix of technologies needs to be oriented towards solving specific urban rainwater problems. Polish cities are undergoing transformation in the way resources will need to be utilized in the future. There is an obvious need to shift from long-established conventional approaches towards innovative sustainable solutions.

The overall conclusion is that no full regime shift towards the adaptive and integrated system of the WFD in Poland; the system for rainwater planning and governance is not clearly reflected in the formal institutional framework nor sufficiently underpinned by the administrative structure at national level.

Key words: *rainwater management, bioretention systems, urban rainwater problems,*

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The role of Small water reservoirs in changing climate

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Recent extreme climate combined with violent rainfall reminded us that life in landscape with agricultural production without water will be more and more difficult. Agriculture has been preparing for climate change during last years, in addition to macro-scale changes, small-scale actions in contact to villages and farmers are also needed. Basic problem for agricultural production is water. Small water reservoirs are creating sources for periods without rain. Climate change has influence at design of basic parts of reservoir and also at water use in reservoir. The paper deals with the necessary changes in the calculation of objects for new prepared water reservoirs and also with the necessary changes in the operational documentation of reservoirs for the management of retained water. Necessary changes are in the design of the objects to carry the flood wave through the spillways and also the necessary discharged water into the flow below the reservoir and also, for example, water loss by evaporation.

The operational documentation of the reservoirs is renewed in the specified cycles, but many things are still taken from the original project documentation. The paper presents proposals for technical solutions and water management calculations for small water reservoirs resulting from climate change and legislation.

Key words: *climate change, water reservoir, evaporation, spillway, flood, water management*

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The evaluation of inflow into municipal WWTP from the point of view of nutrient removal and its impact on the recipient

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At present, the world view of waste is changing. It can become a source of clothes for further use. The same applies to waste water. Lifestyle changes also bring about changes in wastewater production. The quantity produced, but above all the quality of waste water, varies. The paper deals with changes in water quality over a longer period to the municipal waste water treatment plant. The changes of inflow of selected substances and their influence on the purification process are statistically evaluated. An important possible element usable for agriculture is phosphorus in waste water. Phosphorus reserves in the world are gradually declining and wastewater is becoming an interesting place in the world for its recovery. The problem is the amount of recyclable phosphorus and the cost of the new technologies needed. Its concentration and total balance amount is also changing. This affects the efficiency of processes as well as the economy of possible solutions for its recycling.

The thesis evaluates suitable sites and balances for WWTPs in the city of Nitra with the designed capacity 175 450 EI.

Key words: *WWTP, recycling, phosphorus, raw water, nutrients, recipient*

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The importance of volume changes in the determination of soil water retention curves on the Eastern Slovakian Lowland

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Measurement, evaluation and application of water retention curves in heavy soils has own specifics. The source of these specifics is the high content of clay minerals. These cause soil volume changes during moisture changes. In the Eastern Slovakian Lowland conditions were proved up to 40 % of shrinkage from the saturated state. Volume changes are a three-dimensional process. In natural conditions, this is reflected in the vertical movement of the soil surface (potential in the Eastern Slovakian Lowland is up to 0.13 m) and the formation of cracks. This creates a two-domain soil structure consisting of a soil matrix and cracks. The formation of a two-domain soil structure significantly changes the dynamics of hydrological processes in the unsaturated zone. This is also manifested in transport processes and sudden precipitation events in the dry season. The cracks can through own retention capacity receive up to 50 mm of precipitation in the Eastern Slovakian Lowland conditions. Under laboratory conditions, volume changes are manifested by a change in the geometric dimensions of the examined soil samples. During the measurement of the water retention curves of heavy soils, the corresponding volume changes of the soil samples should be measured. Neglecting this physical effect leads to a distorted determination of the water retention curves in heavy soils. These distorted inputs generates an errors in the numerical simulation of the soil water regime. The existing errors then subsequently affect the analysis results. Issues of the impact of volume changes of heavy soils on the course of water retention curves and quantification of their impacts on the results of numerical simulation of soil water regime are often not given due consideration. The examined soil profiles are typical representatives of soils with a two-domain structure. This structure is most visible in the presence of cracks. The two-domain structure of soils is conditioned by the high content of those clay minerals which have the ability to change their volume according to the water content of their structure. Therefore, it depends not only on the content but also on the type of these minerals. In the Eastern Slovakian Lowland, the illitic-montmorillonite structure with the dominant content of montmorillonite is the largest in heavy soils. In the laboratory measurement of water retention curves points, changes in the samples volume were measured in the range of 0.24 - 43.67 % depending on the soil water potential during drainage. In the case of neglecting the effect of shrinkage during the drainage of samples a certain error is occurring in the calculation of the volumetric moisture. The range of this error was 1 - 13 % of volumetric moisture.

Key words: *heavy soils, soil water retention curves, volume changes of soil, Eastern Slovakian Lowland*

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Drought impact on dendrological changes and sap flow measurement in plants

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Climate-change scenarios around the world indicate that many areas of the globe will increase in aridity. Thus, all living organisms will suffer from a water scarcity, especially plants, which do not have locomotive structures that allow them to move elsewhere when water and food becomes scarce. As a result, different terrestrial ecosystems (natural and agricultural) will be severely affected and some may even collapse due to the extinction of plant species. It is therefore important to gain a better understanding regarding the effect of frequent drought stress on biochemical and physiological processes in plants as well as on the plant population and community in an ecosystem. Stem shrinkage and sap flow measurements in plants can be used for early detection and monitoring of water stress. In this study we used Diameter Dendrometer Small (DD-S) from Ecomatik to measure dendrological changes. For sap flow measurement we used SGA5-WS sensors from Dynagage, which use heat stem balance to measure sap in the branches. The research took place during the summer months from 31st July to 14th August 2018 and in the spring months from 27th March to 14th April 2019. As a research material we chose nuts (*Juglans regia*) in the orchard in Nové Zámky, Slovakia. In the summer of 2018, air temperatures reach an average of 19.3 °C, with an increase of almost 35 °C. Precipitation is low over the measured period. The highest value was reached on 1st August (4.4 mm). The sap flow values reached an average of 90 g/h, with higher values (above 120 g/h) being achieved only during precipitation. The diameter of the branches increased just after the rain on 1st and 2nd August, otherwise the dendrometric changes varied between 9.25 and 9.30 mm. The sap flow rate measured from 27th March to 14th April is less than 35 g/h, less than 2/3 compared to summer 2018 measurements. There were no leaves on the trees, nor was transpiration so intense. Evaporation is also influenced by temperature, which was on average only 10.7 °C in the measured period. The precipitation occurred only once during the period under review - on 6th April when the total was only 1.4 mm. Dendrometric changes are not visible, since the trees are not yet in the growth phase, but it is seen a few fluctuations when the branches shrink by 0.2 mm, which was caused by negative air temperatures. Based on the measured data, it is possible for the needs of agriculture to detect the onset of water stress before it is visibly observed on plants. It is necessary to continue to address this issue and to determine the size of the irrigation dose.

