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Methodology to Utilize New and Innovative Tools to Monitoring Potential Quantity of Soil Erosion in Badovc Lake

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ABSTRACT:
Soil erosion is the natural phenomenon of the removal and transportation of the soil particles by forces such as water and wind. The exponential increase in the world of population, has led to numerous anthropogenic activities that intervene on the natural environments and lead to accelerated soil erosion rates (Yang et al. 2003). Activities that increase erosion rates includes agriculture, urbanization, road construction and dams that remove or substantially alter the natural vegetation (Bakker et al. 2008; Montgomery 2007). Accelerated soil erosion rates lead to decrease soil quality and potential land degradation and this is why many scientists consider soil erosion a threat as important as climate change. This paper aims to determine the degree of sedimentation from the basin of Lake Badovc to the drinking water reservoir. The surface runoff that enters directly into the lake is calculated through the flow module determined by measuring the water inflows from the rivers. The batymetry results determine that the volume and surface of the lake at the normal quota of 649.75m above sea level are respectively 26.5 million m3, and1.71 km2. Batimetry also finds a decrease in the physical volume of the lake from1,000,000 m3 due to sediment deposition coming from rivers.

Keywords|
erosion intensity; input parameters; method sensitivity; sediment production,rainfall

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Theoretical Framework

Erosion phenomenon is induced by the combination of various factors. These factors are grouped together in several groups:climate factors (precipitation, rainfall intensity, rainfall duration and distribution, wind);soil factors (soil type, soil moisture, humus, litter layer, soil chemical compounds, bedrock);topographic factors; watershed slope, watershed area, aspect, elevation, vegetation cover hydrographical factors; creeks density, water flow length;human factors;land use factors

Methodology

Based on the climatic-terrestrial, biological conditions and parameters that characterize the watersheds of Kosovo, as well as from the contemporary literature, to estimate the amount of eroded material in the watersheds, it is proposed to use the Potential Erosion Method (PEM), which is a complex methodology designed for use in the field of Integrated Water Resources Management.

The data will be analyzed using the following equations:

$$W = \eta \cdot S \cdot T \cdot h \cdot \sqrt{Z^3} \qquad (1)$$

where:W - is monthly volume of detached soil due to surface erosion(m3/year);
S - is the watershed area (km2);
h - is the average monthly precipitation (mm);
T - is the temperature coefficient;
Z - is the erosion coefficient.

The equation for T, is as follows:

$$T = \sqrt{t/10 + 0.1} \qquad (2)$$

where: t - is the average monthly temperature (°C).
The erosion coefficient Z can be estimated using corresponding tables or calculated from.

$$Z = x \cdot y \cdot \left(\varphi + \sqrt{i_m}\right) \tag{3}$$

where: x – is quantifies the protective nature of the land cover;
y - is a coefficient expressing soil resistance to erosion;
φ - is quantifies the observed erosion process,
i_m - is the mean slope of the catchment (%).
The values' range of the above-mentioned coefficients (x, y, and ϕ) are given in Table 1.

Descriptive variables used in the Erosion Potential Model (EPM).

Coefficient of Land Cover	**x**
Mixed and dense forest	0.05–0.20
Thin forest with grove	0.05–0.20
Coniferous forest with little grove, scarce bushes, bushy prairie	0.20–0.40
Damaged forest and bushes, pasture	0.40–0.60
Damaged pasture and cultivated land	0.60–0.80
Areas without vegetal cover	0.80–1.00
Coefficient of soil erodibility	**y**
Hard rock, erosion resistant	0.2–0.6
Rock with moderate erosion resistance	0.6–1.0
Weak rock, schistose, stabilized	1.0–1.3
Sediments, moraines, clay and other rock with little resistance	1.3–1.8
Fine sediments and soils without erosion resistance	1.8–2.0
Coefficient of type and extent of erosion	**ϕ**
Little erosion on catchment	0.1–0.2
Erosion in waterways on 20 to 50% of the catchment area	0.3–0.5
Erosion in rivers, gullies and alluvial deposits, karstic erosion	0.6–0.7
50 to 80% of catchment area affected by surface erosion and landslides	0.8–0.9
Whole catchment affected by erosion	1.0

The total volume of sediment produced in the different areas of the watershed does not fully reach downstream. A portion is redeposited in streams or other areas of the basin; therefore, it is essential to calculate the specific real sediment production (G) in m3/year by the following equation:

$$G = W \times Dr \tag{4}$$

where: W - is monthly volume of detached soil due to surface erosion(m3/year);
Dr – is sediment delivery ratio.
The equation for Dr, is as follows:

