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SOIL EROSION OF THE CUVERAK RIVER BASIN (WEST SERBIA)

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Abstract

Various factors of erosion, natural and anthropogenic, and general conditions of the area of Cuverak torrential flow contribute to the understanding of the intensity of basin soil erosion. Midterm amount of erosion sediments is W_{year} 646.05 m^3/year. The value of the specific total annual erosion sediments at the mouth of the Cuverak in Kamenica ($G_{yr/sp}$), is 171.48 m^3/km^2/year.

Key words: soil, erosion, river basin, sediment production

Introduction

Soil is the basis of agricultural production, and thus important for the survival of the human race. Formation of soil is a continuous process, but parallel, there are processes of soil degradation. Process of soil regeneration is very slow. The effects of different factors of erosion change the soil and geological substrate. Changes in soil can be slow or fast, as a result erosion characteristics are slow or fast. In Serbia more than 90% of the total soil area is affected by erosion of various types and intensity (Djorovic and Kadovic, 1997). In the Republic of Serbia, it is registered that each year from an area of 21,000 ha layer of soil depth of 16.0 cm has been removed. (Spalevic, 1997). In the Republic of Serbia (Central Serbia) there is 1.221 million ha of eroded soil and 36,000 ha is steady now (Statistički godišnjak, 2008).

In the region of Čačak trends of increase in temperature and decrease in rainfall are evident (Šekularac, 2002). That climatic changes cause deterioration of the physical characteristics of the soil, increasing its erodibility, reducing the role of protective vegetation, and aggravated its natural and artificial regeneration. All this affects intensification of the process of erosion, both surface and deep forms. Negative impact of the erosion endangers agriculture, forestry and water management, thus there is an increasing need for erosion protection and soil reclamation.

Quantitative amount of erosion and regarding how much sediment it causes, is shown on the part of the river basin Kamenica (part of the West Morava river basin), its sub-basin, the area of which is its right tributary of the first order, Cuverak.

Materials and methods

Using the ground of reconnaissance, the elements of the configuration of the river basin were monitored and shown. This basic method is complemented by the use of topographic, geologic and soil maps of certain scales, allowing for defining the nature and impact of natural erosion agents in the studied basin. Using the method of rainfall interpolation by rain-gradient (Bonacci, 1984) and calculation of air temperature for any altitude (Dukic, 1984), meteorological parameters

were calculated for the basin. Quantitative indicators of soil erosion were calculated using the Erosion Potential Method (Gavrilovic, 1972).

Results and discussion

The basic elements of the river basin, important for the occurrence of soil erosion, are size, length, volume and its shape. The river basin Cuverak encompasses an area of 1.62 km^2, the natural length of the main watercourse, L, is 2.2 km, circumference, C, is 6.5 km. In the river basin Cuverak the maximum elongated hydrographic are underdeveloped upper and lower stream. In these parts regularly no major tributaries. In the middle is the main source of sediments. The presented basic elements of the Cuverak river basin and the special features of its relief, the geological substrate, the distribution of land, and the land use have contributed that the process of erosion of the studied river basin has specific quantitative indicators. The main parameters of the Cuverak river basin relief, agents which have the primary responsibility for the occurrence of erosion, are shown in the Table 1.

The mean sea level (M_{sl}) of Cuverak basin is 646.34 m (Table 1), which is calculated by the method of the separation of contour lines every 100 m in height.

The mean elevation difference of the Cuverak river basin, D, is 261.34 m (Table 1).

The average river basin decline, I_m,is 29.6% (Table 1). The condition of the relief of an area is indicated by the coefficient of basin relief erosion energy (E_r), m/$km^{1/2}$, (114.29 m/$km^{1/2}$), Table 1.

Table 1. The basis of the Cuverak basin relief parameters

The name of the basin: Cuverak	
The lowest point of the main watercourse and basin (B), m	385
The highest point of the main watercourse (C), m	754
The highest point of the basin (E), m	793
Average basin main watercourse bed slope (I_a), %	13.9
Mean basin altitude (M_{sl}), m	646.34
Mean basin altitudial difference (D), m	261.34
Mean basin slope (I_m), %	29.6
Coefficient of basin relief erosion energy (E_r), m/$km^{1/2}$	114.29

The following agent of erosion, geologic substrate, with characteristics and diversity contributed to the emergence of the process of erosion in Cuverak basin (Table 2).