Key words: *drought, dendrological changes, sap flow, irrigation*

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Circulation conditions determining high PM₁₀ concentrations in the Sącz Basin (Poland)

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The aim of the study was to investigate the level of atmospheric particulate matter in the Sącz Basin depending on circulation conditions. The study used average daily PM₁₀ concentrations measured from December 2006 to November 2016 at the air monitoring reference station in Nowy Sącz, belonging to the Regional Inspectorate for Environmental Protection in Krakow. A calendar of circulation types for southern Poland was used as well.

Average seasonal PM₁₀ concentrations were calculated for each season of the year. The frequency (%) of exceedances of the acceptable 24-hour average PM₁₀ concentration ($50 \mu\text{g}\cdot\text{m}^{-3}$) was calculated in the analysed intervals, as well as the frequency of exceedances of the information level ($200 \mu\text{g}\cdot\text{m}^{-3}$) and alarm level ($300 \mu\text{g}\cdot\text{m}^{-3}$). Then, particulate concentrations were analysed with respect to types of synoptic conditions. For this purpose, average PM₁₀ concentrations in different types of synoptic conditions and the frequency of these types in each season were calculated.

In the decade from 2006 to 2016, the highest PM₁₀ concentrations in Nowy Sącz were observed in the winter and the lowest in the summer. The average daily PM₁₀ concentration was $85 \mu\text{g}\cdot\text{m}^{-3}$ for winter, $45 \mu\text{g}\cdot\text{m}^{-3}$ for spring, $25 \mu\text{g}\cdot\text{m}^{-3}$ for summer, and $49 \mu\text{g}\cdot\text{m}^{-3}$ for autumn. The most days in which the acceptable PM₁₀ values were exceeded were recorded in December, January and February (66.7–69.5%). The acceptable, information and alarm levels were most frequently exceeded in 2009, 2010 and 2012, and in February 2012 the information level was exceeded on as many as 30% of days.

The research showed a relationship between the PM₁₀ level and the type of accompanying atmospheric circulation. The highest exceedances of the acceptable values were nearly always observed in certain characteristic circulation conditions. Irrespective of the season, the highest PM₁₀ concentrations were found in anticyclonic non-directional types (*Ka* and *Ca*) and in the case of advections of air masses from the southern sector (*SEa*, *Sa* and *SWa*). The highest PM₁₀ concentrations were observed in winter, on average $128 \mu\text{g}\cdot\text{m}^{-3}$ for *Ka*, $115 \mu\text{g}\cdot\text{m}^{-3}$ for *SEa* and $109 \mu\text{g}\cdot\text{m}^{-3}$ for *SWa*.

Lower concentrations accompanied low-pressure systems. In cyclonic conditions, the highest concentrations of particulate matter exceeding the acceptable level were recorded especially in autumn and winter. They were mainly associated with non-directional types (*Bc*, *Cc* and *X*).

Key words: *circulation, PM₁₀ concentrations, Sącz Basin*

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Impact of agriculture on water quality

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The main problem in the use of water resources is pollution and excessive use of surface and groundwater by human activity, particularly agriculture, which has an impact on the environment components, locally and globally, through outflows and hydrological cycles of water circulation. Intensification is often accompanied by increased soil erosion, salinity and sediment loads in water and by the excessive inputs of agricultural (e.g. fertilizers) to increase productivity. The aim of this study was to evaluate the impact of agriculture on the quality of water in water stream (Bocegaj). The impact of agriculture on the water stream was carried out using selected water parameters such as pH, temperature of water, water conductivity, salinity, dissolved substances, undissolvable substances and quantity of nitrites, nitrates, phosphates and ammonium. The samples of water were taken from 2016 until 2018, from April until October, once a month at five locations. The weather condition was observed at sampling days as well. The temperature of water, pH, conductivity, salinity and dissolved substances were analyzed by multimeter Hach Pro + Multy 2. The quantity of undissolvable substances was determined gravimetrically and the quantity of nitrites, nitrates, phosphates and ammonium was made by using the indicator papers for testing of the chemical elements. According to the decree of the Slovak Republic Government no. 269/2010 Z.z. the monitored parameters didn't exceed the limit given by the government, except of dissolved substances which exceeded the limit of 0.900 mg.l⁻¹ in 2018 with 0.922 mg.l⁻¹. Water parameters changed at some locations during the three-year period. The water in the stream was slightly acidic in 2016 and it was slightly alkaline in 2018. Slight change of pH was caused by the use of nitrogen fertilizers, potassium fertilizers, phosphorous fertilizers and slurry (their decomposition) on the surrounding agricultural land. During the observation period, the temperature of water increased on average by 4 °C. Conductivity of water was moving on the scale from 500 μS.cm⁻¹ to 800 μS.cm⁻¹. In 2018 the quantity of dissolved substances, undissolvable substances and turbidity was higher than previous years. Increase of quantity of turbidity was probably caused due to abrasion or bank attrition. The recorded concentrations of nitrates, nitrites and phosphates in water were caused by the leak or flow of water from the surrounding agriculture used soils. There were used different types of fertilizers like ammonium nitrate, nitrate, sulfate ammonium and slurry. It is necessary to use correct method of fertilizers application and to build excrement storage tanks to avoid the penetration of nitrogenous substances into groundwater, which enter into surface waters and thus pollutes them. Excluding the mentioned causes of water pollution, the water quality in the flow is also influenced by the waters that enter the selected flow.

