Dripping Rainfall Simulators Design for Soil Research

MSc Vukašin Rončević[1*], PhD Nikola Živanović[1], PhD Ratko Ristić[1], PhD John van Boxel[2] and PhD Milica Kašanin-Grubin[3]

1 University of Belgrade – Faculty of Forestry, Kneza Višeslava 1, 11000 Belgrade, Serbia
2 University of Amsterdam – Institute for BIodiversity and Ecosystem Dynamics (IBED), Science Park 904, 1098 XH Amsterdam, The Netherlands
3 University of Belgrade – Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

*author to whom correspondence should be addressed (vukasin.roncevic@sfb.bg.ac.rs).

INTRODUCTION

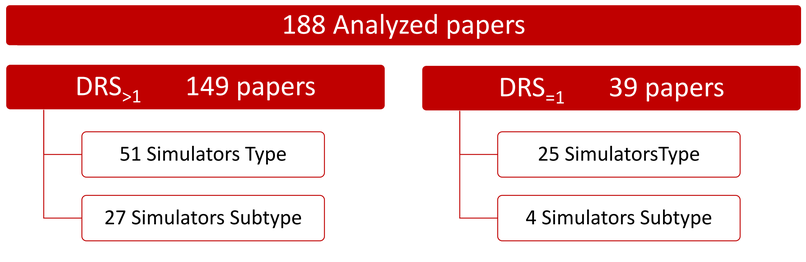
Dripping rainfall simulators (DRS) are important instruments in soil research. However, a large number of non-standardized simulators have been developed, making it difficult to combine and compare the results of different studies in which they were used. To overcome such a problem, it is necessary to become familiar with the design and performances of the current rainfall simulators applied.

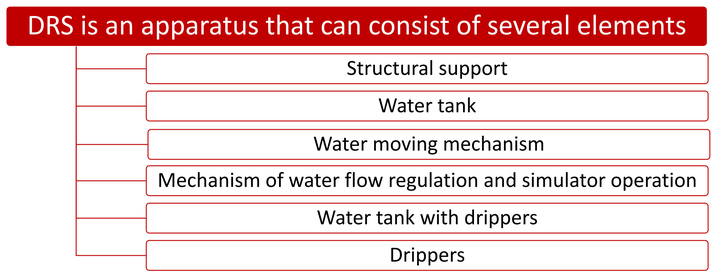
METHODS AND MATERIALS

It has been conducted a search for scientific papers describing dripping rainfall simulators and papers that are thematically related to the soil research using DRS. Simulator design analysis was performed integrally, for simulators with more than one dripper (DRS>1) and with one dripper (DRS=1). Descriptive and numerical data were separated from the papers and sorted by proposed categories, according to which the types and subtypes of used simulators are determined.

RESULTS AND DISCUSSION

The six groups of elements that simulators could consist of have been determined, as well their characteristics, representation and statistical analyses of their available numerical parameters. The characteristics of simulators are analyzed and presented, thus is facilitated the selection of simulators for future research. Description of future simulators in accordance to the basic groups of simulator elements should provide all data necessary for their easier replication and provide a step closer to the reduction of design diversification and standardization of rain simulators intended for soil research.





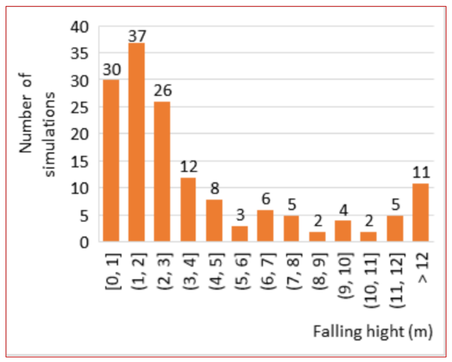


Figure 2. Number of conducted simulations at different drops falling heights.

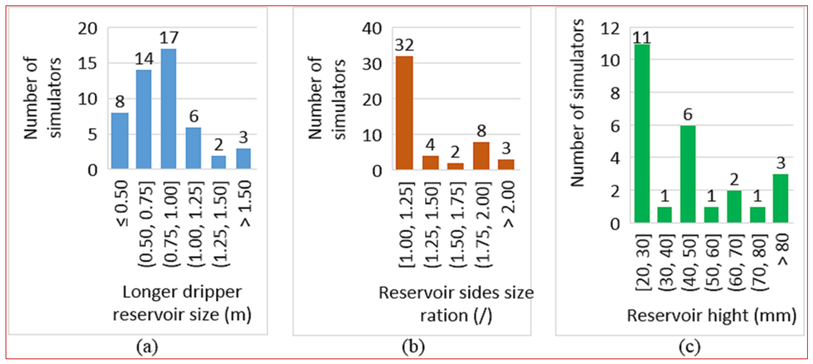


Figure 6. Rectangular box water tank size: (**a**) Number of different simulators of a certain size of the long side of a rectangular box water tank with drippers; (**b**) Number of different simulators of certain values of the ratio of the long and short; (**c**) Number of different simulators of certain height.