The geological substrate of Cuverak basin is diabase (1.62 km^2, i.e. 100.00%), characterized by properties that is poorly permeable rock, which contributes to the non-resistance soil erosion process. Coefficient of geological substrate water permeability (S_1=1.00), indicates nonresistance of Cuverak basin (Table 2).

The soil properties to a lesser or greater extent, contributed to the erosion process. In the area of Cuverak river basin, effects of pedogenetic factors are present as well as skeletoidal brown soil on the diabase. Group of shallow soil of Cuverak basin belongs to brown skeletoidal soil on diabase, with the profile type of Ah-C. In this soil of the studied basin a strong degree process of erosion was represented (Šekularac, 2000).

Table 2. The Cuverak basin geological supstrate, coefficient of water permeability (S_1) and erosion resistance

The name of the basin: Cuverak		
F_{ppr}-Poorly permeable rocks		
• Diabase	km^2	1.62
	%	100.00
Coefficient of geological substrate water permeability (S_1)	1.00	
Resistance of geological substrate to erosion	Nonresistant	

The elements of climate which contribute to the occurrence of the process of soil erosion are rainfall, air temperature and soil temperature. The average annual rainfall (R) in Cuverak basin is 770.2 mm, and the mean annual air temperature (t) is 8.4^0 C, which indicates that these two elements of climate play an important role on soil erosion in study area.

Representation of the another factor of the process erosion, vegetation, both domestic as well as those of anthropogenic origin, and vegetation cover coefficient (S_2), are shown in Table 3.

Table 3. The structure of the Cuverak river basin according to the plant cadastre and vegetative cover coefficient (S_2)

The name of the basin: Cuverak			
F_f	Forests and coppice of good spacing	km^2	0.90
		%	55.55
F_g	Orchards	km^2	0.15
		%	9.26
	Meadows	km^2	0.07
		%	4.32
	Pastures and devastated forests and coppices	km^2	0.35
		%	21.61
$\sum f_g$		km^2	0.57
		%	35.19
F_b	Arable land	km^2	0.15
		%	9.26
	Infertile soil	km^2	0.00
		%	0.00
$\sum f_b$		km^2	0.15
		%	9.26
Vegetation cover coefficient (S_2)		0.71	

The total area under forests and coppice of good spacing ($\sum F_f$) in the basin Cuverak is 0.90 km^2 (55.55%), the amount of grasses vegetation ($\sum F_g$) is 0.57 km^2 (35.19%), and the barren land

($\sum f_b$) is 0.15 km^2 (9.26%). That indichates that the studied area is well protected from the effects of erosion processes: coefficient of vegetative cover, S_2 is 0.71 (Table 3).

In which scope the potential of Cuverak watercourse presents great destructive power and a factor of erosion, can be indicated by elements of hydrographic and hydrological characteristics of the study area. Characteristics of family of torrential flow of the Cuverak basin are: F_b: E; IV; Z=0,31 which means that Cuverak torrential flow is IV class with destructive erosion coefficient (Z) of 0.31 (weak intensity of erosion processes, deep type).

Due to all these characteristic of Cuverak basin a certain amount of sediment is produced and certain intensity of erosion is manifested. Size of process erosion of the Cuverak river basin is shown by mean annual erosion sediment (W_{year}=646.05 m^3/year). Measured midterm the total volume of sediments (G_{year}), which reachs the mouth of Cuverak is 277.80 m^3/year, and the total specific annual erosion sediment that reaches the mouth of the Kamenica ($G_{yr/sp}$), is 171.48 m^3/km^2/year. These data indicate that from the Cuverak basin areas disappear per year 0.323 ha of soil by the effect of erosion, the depth of 0.2 m, and 0.06 mm soil disappears from the basin area per year. In addition to acceptance of the mean bulk density of 1.5 g/cm^3 per year 0.48 t/ha is lost.

Conclusion

The Cuverak torrential flow has its own specific features: IV class destructiveness, coefficient of erosion (Z) 0.31, which indicates the strength of weak erosion of deep type. The above, and other factors of erosion of the basin has contributed that annual erosion sediment was 646.05 m^3/year, while the intensity of erosion was 171.48 m^3/km^2/year.

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