Key words: *water, quality of water, agriculture*

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Analysis of changes in the structure of land use in the Poznań agglomeration on the example of the Rokietnica commune

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The dynamic socio-economic development of suburban areas also causes changes in the urbanization of these areas. As a result, it is possible to observe an intensive development of housing construction. These changes are noticeable in areas located both in Poland and in Europe. The main aim of the work was to conduct a quantitative analysis of changes in the structure of land use in the Rokietnica commune. It is one of the 17th communes located in the poznański district in the Wielkopolskie Province, in Poland. The work was aimed at capturing the changes in land use that took place in the Rokietnica commune (in particular the development of settlement) in the period from the end of the 19th century to the present day. Topographic maps were used to assess the changes that took place in the studied area. The oldest of them is the German so-called Messtischblatt from the end of the 19th century. The next ones were, among others, maps of the Polish Military Geographical Institute from the 1930s. All maps used were made on the scale 1: 25,000. The next materials used were aerial photographs available to the public on the Internet as well as the Spatial Information System of the Commune Office in Rokietnica. There is a large availability of databases that provide free satellite imaging such as USGS EarthExplorer, LandViewer or Copernicus Open Access Hub, so the work also used a series of satellite images to capture the changes that have occurred over the past 30 years. The analyses were performed in free and open geoinformation software QGIS 3.4 and SNAP 7.0.0, which is dedicated to the processing of satellite data. They included, among others, georeference and vectorization of available cartographic materials. Photogrammetric materials were subjected to a variety of processes. The last one was subjecting them to supervised classification, which resulted in obtaining maps of land use in selected years. The comparison of the obtained results made it possible to determine the changes, consisting mainly in the increase of areas covered by residential buildings and decrease of agricultural areas. This may be due to the current trend of moving the residents of cities to their outskirts - the Rokietnica commune is located about 20 km from the center of the Poznań agglomeration.

Key words: *remote sensing, GIS, commune of Rokietnica, land use changes*

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Small sacral architecture in cultural landscape of Požitavie

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Small sacral objects - SSO both inside and outside of urban areas, together with solitary, group and area greenery, represent an important way of connecting rural landscape and urban areas of towns and villages. An important way is not only from the architectural, but also cultural and historical point of view. They also represent a way of linking centers and sites of greater importance in a rural country, and also help to smoothly link the impact, application of materialized elements of religion and materialized, religious culture and architecture with the landscape. Greenery, which is an integral part of these places, significantly affects the character features of places and objects. Greenery in relation to SSO is closely related and creates not only the overall character of the place, but also connection with the landscape and the system of greenery in space proportionally, but also compositionally. Together with the SSO, they form one whole and form the "Genius loci" – the spirit of the place, not only at the local but also at the landscape level. This document presents the results of the research carried out within the project Vega 1/0371/18 SakralArch: Preservation of the historical heritage and architectural diversity of small sacral buildings in the cultural landscape of Slovakia, grant agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic.

The subject and the aim of the research are results focused on the analysis and evaluation of the state and links of SSO to the landscape. The article, which is a summary of the survey, points out and evaluates the results of measurements, analyzes and data, not only about the SSO objects themselves, but also their inter connection and connection with greenery, visual connection with the landscape and landmark in a rural settlement. It evaluates the current status of SSO and greenery objects, which are both directly and indirectly linked to objects, together with an assessment of the perspective of preservation of the cultural and historical heritage for the future.

The results are beneficial in the area of the linking of green elements with sacral objects in the cultural area Požitavie, in three model areas within years 2017 – 2018.

Key words: *small sacral architecture, greenery, cultural landscape, countryside or village country space*

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Optimization of pumping station's operational regime in drainage canal systems of the eastern Slovak lowland

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The drainage channel systems of the lowland areas are equipped with control elements, among which drainage pumping stations play an important role. The pumping stations accelerate flow of drainage water in canal and make the operation of drainage facilities more efficient. In the past, the design of drainage channel systems and pumping station operation rules was based on the steady-flow theory with assumption of regular maintenance of the canals. The experience of the operators shows the low efficiency of operation of these devices due to the low longitudinal slope and the high hydraulic roughness of the canal and the largely schematic operational rules of the pumping stations. The authors of the paper have focused on design of a numerical 1D model of non-steady flow, which would enable to optimize the operating mode of pumping station. The model based on Saint-Venant's equations, which are numerically solved using the implicit Preissmann scheme, was verified by laboratory experiments on a hydraulic model and measurements on a hydraulic flume. The numerical model optimized operating rules, especially at higher hydraulic roughness, has been able to reduce the number of manipulations with pumps and extend their operating time.

Key words: *soil drainage, canal system, pumping station, numerical model*

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Altitudinal zones influence on selected quantitative and qualitative attributes of lingonberry (*Vaccinium vitis-idaea*) in Tatra National Park

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Lingonberry (*Vaccinium vitis-idaea*) is a small evergreen shrub that bears edible fruit, native to Tatra National Park in Slovakia. In this study there was observed, whether altitudinal zones have an impact of selected quantitative and qualitative parameters on wild-grown fruits of lingonberry (*Vaccinium vitis-idaea*) in Tatra National Park in Slovak Republic. Berries were collected from total 9 altitudinal heights from 900 to 1700 m a.s.l. following the distance of 100 height meters between two altitudinal zones during summer of 2017. Any statistically significant increase or decrease of fruit weight, fruit size, content of glucose, fructose, malic acid, total soluble solids, pH, total sugar content, titrable acidity, density, total polyphenol content and total antioxidation capacity was observed and it was found that the altitude didn't have any impact on the analyzed parameters in berries. Similarly, any statistical significance in content of Cu, Zn, Mn, Fe, Cr, Ni, Co, Pb, Cd and Hg was observed, and no increase or decrease of heavy metals content in dependence on altitude was present. From the observed heavy metals contents of none exceeded the allowed maximum level in fresh fruits. Higher content of Ni caused a decrease of TAC in berries. Higher fruit weight decreased the total polyphenol content, the lightest fruits (0.21 g⁻¹) contained the highest total polyphenol content (4281.56 mg.kg⁻¹) and vice versa. Fruits with larger diameter contained less Hg.