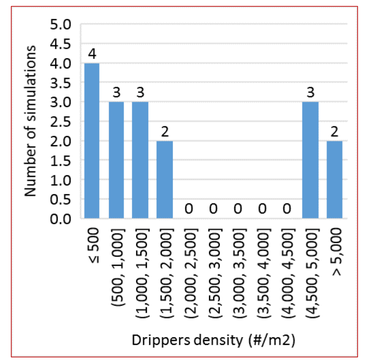


Figure 11. Number of different simulators of a certain value of the density of the drippers arrangement.

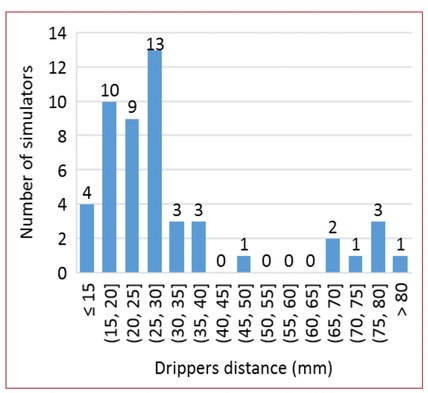


Figure 10. Number of different simulators of a certain value of the mutual spacing of the drippers.

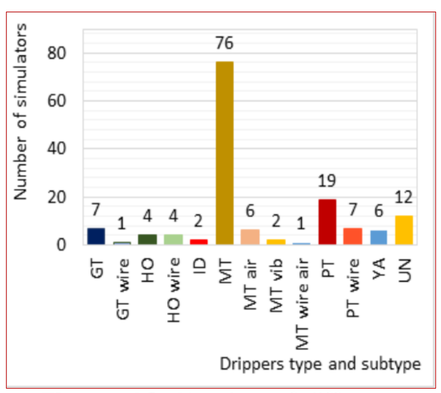


Figure 13. Number of different simulators with drippers of a certain type and subtype.

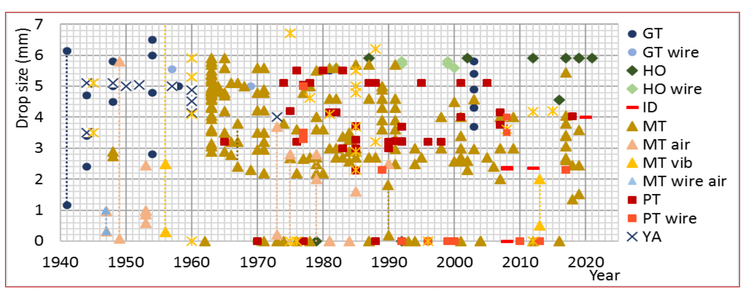


Figure 12. Type and subtype (modified performance drippers) of drippers and corresponding sizes of generated drops applied in previous rainfall simulations (GT - Glass tubes, GT wire - Glas tubes with threads, HO - Holes in dripper reservoir, HO wire - Holes in dripper reservoir with threads, ID - Irrigation drippers, MT - Metal tubes, MT air - Metal tubes under influence of air flow, MT vib - Metal tubes under influence of vibration, MT wire air - Metal tubes with threads under influence of air flow, PT - Plastic tubes, PT wire - Plastic tubes with threads, YA - Hanging yarn and UN - unspecified drippers type).

