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SOIL EROSION OF RUJEVAC SMALL BASIN (WEST SERBIA)

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Abstract

Various factors of erosion, natural and anthropogenic, and general conditions of the area of Rujevac torrential flow contribute to the understanding of the intensity of basin soil erosion. Midterm amount of erosion sediments is W_{year} 233.57 m^3/year, and the specific amount of the total annual erosion sediments that reaches the mouth of the Rujevac in Kamenica ($G_{yr/sp}$), is 60.36 m^3/km^2/year.

Key words: *erosion, soil, small basin, sediment production*

Introduction

Soil is the basis of agricultural production, and thus for the survival of the human race. Formation of soil is a continuing process, but at the same time, 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 (Djorović and Kadović, 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. (Spalević, 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 left tributary of the first order, Rujevac.

Materials and methods

Using the method of reconnaissance of the ground, the elements of the configuration of the 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 (Dukić, 1984), meteorological parameters were calculated for the basin. Quantitative indicators of soil erosion were calculated using the analytical Gavrilović's method (1972).

Results and discussion

The basic elements of the basin, which are important for the occurrence of soil erosion, are size, length, volume and its shape. The characteristics of the Rujevac basin: area (F) is 0.89 km^2, length (L) 1.12 km, circumference (C) 4.15 km. Rujevac basin has elongated shape with underdeveloped network of tributaries, which causes that there are no conditions causing the rainfalls to get concentrated, and therefore there is no erosion. The presented basic elements of Rujevac basin and the special features of its relief, the geological substrate, the distribution of soil, and the soil use have contributed that the process of erosion of the basin has specific quantitative indicators. The main parameters of the Rujevac basin relief, agents which have the primary responsibility for the occurrence of erosion, are shown in the Table 1.

Table 1. The basis of the Rujevac basin relief parameters

The name of the basin: Rujevac	
The lowest point of the main watercourse and basin (B), m	410
The highest point of the main watercourse (C), m	518
The highest point of the basin (E), m	580
Average basin main watercourse bed slope (I_a), %	6.3
Mean basin altitude (M_{sl}), m	505.73
Mean basin altitudial difference (D), m	95.73
Mean basin slope (I_m), %	19.0
Coefficient of basin relief erosion energy (E_r), $m/km^{1/2}$	55.55

The greater parameters of the relief influence the greater occurrence of soil erosion.

The mean sea level (M_{sl}) of Rujevac basin is 505.73 m (Table 1), which is calculated by the method of the separation of contour lines every 100 m in height.

Mean basin altitudial difference (D) of Rujevac basin is 95.73 m, a result of the difference of the mean basin altitude and altitude of estuary (Table 1).

For the definition of mean basin slope (I_m=19.0%), it is assumed that the vertical distance between contour lines (h) is 100 m (Table 1). The condition of the relief of an area is indicated by the coefficient of basin relief erosion energy (E_r), $m/km^{1/2}$, (55.55 $m/km^{1/2}$), Table 1.

The following agents of erosion, geologic substrates, with their characteristics and diversity contributed to the emergence of the process of erosion in Rujevac basin (Table 2).

Table 2. The Rujevac basin geological supstrates, coefficijent of their water permeability (S_1) and their erosion resistance.

The name of the basin: Rujevac		
F_{ppr}-Poorly permeable rocks		
Diabase	km^2	0.54
	%	61.20
Lake sediments of tertiary clay and loam	km^2	0.35
	%	38.80
Coefficient of geological substrate water permeability (S_1)	1.00	
Resistance of geological substrate to erosion	Nonresistant	

The geological substrates of Rujevac basin are: diabase (0.54 km^2, i.e. 61.20%), lake sediments of tertiary clay and loam (0.35 km^2, i.e. 38.80%), characterized by properties that are poorly permeable rocks, which contributes to the nonresistance soil erosion process. Coefficient of geological substrate water permeability (S_1=1.00), indicates nonresistance of Rujevac basin (Table 2). The soil and their properties as an agent of erosion, to a lesser or greater extent, contributed to this process. In the area of Rujevac basin, effects of pedogenetic factors are present as well as following soils: eroded vertisol and skeletoidal brown soil on the diabase.

Eroded vertisol is profile type A_h–A_hC–C. Eroded vertisol belongs to the deep soil, in Rujevac basin low level of process erosion is expressed. Group of shallow soil of Rujevac 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). 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 Rujevac basin is 752.3 mm, and the mean annual air temperature (t) is 9.2^0 C, which indicates thet 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. Plant cadastre and vegetative cover coefficient (S_2) of the Rujevac basin

The name of the basin: Rujevac			
F_f	Forests and coppice of good spacing	km^2	0.36
		%	40.45
F_g	Orchards	km^2	0.17
		%	19.10
	Meadows	km^2	0.14
		%	15.73
	Pastures and devastated forests and coppices	km^2	0.04
		%	4.49
$\sum f_g$		km^2	0.35
		%	39.32
F_b	Arable land	km^2	0.18
		%	20.23
	Infertile soil	km^2	0.00
		%	0.00
$\sum f_b$		km^2	0.18
		%	20.23
Vegetation cover coefficient (S_2)		0.76	

The total area under forests and coppice of good spacing ($\sum F_f$) in the basin Rujevac is 0.36 km^2 (40.45%), the amount of grasses vegetation ($\sum F_g$) is 0.35 km^2 (39.32%), and the barren land ($\sum f_b$) is 0.18 km^2 (20.23%), so the study area is protected from the effects of erosion (coefficient of vegetative cover, S_2 = 0.76), Table 3.

In which scope the potential of Rujevac 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 Rujevac basin are: F_b: E; IV; Z=0,23 which means that Rujevac torrential flow is IV class with destructive erosion coefficient (Z) of 0.23 (weak intensity of erosion processes, surface type). Due to all these characteristic of Rujevac basin a certain amount of sediment is produced and certain intensity of erosion is manifested. Size of process erosion of the Rujevac basin is

shown by mean annual erosion sediment (W_{year}=233.57 m^3/year). Measured midterm total volume of sediment (G_{year}), which reachs the mouth of Rujevac is 53.72 m^3/year, and the total specific annual erosion sediment that reaches the mouth of the Kamenica ($G_{yr/sp}$), is 60.36 m^3/km^2/year. These data indicate that from the Rujevac basin areas disappear per year 0.12 ha of soil by the effect of erosion, the depth of 0.2 m, and 0.02 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 0.18 t/ha is lost.

Conclusion

Rujevac torrential flow has its own specific features: IV class destructiveness, coefficient of erosion (Z) 0.23, which indicates the strength of weak erosion of surface type. The above, and other factors of erosion of the basin has contributed that annual erosion sediment was 233.57 m^3/year, while the intensity of erosion was 60.36 m^3/km^2/year.

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