Key words: *lingonberry, Tatra National Park, heavy metals, total polyphenol content, fruit diameter, fruit weight*

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***Pectinatella magnifica*: effect of the age of sample on the quality of DNA**

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Pectinatella magnifica is a freshwater organism from *Bryozoa* group, which originates from North America, where it was found in 1851 by Joseph Leidy in Philadelphia region. Today it is known as an invasive species in the most of Europe and part of Asia. In the Czech Republic it was found in half of 20th century in Vltava river. Today the main habitat in Czech Republic is in the protected landscape area (PLA) Třeboňsko. It is characteristic with round shaped colonies which can get weight in tens of kilograms. These colonies are covered with zooids which are grouped in rosettes and filled with gel like matrix, which is made up of 98% water. These zooids produce every year large amount of internal buds, called statoblasts. Produced statoblasts can be mostly found floating on water surface. Their quick spread is possible not even by their great amount and hydrochoric way, but also by zoochoric way on feathers or fur of animals and antropochoric way on ship hulls or fishing tackels. This spread is possible because of anchor like hooks, which statoblasts of this species have. For produce of colony and statoblasts *Pectinatella* needs specific conditions. In the first part of life cycle is the most important substrate for statoblast attachment. Optimal for statoblast attachment are for example submerge parts of plants or sunk wood. For all parts of life are also important factors like water temperature or water quality. *Pectinatella magnifica* is species of oligotrophic and mesotrophic waters with minimal temperature 20°C. During whole year colonies of *Pectinatella magnifica* grow from simple cover to round colonies. The main way of reproduction is asexual by statoblasts, but in colonies there is also a massive sexual reproduction. For cognition of species are used different methods including ecological or molecular studies. For molecular studies it is important DNA of high quality, which is affected by way of isolation, used material and also the age of studied sample. Material for this study was gained in PLA Třeboňsko in ponds Veselí, Nový Kanclíř, Staňkovský, Hejtman and Cep. Samples were collected by scraping surface layer of zooids and statoblasts and fixed in 96% ethanol. For isolation of DNA there were used statoblast, which were cleaned from surface impurities. As method of isolation which was used for getting DNA it was used isolation method with CTAB-PVP (cetyl trimethylamonium bromide polyvinyl pyrrolidone). In this study there were compared samples of different age for finding out the influence of age of sample on amount and quality of isolated DNA.

Key words: *Pectinatella magnifica*, DNA, Isolation, sample age**Contact address:** Studentská 1668, 370 05, České Budějovice, Czech Republic
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Land use changes through last 200 years in various production areas of South Bohemia

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Since the beginning of the Neolithic agricultural landscape, the natural potential for expanding agricultural activity has been observed. This effort has always resulted in rapid deforestation and plowing of the most fertile soils, while maintaining a higher proportion of forests, pastures and unused land on less fertile soils. The landscape structure, formed by land use, has changed many times over the course of history depending on political, economic, technological and demographic changes. Most of Europe's cultural landscapes are the result of a long-term history of land use, with different phases overlaid, reshaped or exchanged. At present, we can observe a complex mosaic of land use and multilayered historical composition in many areas. As in the past, in our time there is no unified direction of landscape development. Rapid changes in manufacturing and information technology, as well as the demands of a society that is changing the economic base of households, are characteristic. Land use and profits in one area are expanding as efficiently as they are spectacularly shrinking in other regions.

The change in the structure and use of the landscape in the Czech Republic primarily reflects the individual phases of the historical and socio-economic development of the territory, as well as the political organization of the state, as in other European countries. Since the middle of the 19th century, these were mainly changes caused by war conflicts, their direct and indirect consequences, changes in the state system and related political acts. The changes that occurred after 1989 meant a change in almost all attributes of the landscape and socio-economic conditions. Changes in the structure and use of the landscape were determined primarily by the frequent transfer of arable land to meadows and pastures due to the subsidies policy of the state and later of the European Union. The socio-economic conditions have improved mainly due to the easing of market conditions, the renewal of business opportunities and the return to traditional values of the concept of ownership in general.

These conditions during the whole period of historical development in the territory of our country aimed to fundamental and often irreversible changes in the use of land with overlap into all the actions and activities of nature, landscape and society as a whole. The analysis was based on historical maps, aerial and satellite images from the point of view of real land use; from the point of view of the state of recorded written documents kept in individual cadastral records. The basic unit for determining changes in land use was the territory of the present South Bohemian Region. The territory of the South Bohemian Region was subsequently divided into three basic production areas, i.e. the potato, grain and forage areas.

Key words: *land use, production areas, South Bohemia, production areas*

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Changes to the intensity of erosion processes in mountain river under the influence of its training at the example of selected part of Porębianka stream

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The transformation of the catchment area causes changes in the dynamics of water flow and sediment delivery to the river beds. Human activities resulting from incomplete understanding of fluvial processes affect the hydrodynamic imbalance of mountain river beds. The most common effect of hydrodynamic imbalance is the emergence of an advantage of erosion processes leading to: river bed incision, disturbance of the hydrological relationship between the river and its valley, and disruption of the river's continuity. Modern activities should be aimed at restoring the balance of fluvial processes, and the assessment of the stability of the river bed bottom is helpful in planning them, which allows for the development of forecasts of changes in the horizontal and vertical system as well as cross-sections, parameters directly affecting the shape of the watercourse particularly important from the point of view of good engineering practice in the field of maintenance and hydrotechnical works. This paper attempts to determine the impact of the river training works carried out on the change in the intensity of erosion processes in the 2070 m Porębianka stream section, where bottom correction is performed using thresholds and steps. For this purpose, bottom stability analysis was carried out for conditions with existing transverse hydrotechnical structures and a forecast in the event of their removal. Simulation of the bottom stability and assessment of the Porębianka channel capacity at the selected location was performed for the following flows: $Q_{50\%}$, $Q_{25\%}$, $Q_{10\%}$, $Q_{5\%}$, $Q_{2\%}$, $Q_{1\%}$.