Experimental Research of Soil Resistance Using Portable Field Rainfall Simulator

PhD Nikola Živanović[1*], MSc Vukašin Rončević[1], MSc Stevan Ćorluka[2], PhD Vladimir Čebašek[3], PhD Milica Kašanin-Grubin[4], PhD Snežana Štrbac[4] & MSc Nevena Antić[4]

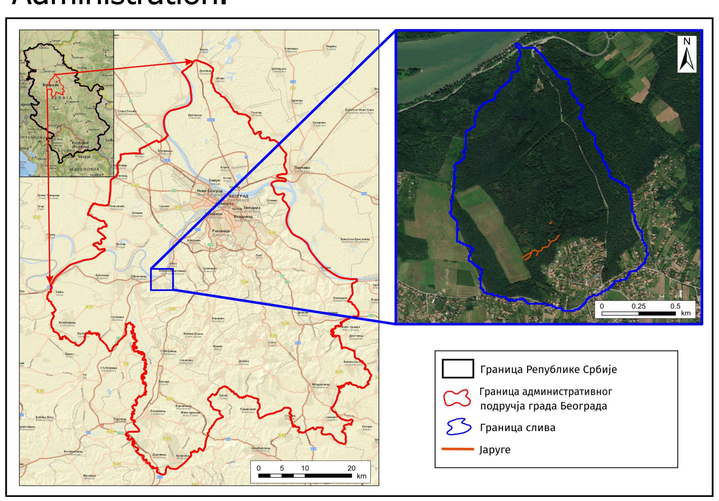
[1]University of Belgrade – Faculty of Forestry, Kneza Višeslava 1, 11000 Belgrade, Serbia
[2]Mining Institute, Batajnički put 2, 11080 Belgrade, Serbia
[3]University of Belgrade – Faculty of Mining and Geology, Đušina 7, 11120 Belgrade, Serbia
[4]University of Belgrade – Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

*Corresponding author: nikola.zivanovic@sfb.bg.ac.rs

SETOF Soil Erosion and TOrrential Flood Prevention: Curriculum Development at the Universities of Western Balkan Countries

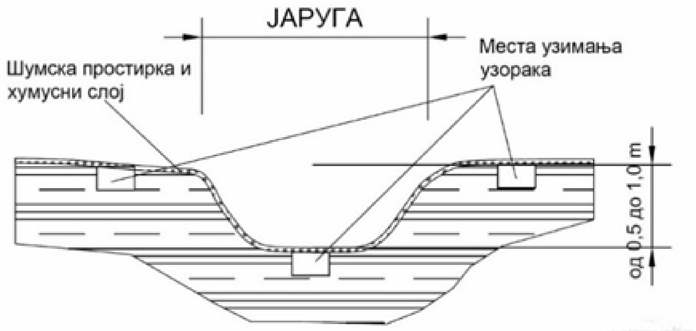
INTRODUCTION

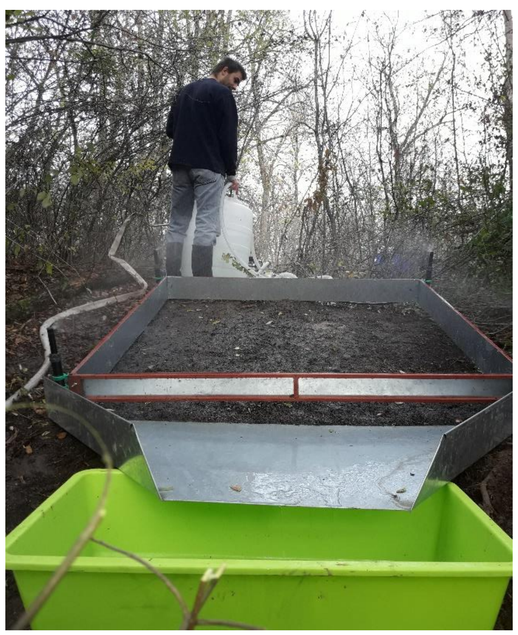
Degraded areas of forests, due to the action of erosion processes, have a reduced capacity to perform ecosystem services and a reduced production potential of wood mass. One of that kind is the site of the experimental research represented mainly by coppice forests, wort and ceris (Quercetum frainetto - cerris), which has the function of protecting the soil from erosion. In order to achieve an appropriate solution for remediation, it is necessary to determine the elements of the mechanisms of erosion processes, by analyzing the physical and mechanical parameters of the soil. The narrower area of the experimental site is located directly above the large front section of the "Duboko" landslide. The experimental research was carried out in the 47th ward, section d, of the "Košutnjačke šume" economic unit, which is managed by the "Lipovica" Forest Administration.



METHODS AND MATERIALS

Experimental soil testing has conducted using a portable field rainfall simulator in the forest area in the gullies and the conditionally stable zone of the gullies' banks. It's been observed the effects of changes in soil moisture on changes in the mechanical parameters of the soil, as well as the formation of surface runoff and soil erosion.