Key words: *river training, bottom stability analysis, Porębianka stream*

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Grain size changes in soil properties due wind erosion in long term duration

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One of the major threats to European soils is their degradation due to soil erosion by wind and water. While data on soil erosion by water are more frequently available within Europe, the current knowledge about spatial extent and amount of wind erosion is limited. Bigger part of all beginning researches has started with creating empirical models and equations (e.g. Universal Soil Loss Equation, Wind Erosion Equation). The rapid and accurate estimation of soil loss by wind erosion still remains challenge. Climate (primarily wind speed and precipitation), soil characteristics, the state of the soil surface and field length are the most important factors that determine the extent of wind erosion. The susceptibility of a soil to wind erosion depends on its aggregation and aggregate stability as affected by its texture, organic matter and moisture content. The content of historical grain size distribution was analysed from the records of Complex Soil Survey from years 1961 - 1970 provided by Soil Science and Conservation Research Institution. These data were compared with the outcomes of pan-European survey of soil (2011), which can be downloaded from the JRC website. To refine the results, we performed in the years 2015-2018 own mapping of grain size distribution in 5 cadastral areas degraded by wind erosion. However, fewer studies have quantitatively linked wind erosion to detailed grain-size fractions. In this study, we examined the effects of enhanced wind erosion on surface soil particle-size distribution in long term duration. In the wind susceptible environment, our findings suggest that significant soil texture change (e.g., the loss of soil fines) driven by wind erosion could happen rapidly and soil fine particles (e.g., silt and clay) may be depleted within a few years. Our results indicate that the soil surface became within 46 years much rougher, but in most of the areas influenced by the erosive effect the accumulation of fraction of the silt particles occurred. Analysis of changes in the frequency of occurrence of soil types in the observed time horizon indicates a growing trend of soil types from a strong representation of dust particles (silt, silt loam).

Key words: *wind erosion, soil particles, particle size distribution, soil loss*

Acknowledgment: This paper was created with the support of the Research and Development Support Agency for the preparation of this paper as well as the participation in the conference within the project APVV-16-0278 Use of hydromelioration structures for mitigation of the negative extreme hydrological phenomena effects and their impacts on the quality of water bodies in agricultural landscapes (Využitie hydromelioračných stavieb na zmiernenie negatívnych účinkov extrémnych hydrologických javov vplývajúcich na kvalitu vodných útvarov v poľnohospodárskej krajine).

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The use of unmanned aerial systems for detection of damage caused by game on agriculture fields

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Every year, wild game causes damage on agricultural land and fields as well as land owners as the hunting grounds reveal and solve them at the time of harvest. The use of unmanned aerial systems enables them to compare the yield map with the revealed damaged crop and consequently quantify the losses of crop yield in tons per hectare automatically. Every year, wild game causes damage on agricultural land and fields as well as land owners as the hunting grounds reveal and solve them at the time of harvest. The use of unmanned aerial systems enables them to compare the yield map with the revealed damaged crop and consequently quantify the losses of crop yield in tons per hectare automatically.

The disputes usually result in long trials and examinations of forensic experts, which often last for a very long time. It especially concerns the implementation of the provision of paragraph 53 of the Act no. 449/2001 Coll. on hunting which expresses a duty for for the owner (user) of the land to do some prevention against the damage caused by game. The user of the hunting land has to carry out the similar measures which aim to prevent damages or minimize it. It means, for example, building light fences, fencing with various signalization, audio devices, some repellent paintings, and so on. In many cases, the hunting associations express a very lax approach to the farmers and farms which force the hunting clubs to repay them. Setting the level of damage, which is often very difficult to express, is a really serious problem because the other factors can play an important role as well. And what is more, the farmers often apply for more money than they actually lost. All these purposes have caused the authors to develop new methods and processings of dates, which will be able to solve these problems in the future. The use of UAS(unmanned aerial systems) seems to be optimal, having low costs when comparing to aircraft during monitoring of a specific area.

This article deals with the use of unmaned aerial vehicles in an accurate quantification and comparison of damages that wild game causes on an agricultural land and fields. The problematics is significant mainly at the time of harvest when the damages could be the biggest, especially on the hunting grounds. The use of the unmanned aerial systems in comparison with unmodern common methodes is much more faster and enables to compare the yield map with the revealed damaged crop and consequently quantify the losses of crop yield in tons per hectare automatically.

The study is a part of the long-term research of the Faculty of Agriculture, University of South Bohemia in České Budějovice and was created with the support of the Security Research Project of the MVČR No. VI20172020098. Acknowledgments belong to CHMI (branch České Budějovice) for meteorological data from Temelín and České Budějovice, to operators in the area around Temelín for enabling monitoring of agricultural crops growth in the affected areas.

Key words: *unmanned aerial systems, wilde game, damage, culture field, precision agriculture*

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Aquatic ecosystems drainage channels East Slovakian Lowlands

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Ecosystem services essentially mean the benefits and benefits that ecosystems provide to us; water, food, soil formation, air and water purification, flood and drought protection, crop pollination, etc. The methodological approach of the research was based on the concept of estimating and evaluating ecosystem services in different scenarios of measures in order to propose effective measures to achieve good ecological status of water bodies and adjacent ecosystems. The ecosystem services were evaluated using a simplified ecological status classification based on the Common International Classification of Ecosystem Services (CICES) (EEA, 2018) and knowledge on the environmental and water status assessment of these channels to contribute to an improved quality of life for society. With the method of linking spatial units and tabular values, the significance of the selected nine ecosystem services was determined in principle by expert evaluation. The economic assessment of the effectiveness of funds spent on ecological status requires quantification of benefits, which should be the best argument for justifying the economic rationality of their use. The benefits of environmental investments do not take the form of an immediate monetary effect. The paper deals with the practical evaluation of ecosystem services in several channels on the Eastern Slovak Lowland.