RESULTS AND DISCUSSION

It was established that the change in the current soil moisture affects the change in the mechanical parameters of the soil. The values of soil shear resistance and resistance to penetration are lower in tests in gullies, compared to tests on gullies' banks. The presence of cracks and macropores influenced the appearance of rapid infiltration of part of the precipitation into the soil, which resulted in small amounts of runoff water on the exit profile (3.76-32.71% of the total volume of rain). Surface erosion occurs in the form of tearing off entire microaggregates and their transport via micro-furrows to the outlet profile. The soils of the research area are sensitive to erosion processes when they are in a state of low natural humidity. With an increase in humidity above 20%, the soil becomes more sensitive to erosion processes and other forms of physical degradation. After an increase in the current humidity above 42% (the average value of the yield point), the soil is in a saturated state when the resistance forces cease to act.

Soil erosion rates based on anatomical changes in exposed roots – case study from south west Bulgaria

Dimitar Petrov Dimitrov, Eli Pavlova-Traykova
Forest Research Institute – Bulgarian Academy of Sciences

INTRODUCTION

In recent years different methods for soil erosion assessment have been used. Because of its high accuracy in estimations dendrogeomorphology was selected as one suitable and reliable scientific method to achieve main goals of this study.

In the research it is presented first part of complex research on soil erosion. Calculation of erosion rates pending for the next project period.

OBJECTIVES

The main goal of the study is to date denudation events using anatomical responses of the tree-rings of the roots.

METHODS AND MATERIALS

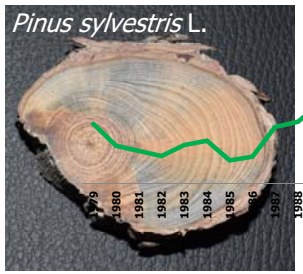
The study region is the watershed of the Sedelska River, South West Bulgaria. The watershed of the river is situated on the territory of one of the most affected by soil erosion regions in Bulgaria - Regional forestry directorate Blagoevgrad.

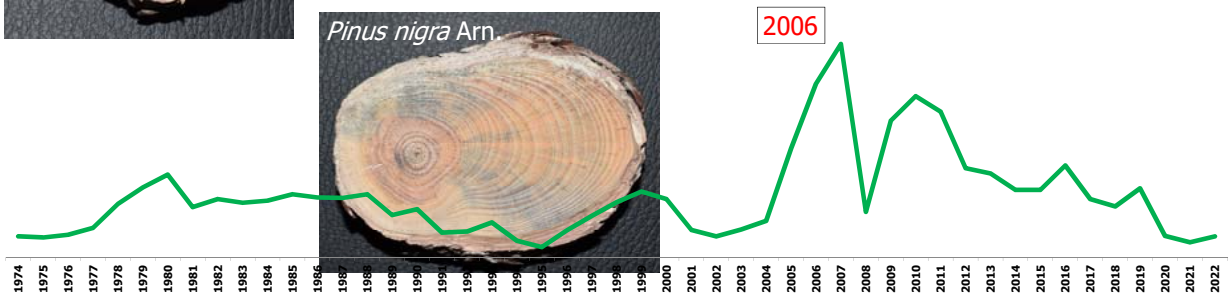
The samples from different tree species are used. Coniferous tree species (*Pinus nigra* Arn. and *Pinus sylvestris* L.) and broadleaves tree species (*Platanus orientalis* L. and *Quercus frainetto* Ten.) were studied. In total 30 trees were cored for dendrogeomorphologycal analysis. One sample from the root and one sample from the stem have been taken from each study tree.

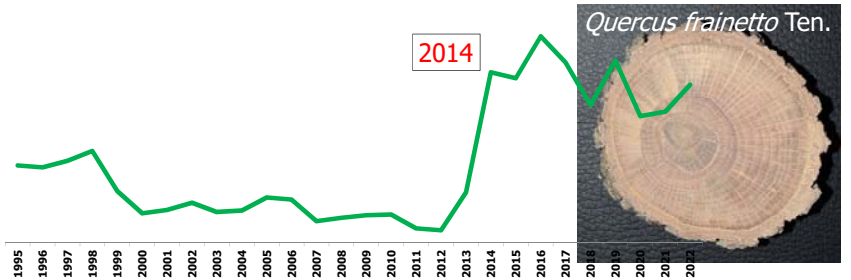
Pinus sylvestris L.

Quercus frainetto Ten

RESULTS AND DISCUSSION







ACKNOWLEDGEMENTS

The present study was conducted in relation to implementation of a project approved for financing on the basis of the Fund for Scientific Research Competition for financing fundamental scientific research of young scientists and postdoctoral students - 2021, with number КП-06-М56/5 with topic "Soil erosion assessment and efficiency of applied erosion control activities in Sedelska river, tributary of Struma river".

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GIS APPLICATION FOR HYDRLOGICAL FEATURES PREVIEW OF FLOODPLAIN FORESTS

[1]Vesna Nikolić Jokanović, [1]Dušan Jokanović, [2] Radovan Savić, [1]Aleksandar Anđelković

[1]University of Belgrade, Faculty of Forestry, assistant professor, Kneza Višeslava 1, 11000 Belgrade, Serbia,
[2]University of Novi Sad, Faculty of Agriculture, full professor, Trg Dositeja Obradovića 8, 21000 Novi Sad

SETOF Soil Erosion and TOrrential Flood Prevention: Curriculum Development at the Universities of Western Balkan Countries

ABSTRACT or INTRODUCTION

The main ecological factor, which determines survival and productivity of pedunculate oak forests, is abundance of soil water (Matić, 2000). As for higrophilous oak pedunculate forests in Ravni Srem, they are located in alluvium of the river Sava in Vojvodina. There is a dominant presence of soft (willow, poplar) and hard (hornbeam, oak pedunculate, ash) deciduous species in this area. Decline of oak pedunculate forests is a huge problem and some papers related to its site features and watering regime in Ravni Srem area are familiar with this issue (Medarević et al., 2009; Letić et al., 2014; Nikolić, 2017).

OBJECTIVES

Ravni Srem forests occupy alluvial flat area of the river Sava, consisted of soft and hard decidious forests of a very high quality. This forestry area includes all forests in Srem and it is divided into: Gornji Srem, with all management units western from Sremska Mitrovica to the public border with Croatia and Donji Srem, that includes all management units eastern from Sremska Mitrovica to the teritory of municipality Zemun. In 1932, in the area of Gornji Srem was built a protective embankment that exluded influence of flooding to these alluvial forests. On the other side, flooding still has a very significant impact to oak pedunculate forests in Donji Srem.

METHODS AND MATERIALS

Spatial interpolation of data related to groundwater level at researched area was displayed by using ArcGIS software – model Kriging. In geostatistics, Kriging is a method of interpolation for which the interpolated values are modeled by a Gaussian process governed by prior covariances, as opposed to a piecewise-polynomial spline chosen to optimize smoothness of the fitted values. For the whole researched period (2010-2013), an average (reference) groundwater level during vegetation period was determined and, based on climate factors (before all precipitation quantity during vegetation period), there were established the driest and the wettest year within a researched period, respectively.

RESULTS AND DISCUSSION

The paper deals with influence of groundwater level fluctuations on site characteristics of this species in the area of Donji Srem. It should be emphasised that researched locality is under influence of flooding and groundwater. For the whole researched period (2010-2013) was determined an average (reference) groundwater level. For extreme years (2010 as the wettest and 2012 as the driest) was also determined an average groundwater level. Medium groundwater levels were always determined during vegetation period, because plants adsorb the most water in that time. Based on obtained results, it can be deduced that an average rising of groundwater level in 2010 was 0.9 m, while an average falling in 2012 was 1 m from reference level. These deviations suggest presence of potential risk zones that can endanger pedunculate oak survival. Using of geostatistical analysis enables risk zones defining, which is of a great practical importance. It should be emphasised that during whole research in Donji Srem was recorded dominantly high reference groundwater level (from the top of piezometric construction to the depth of 1 m). Bearing in mind presence of high groundwater level, and that flood water of the river Sava retain for a long time, as well, mutual impact of hydrogeological and hydrological factors causes that these site conditions are more suitable for another higrophilous species such as ash, poplar, willow, than for pedunculate oak.

Study on water runoff at ecological station "Igralishte"

Eli Pavlova-Traykova

Forest Research Institute – Bulgarian Academy of Sciences

ABSTRACT

Climate change and its influence on ecological conditions led to changes in annual and monthly amounts of precipitations and also to a decrease in the ability of soils to deal with water quantities. In recent years floods caused by single rain became more and more common and for that reason studies of the ability of vegetation and soils to deal with the formation of a high quantity of water runoff are of great importance for undertaking appropriate actions for the mitigation of flooding risk.

The study region is part of the territory of the Ecological station "Igralishte", which is situated on one of the tributaries of the Sedelska river. The region is characterized by severe erosion processes in the past and specific ecological conditions that are prerequisites for significant water runoff.