Key words: *ecosystem services, water, drainage channels, evaluation*

Acknowledgment: This paper was created with the support of the Research and Development Support Agency for the preparation of this paper as well as the participation in the conference within the project APVV-16-0278 Use of hydromelioration structures for mitigation of the negative extreme hydrological phenomena effects and their impacts on the quality of water bodies in agricultural landscapes (Využitie hydromelioračných stavieb na zmiernenie negatívnych účinkov extrémnych hydrologických javov vplývajúcich na kvalitu vodných útvarov v poľnohospodárskej krajine).

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Characteristics of water management in open pit lignite post-mining grounds

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This paper assesses the hydrological water management system in the upper layers of post-mining grounds based on the example of the open coal pit “Kazimierz Północ” in coalmine „Konin”. Based upon the metrological conditions, primarily the sum of rain precipitation as well as the average air temperature, the water management system of the post mining area was analysed and assessed. Three very characteristic periods were selected for detailed analysis – the hydrological periods: wet (2006/2007), dry (2017/2018) as well as an average (2008/2009). The analysis of the metrological conditions, the soil, as well as the humidity of the ground which form the upper layers of the excavation heap shows that the water management system of post-mining grounds may be classified as rain precipitation-retention. Rain precipitation is the only resource of hydration for the plants used in the re-cultivation of the area.

Key words: *water deficit, water supply, re-cultivation of post-mining areas*

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Presentation of an Innovative Concept of Bank Stabilization

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The basis for the stabilization process is technical ways of bank stabilization, stabilization methods of biological engineering and biotechnical ways of stabilization. Another group is longitudinal redirecting constructions (built along the banks) and transversal redirecting constructions (built perpendicular or slanting to the bank). Less often they are used in our country breakwaters.

Stabilization of sand banks is very complex. We propose various forms of stabilization. We propose to modify the slope in several tilts. In addition, it is necessary to plant appropriate shrubs and trees.

At the bottom of the bank we propose different types of stabilization - this is the goal of the article presentation.

Key words: *shore stabilization, reservoir, water, stabilization structure, gravel and sand extraction*

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Results of water balance measurements in sandy and silty-loam soil profiles using lysimeters

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The aim of this paper is to compare the development of individual components of the water regime in two different soil profiles from the East Slovak Lowland under the same meteorological conditions. Two different soil profiles were examined in two identical lysimeters: sandy and silty-loam. A constant groundwater level of 1 m below ground was maintained in both soil profiles. Under the same meteorological conditions, all differences in the development of water balance members were caused only due to differences in soil profiles. The changes in the water content of the soil profiles as well as the flows at their upper boundary (precipitation, evapotranspiration) and flows at the bottom boundary (inflows/outflows) were compared. The examined lysimeters are part of the Lysimetric station in Petrovce nad Laborcom, which belongs to the Institute of Hydrology of the Slovak Academy of Sciences. The study period was from 19.05.2018 to 26.11.2018, which is 192 days. The first examined lysimeter was imported from the Poľany site. The location is located on the site of the remains of an old eolian sand dune. The second examined lysimeter comes from Vysoká nad Uhom. The surface of the lysimeters and their surroundings is made up of grass vegetation, trimmed to a height of ≈ 12 cm. Lysimeters are cylindrical, with internal diameter = 1,128 m and height = 2,5 m (surface area = 1 m^2 , cylinder volume = $2,5 \text{ m}^3$, total weight ≈ 5300 kg). For the purposes of balancing individual members of the water balance in lysimeters, the following equation was used: $\Delta W = P_{\text{lys}} + D - ET_a \pm BF$, where: ΔW is the change in the water content of the lysimeter (it is identical to the weight change of the lysimeter); D is the dew on the surface, ET_a is the actual evapotranspiration and BF are the flows at the lower boundary of the lysimeter (positive are inflows, negative are outflows). When comparing both profiles it is clear that under the same meteorological conditions and with constant groundwater level table the soil profile from Vysoká nad Uhom was more prone to dryness. Sandy soil profile from Poľany reacted more quickly to precipitation (or evaporation). Due to the higher hydraulic conductivity of the sandy soil compared to the dusty-loamy soil, the groundwater level response to external stimuli was much faster. For this reason, a higher inflow of water (BF) in the sandy (347,3 mm) than in the dusty-loam soil profile (242,5 mm) was necessary to maintain a constant groundwater level table. On the other hand, it is clear that if the groundwater level table is not kept constant, due to the faster water movement in the sandy profile, the sandy soil water supply would be exhausted faster and the soil drought would occur earlier.

Key words: *evapotranspiration, precipitation, water balance, lysimetric research*

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Assessment of trace elements leachability and ecotoxicity from bottom sediment

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The structure of sediments makes them a natural geosorbent, in which pollutants introduced to the water environment accumulate. Leaching of trace elements from sediments is particularly dangerous and may lead to the pollution of surface and groundwater, as well as soils.

The aim of the studies were: to assess the trace elements leachability from bottom sediments, to evaluate the ecotoxicity of water extracts prepared from bottom and to assess the effect of the granulometric composition and content of total organic carbon on the leachability of trace elements.

The Rożnów dam reservoir is located in the Lesser Poland Voivodeship in southern Poland. Currently, the surface of the reservoir amounts to 1776 ha, the total capacity does not exceed 165 million m³, whereas flood storage amounts to 80 million m³. The area of the reservoir is 1776 ha, and the reservoir length amounts to 18-22 km. The main tasks of the reservoir include flattening the flood wave on the Dunajec and the Vistula as well as mitigating its effects, production of electricity, and water supply for both the industries as well as individual recipients. Additionally, the reservoir exhibits landscape and tourism values. The samples of bottom sediments were collected at 46 points. The upper layers of bottom sediments (0–15 cm) were collected using the Ekman sampler.

The study demonstrated that the leachability of trace elements from bottom sediments does not pose a hazard to the environment. The Microtox test showed low toxicity of test water extracts. The clay and silty content was the dominant fraction in the bottom sediments. Fine fractions have high sorption capacities for trace elements. The studies of relation between leachability of trace elements, ecotoxicity, granulometric composition and TOC content are important for ecological risk assessment process and for management of bottom sediments.

Key words: *bottom sediments, trace elements, leaching, toxicity, Microtox*

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Climate Change and Remote Sensing in Urban Water Management

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Onshore water resources are an example of recycling our Earth's resources. It is the result of the constant circulation of water in nature, which represents a hydrological cycle consisting of small and large water circulation. Within this cycle, precipitation is an essential source of all land-based water, including those that originated in ancient geological times and are mainly a water supply in the deep horizons of the Earth's crust. The resources to restore balance in these water reservoirs are only rainfall, which is currently subject to a phenomenon called climate change. This is felt in particular by extreme events, which represent extreme rainfall and especially uneven rainfall distribution throughout the year. Thus, floods and erosion causing downpours come at certain times, followed by droughts when water is scarce.

Land use changes have caused a major change in the hydrological regime, with a significant impact on the runoff regime in the area. In urbanized regions, mainly due to the extreme increase of areas with minimal permeability, the accumulation capacity of the area is reduced and the waste water flows out of use and contributes to the amount of water coming to waste water treatment plants and flood situations.

The extent of the areas in urbanized areas contributing to runoff can be identified by remote sensing images; in particular using multispectral images where surface characteristics can be distinguished using the LAI index and controlled image classification. At the same time, it is possible to identify areas that could be used to create space for rainwater infiltration and accumulation below the surface. The paper evaluates the extent of land use changes in the city of Nitra, from 1954 to 2017. Specifically, the change in the growth of areas with minimal infiltration capacity in the area of the Slovak University of Agriculture and the potential of rainwater utilization and their accumulation in the area are monitored.

Key words: *remote sensing, town, urbanised area, water management*

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Horizontal and vertical gardening on 3D printed natural composites supported on prefabricated timber structures

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The concept of the paper belong to the topic of modern approaches for designing and maintaining urban spaces. This paper is based on the results of two different research and tests. One is designing, producing and constructing of timber composites of different species of wood using carpentry joints. The other is 3D printing technology together with novel quick setting peat composite material suitable for printing and for use in gardening. Urbanism with its problems require more attention for greenery. Due to decreasing areas for that, the mankind have to use more and more building surfaces for that – both as horizontally and vertically. Elaboration of current construction technology enable to mix supporting structures (even long span) of prefabricated solid timber or timber composite details with 3D printed fillings of peat and soil composites for gardening on flat or inclined roofs and vertical facades. Timber structures use prefabricated solid or concentrically composited laminated timber of different species of wood with carpentry joints for connections to avoid condensate on metallic parts because of non-controllable environment. Details are made with CNC processing in the factory in exact indoor conditions (temperature, humidity) and are easily assembled on the building site. After montage the timber details get will be in different weather conditions and the carpentry joints will be locked because of different expanding and decreasing of solid wood or lamellae of different species of wood. Composites for gardening/plants uses peat, soil, oil shale ash, silica fume and some other components for fast hardening and nutrients. Chemical reactions for fast hardening due to 3D printing technology need high pH at first but will be lowered quickly to a value suitable for different species of plants including productive. It is possible to make green sculptures. 3D seeding with more viscose composite is also possible on already hardened basis. Composite in congealed form can keep its shape for a long time without any outer container. By inside and field test results until now 12 months regardless spray for watering or heavy rain on it. Peat composites bind nutrients and water for longer period than usual because they are prevented from leaching out what got proved by tests with different species of herbs, flowers, vegetables, potherbs, frutexes and even oak trees. Most of them germinated and rooted well from the very beginning and lasted longer than usual in good health with only dipping. With mixed 3D technology (timber structures and soil composites) it is possible to reduce the labor-intensive craft in gardening in the future.

Key words: *composited laminated timber, peat composites, 3D gardening*

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The effect of N fertilizer on time domain reflectometry probe measurement accuracy in the field conditions

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There are many methods used for soil water content determination which can be divided into direct gravimetric methods that use soil samples to evaluate the water content or indirect methods that are based on the measurement of another soil property which is dependent on soil moisture. In the case of gravimetric method, soil moisture is determined from soil samples of known weight or volume after drying in the oven. The gravimetric method is the standard reference method against which other techniques are usually calibrated. Time domain reflectometry (TDR) is nowadays well established indirect dielectric technique to measure volumetric water content, however its accuracy is influenced by high concentration of salts in the soil. The volumetric water content measurements by both gravimetric method and TDR method were carried out at the experimental site in Slovakia during the period April – October 2017 once per week during two month period (April and May 2017) and once a month during the rest of the vegetation period of maize (June to October 2017). We focused on the four variants of the field experiment at the locality Dolná Malanta (Nitra, Slovakia): control treatment without biochar and N fertilizer (B0+N0), treatment with biochar at 20 t.ha⁻¹ without N fertilizer (B20+N0), treatment with biochar at 20 t.ha⁻¹ and N fertilizer at dose 160 kg. ha⁻¹ (B20+N160) and treatment with biochar at 20 t.ha⁻¹ and N fertilizer at dose 240 kg. ha⁻¹ (B20+N240). In this contribution we evaluated the TDR calibration technique using side-by-side gravimetric and TDR soil moisture measurements to improve time domain reflectometry measurement accuracy. The paper also aimed to investigate the linear relationship between both methods. As a result of the statistical analysis the linear relationship between the gravimetric and TDR methods was found to be significant. In the case of B0+N0 the R² was 0.93, B20+N0 R² was 0.97, in the treatment B20+N160 the R² value was 0.97 and in B20+N240 R² was 0.98. Besides the strong correlation was found between both methods, we assume that the TDR probe may lead to errors in the results without previous calibration. We have found that in treatments with added N fertilizer (B20+N160 and B20+N240) the accuracy of measurement by the TDR device was lower when compared to the gravimetric method. For non-fertilized treatments (B0+N0 and B20+N0), the differences might be caused by TDR device measurement accuracy. We assumed that the higher measurement inaccuracy may be caused by increased salt concentration in the soil as a result of applied N fertilizer.