In the research, information from two experimental watersheds is used. The quantity of the annual and monthly runoff is determined and the quantity of precipitations is analyzed.

Key words: water runoff, soil erosion, Sedelska river

OBJECTIVES

The purpose of the investigation is to determine the amount and dynamics of water runoff in small-scale watersheds with a different types of land cover.

METHODS AND MATERIALS

Ecological station "Igralishte" is situated in Maleshevska Mountain and it was established in 1970. Since that year a lot of significant research on different thematic have been conducted in 4 experimental catchments with different characteristics and sizes (fig.1).

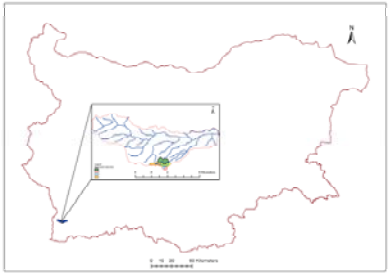


Figure 1. Location of Ecological station "Igralishte"

Nowadays, in the station "Igralishte" mainly soil erosion and hydrological research are carried out. The current study was conducted in two experimental catchments – watershed 2 and watershed 4. The results cover a five-year study period. The amount of surface water runoff is determined in hydrometric stations. Precipitations are measured with rain gauges.

The water runoff coefficient was calculated as the ratio of the total water runoff to the amount of precipitation in the catchment.

RESULTS AND DISCUSSION

In mountain watersheds, such as the Sedelska River, the vegetation is decisive for the formation of water runoff, and of the elements of the climate, the main influence has precipitation. In Bulgaria, precipitation with an amount ≥ 9.5 mm and an intensity ≥ 0.180 mm/min is considered as precipitation that causes runoff.

In the research, for the period of investigation, more water runoff from the watershed with less vegetation is established fig. 2.

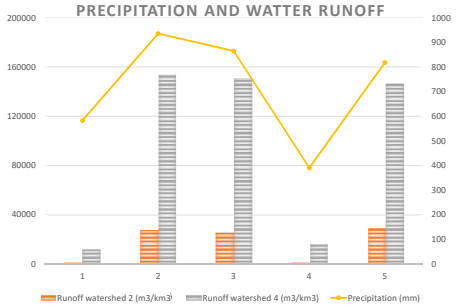


Figure 1. Precipitation and water runoff dynamics

In the studied watersheds, the occurrence of runoff maxima (December-March) is associated with the winter maximum and summer minimum of precipitation, respectively (fig.3). A clear relationship is established between the annual amount of precipitation and the annual water runoff.

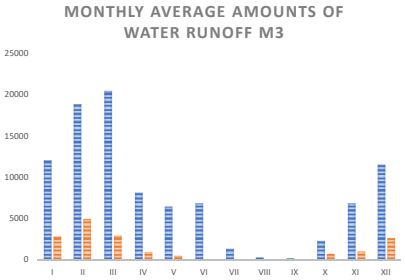


Figure 3. Average amounts of water runoff

Water runoff coefficient is calculated as follow – for experimental watershed 2 it is 0.024 and for the watershed 4 – 0.134.

The duration of the water runoff is also calculated, and again at catchment 4 it was longer by about 10 days. When comparing the results obtained for past periods, it was found that this period has decreased in both watersheds. The total amount of runoff has also decreased, and these results are mainly due to an increase in plant cover (grassing), a decrease in the percentage of arable land and improvement of tree vegetation.

ACKNOWLEDGEMENTS

The present study was conducted in relation to implementation of a project approved for financing on the basis of the Fund for Scientific Research Competition for financing fundamental scientific research of young scientists and postdoctoral students - 2021, with number КП-06-М56/5 with topic "Soil erosion assessment and efficiency of applied erosion control activities in Sedelska river, tributary of Struma river".