Key words: *soil water content, time domain reflectometry, gravimetric method, calibration technique*

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Characteristic features of traditional cultivated wine-growing landscape

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One type of cultivated agricultural landscape is the traditional landscape of vineyards, in Slovakia. Small-blocks, which were sustainably managed in the past, represent also a specific way of life and cultivation of land, often creating an image of a place, locality or region. The Paper presents our research aimed on evaluation of visual-aesthetic aspect of traditional cultivated vineyard, especially its visible physical aspects. We consider them as landmarks that have been continually transformed and changed the primal landscape structure and became the result of specific cultural geomorphology and spatial articulation. This typical character of the area was created gradually, mainly through the introduction of various elements, which made the work easier and life more comfortable for humans. The second impact, which could be consider, is using the various constructional and technological methods of cultivation and to overcome obstacles associated with the natural specifics of the local landscape. Man has become a co-creator of a certain character of the territory, which we consider as an external visual appearance - the individual physiognomy of the landscape. A well-maintained, visually beautiful and aesthetically pleasing landscape is a sign of stable, balanced management, functionality, care and culture of the people who have lived there. We would like to point out the characteristic features of the traditional cultivated vineyard landscape, highlight its visual - aesthetic values, related to its appearance, which in the case of neglect, lack of care and change of traditional way of management, leads to destroying their sustainability or it could lead to their disappearing. At the same time, this experience can be an inspiration for further planning and landscape architecture.

Key words: *traditional cultural landscape, visual quality of the environment, characteristics of traditional vineyards...*

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Differences in soil water retention characteristics after biochar amendment

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Biochar is a solid porous material with high carbon content. It is the product of thermal degradation of organic materials in the absence of air (pyrolysis). Biochar was primarily discussed from the point of view of carbon sequestration, and its potential to reduce greenhouse gas emissions to the atmosphere. Soil amendment with biochar is currently the one of highlights in scientific community due to improve soil fertility and to moderate climate change. Various studies have shown that biochar has the potential to influence bulk density, soil porosity, soil water content, the available water capacity of the soil and the soil water retention curve. In this study we have focused on impact of amended biochar on soil water retention curve and available water capacity. In laboratory conditions were prepared samples with recalculated biochar in amount of 0, 20, 40 and 80 t.ha⁻¹. The used soil was classified as silt loam with the content of sand 15.2%, silt 59.9% and clay 24.9%. The used biochar was produced from mix of different poplar varieties (*Populus*) by pyrolysis at 520 °C. Soil water retention curves were determined from samples with volume of 100 cm³ through the use of standard pressure plate apparatus. Our results confirmed the results of other scientific studies that higher amount of biochar increased available water capacity of silt loam soil.

Key words: *biochar, soil characteristics, soil hydrolimits*

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Design Suggestions for the Organization of Landscape Space at the Renovation of the Ensemble of Postal Station in Bila Tserkva

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The preservation of unique hazardous structures, construction and landscapes is meaningful for each city and a country as a whole. Therefore, such facilities are the carriers of historical memory, which is the basis of the tourist attraction of the region. They provide cities with unique coloring, so their preservation is of a great importance. In Bila Tserkva, which is located in the Kyiv region, a unique in Ukraine ensemble of the Postal Station building, which has a monument of national importance, has been preserved. Built in the classic style by local tycoon Count Branicki in the first half of the nineteenth century, the buildings feature prominently in the three-dimensional composition of the streets and surrounding buildings. The area of the plot covers 1.6 hectares. Functionally complex is divided into different sections: main and household. The first part consists of the post office, the hotel and the coachman premises, which make the front yard (court of honour). The second part consists of the stable, the forge, the coachman and the caretaker's house. Nowadays, a restaurant is located on the territory of the hotel, the post office is occupied on the premises, the coachman room is rented and used as a trading platform, carriage house, forges and stables are abandoned and are used as storage facilities. The reconstruction project proposes the formation of a tourist cluster with the location of attractive facilities for tourists. For instance, it is possible to arrange a café in the coachman room, a museum carriage and harnesses or retro car museum in the carriage room, a post office museum in the room of a caretaker. Industrial buildings that undermine the integrity of the ensemble and lack in an architectural quality should be demolished and a reconstruction of the landscape is performed instead. The concept of development the ensemble territory has expanded on such areas as the central one with a fountain "Postman", a garden in a regular style, a horse rent playground and a multifunctional public area. With the establishing of the plants assortment, first and foremost, it is necessary to use the plantations which are common for a significant periodic construction. The tree planting is intended in front of the buildings that would not block them but emphasise their classic architecture. These requirements are met by grafted tree trunks of Norway maple (*Acer platanoides* 'Globosa'), common ash 'Nana' (*Fraxinus excelsior* 'Nana'). To create a hedgerow a common hornbeam can be used (*Carpinus betulus* L.). The boxwood evergreen (*Buxus sempervirens* L.) is perfect for curbs. The renovation of the Postal Station ensemble territory is an urgent task, the solution of which will help to preserve and popularize this monument of history and increase the tourist attraction of the city of Bila Tserkva both in Ukraine and abroad.

Key words: *renovation, reconstruction, improvement, landscape space, gardening, ensemble, Postal Station*

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Title: **ENVIRO NITRA 2019**

Summary of scientific abstracts online from the 24th international scientific conference ENVIRO 2019, held under the auspices of the Dean of Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra prof. Ing. Dušan Igaz, PhD. and the Dean of the Faculty of Environmental Engineering and Land Surveying, University of Agriculture in Krakow prof. Krzysztof Gawroński, PhD, DSc.

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