Integrated Watershed Management – Trends and Perspectives

Filip Vasić*, Miodrag Zlatić, Nada Dragović, Nikola Jovanović, Milica Caković

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

INTRODUCTION

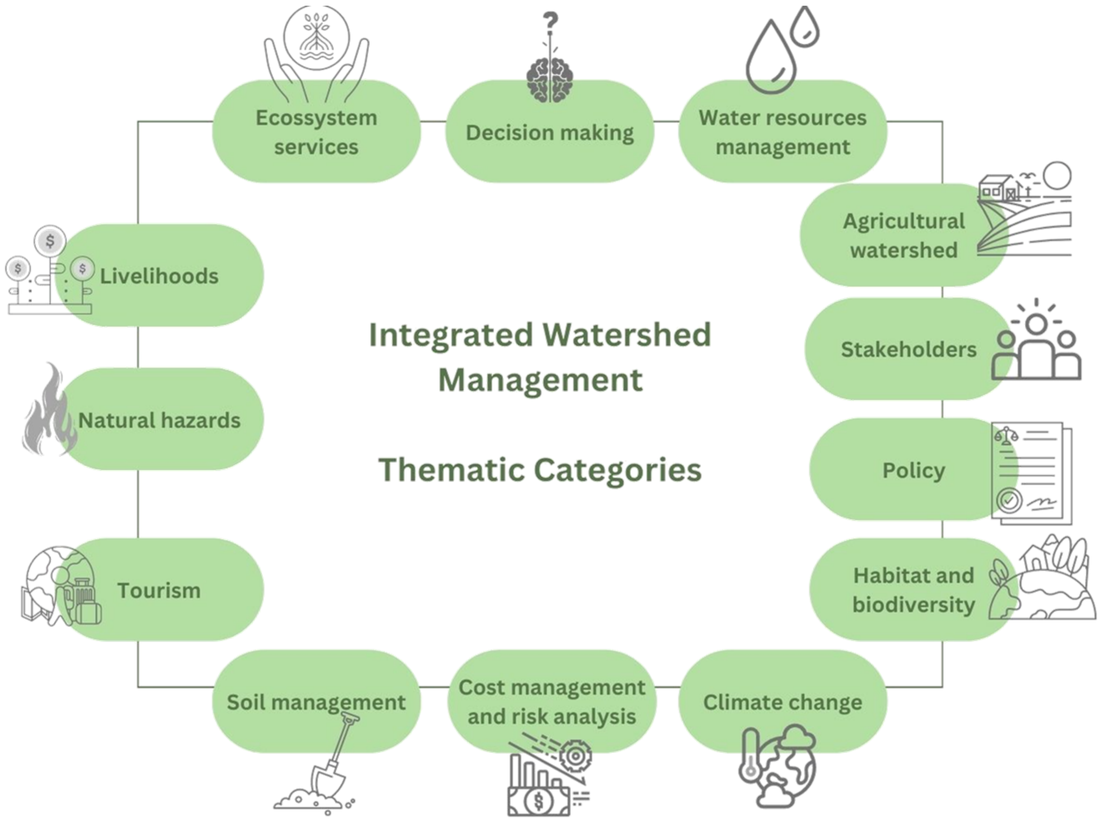
Integrated watershed management has gained increasing importance in recent years, given its ecological, economic and social importance. In order for watershed management to be in accordance with these principles, and at the same time efficient, it is necessary to analyze and integrate a number of different factors.

OBJECTIVES

The goal of this paper is to conduct a review of the literature in the field of integrated watershed management and to establish the trends of important thematic research factors in the mentioned field for the period 2018-2022.

METHODS AND MATERIALS

Review of the available literature was made within the "online" platform "Web of Science". A literature review was conducted for papers in English and German using "integrated watershed management" as a keyword for the search within the title. Rayyan (http://rayyan.qcri.org) application for systematic review of scientific literature was used to perform this review.



RESULTS AND DISCUSSION

Thirteen thematic categories have been determined in this field and are listed in the scheme. The synthesis of the results obtained by reviewing trends in scientific research in the mentioned area can serve as a significant basis for the organization and planning of integrated watershed management. In order to achieve the synthesis of the previously mentioned factors, close cooperation of the respective participants, who come from different fields, is necessary. This collaborative approach will potentially succeed only if the parties involved are committed to it. Such commitment should be built on an understanding of the problems and needs recognized by all parties involved. In addition, it is important to establish the decision makers who can influence the approaches and strategies, considering that their commitment in this approach is of particular importance.

KA2 – Cooperation for innovation and the exchange of good practices –Capacity Building in the field of Higher Education Soil Erosion and Torrential Flood Prevention: Curriculum Development at the Universities of Western Balkan Countries/SETOF

An Ecosystem Approach to Natural Resource Management: Case Study of the Topčiderska River, Serbia

Katarina Lazarević[1]*, Mirjana Todosijević[1], Natalija Momirović[2], Nada Dragović[1], Ranka Erić[1]

[1]University of Belgrade, Faculty of Forestry, Kneza Višeslava 1, 11030 Belgrade, Serbia
[2]Institute of Forestry, Kneza Višeslava 3, 11030 Belgrade, Serbia

SETOF Soil Erosion and TOrrential Flood Prevention: Curriculum Development at the Universities of Western Balkan Countries

University of Belgrade Faculty of Forestry

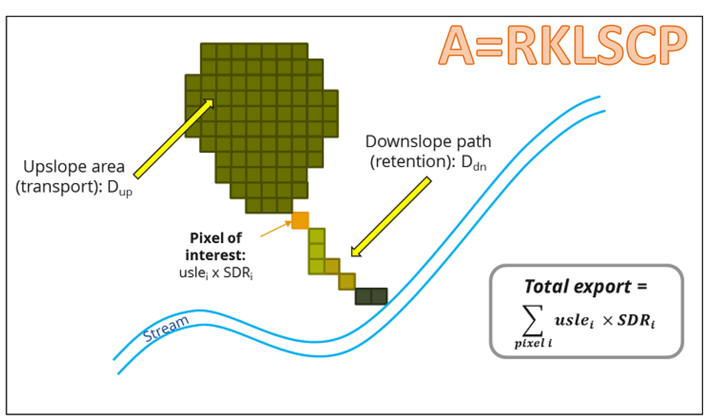
INTRODUCTION

Due to increasing demand, climate change, and world population growth, natural resources are getting exploited fast. One of the most important natural resources is soil, which is susceptible to degradation. Erosion as one of the forms of land degradation is also one of the most global environmental problems. Soil, as the foundation of basic ecosystem functions, provides benefits (ecosystem services) to people, erosion control, water infiltration, food, fuel, fibers… This research is using the ecosystem approach as a strategy for natural resources management for promoting sustainability and conservation.

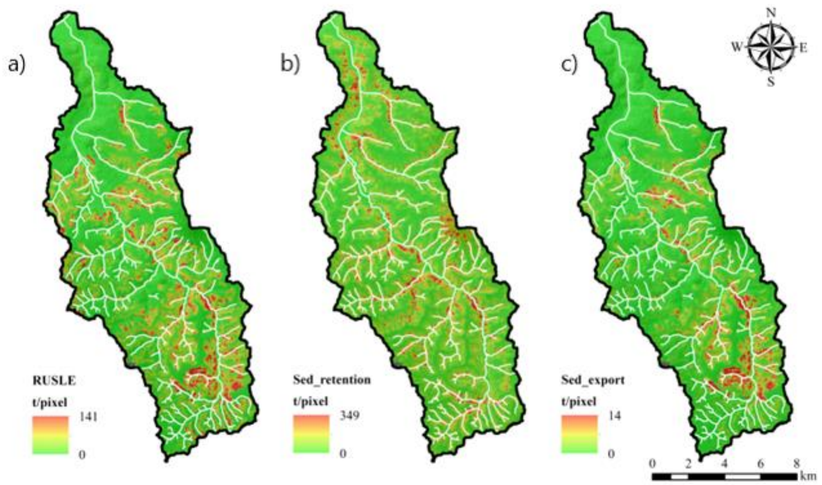
InVEST integrated valuation of ecosystem services and tradeoffs

METHODS AND MATERIALS

The research was done in the Topčiderska River watershed (Belgrade, Serbia). The InVEST Sediment Delivery Ratio model was used, to quantify erosion intensity, with a spatial distribution output map of overland sediment generation and delivery to the stream. InVEST SDR, a spatially explicit model is using a method based on the concept of hydrological connectivity and the (R)USLE model in GIS environment. The input data required by this model are digital terrain model (DTM), anual rainfall erosivity factor (R), soil erodibility factor (K), watershed (vector), biophysical table containing land use class numbers and C and P factor values, and calibration factors (SDRmax, IC0, k).



RESULTS AND DISCUSSION



The results of the InVEST SDR model for the Topčiderska River watershed in t/pixel: a) soil loss according to (R)USLE; b) sediment retention; c) sediment export.
The InVEST model optionally provides the possibility to economically represent the benefits obtained from the soil. Increasing soil productivity is directly related to soil loss. If the processes of degradation (erosion) are more pronounced, the intensity of the productive surface layer decline is greater, and so are the benefits of such soil.

From the economic point of view, the special impact of this situation (soil loss) is reflected in the agricultural areas of which about 46.75% are in the watershed area. Thus, using the benefit-cost ratio, ecosystem services are valorized through plant production, i.e. food production. The benefits that man has from this kind of soils are thus significantly reduced and limited, but the indirect benefits through cultural services (education, traditional knowledge, spiritual well-being, recreation...) are increased.