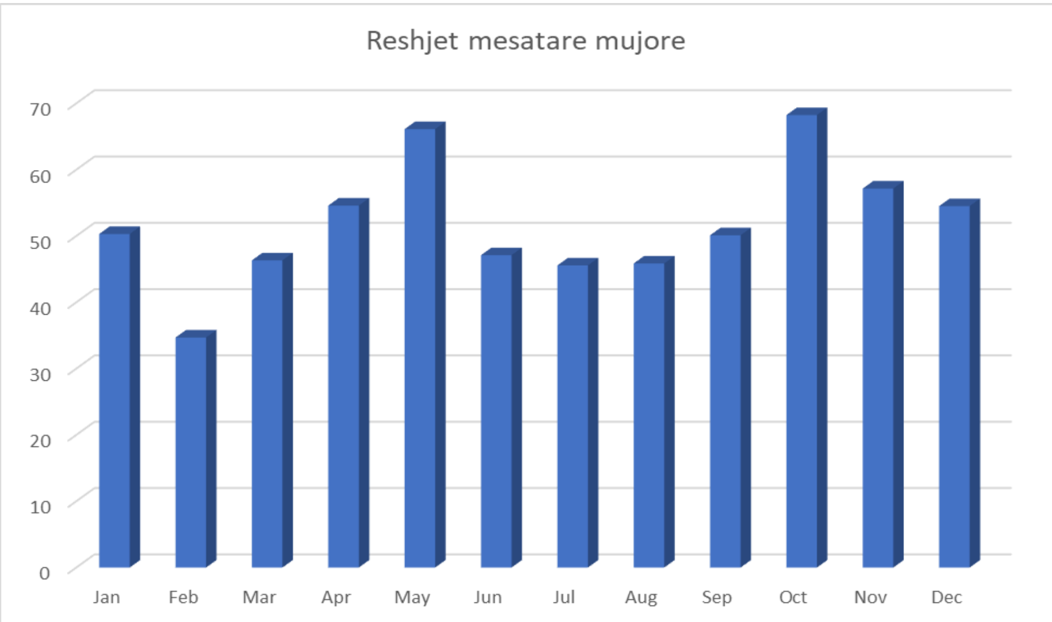
$$Dr = \frac{\sqrt{H \times P}}{0.25 \cdot (L + 10)} \tag{5}$$

where: H - is the average height distance of the basin (or sub unit), expressed in (km);
P - is the perimeter of the basin (or sub unit) (km);
L – is the length of the basin (km).

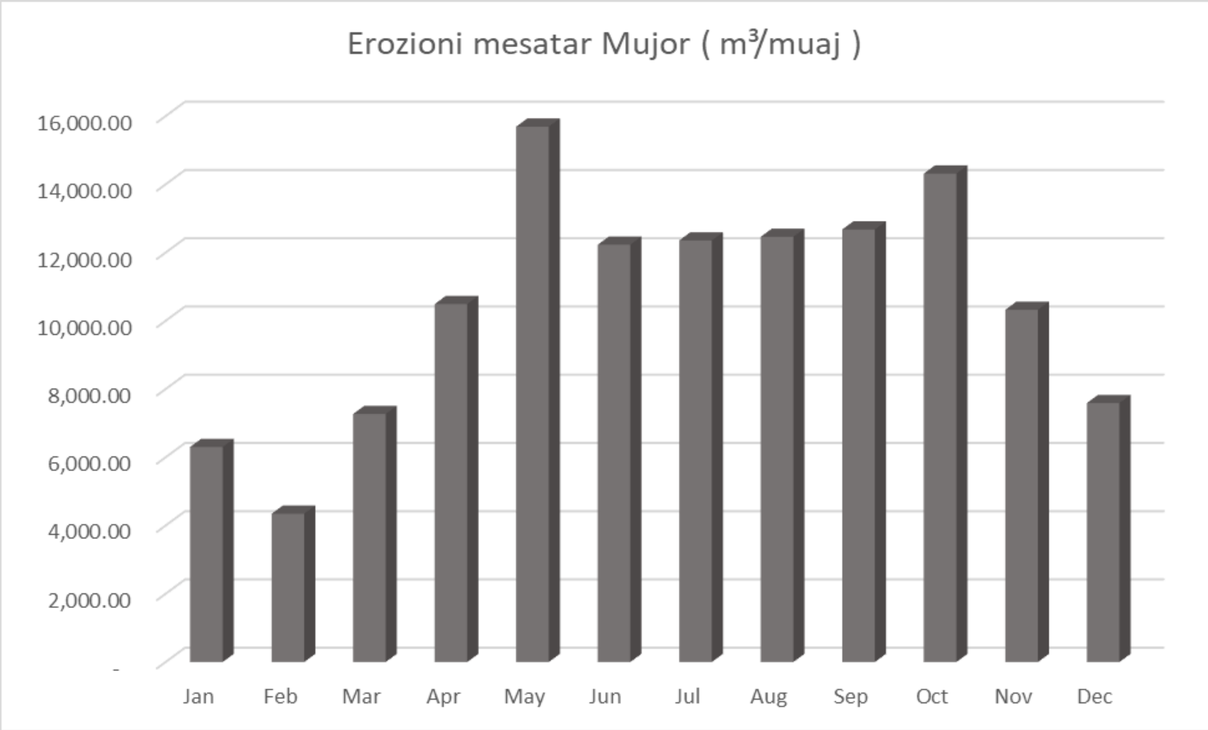
	pi()	3.14
Surface of the Watershed	S	104.2
Ground cover coefficient	x	0.4

Soil erosion coefficient	y	1.5
Erosion coefficient	ϕ	0.6
The average slope of the pond	i	0.25
Average basin height (km)	H	0.9
Perimeter of the catchment area (km)	P	21.7
Length of largest water line (km)	L	9.8

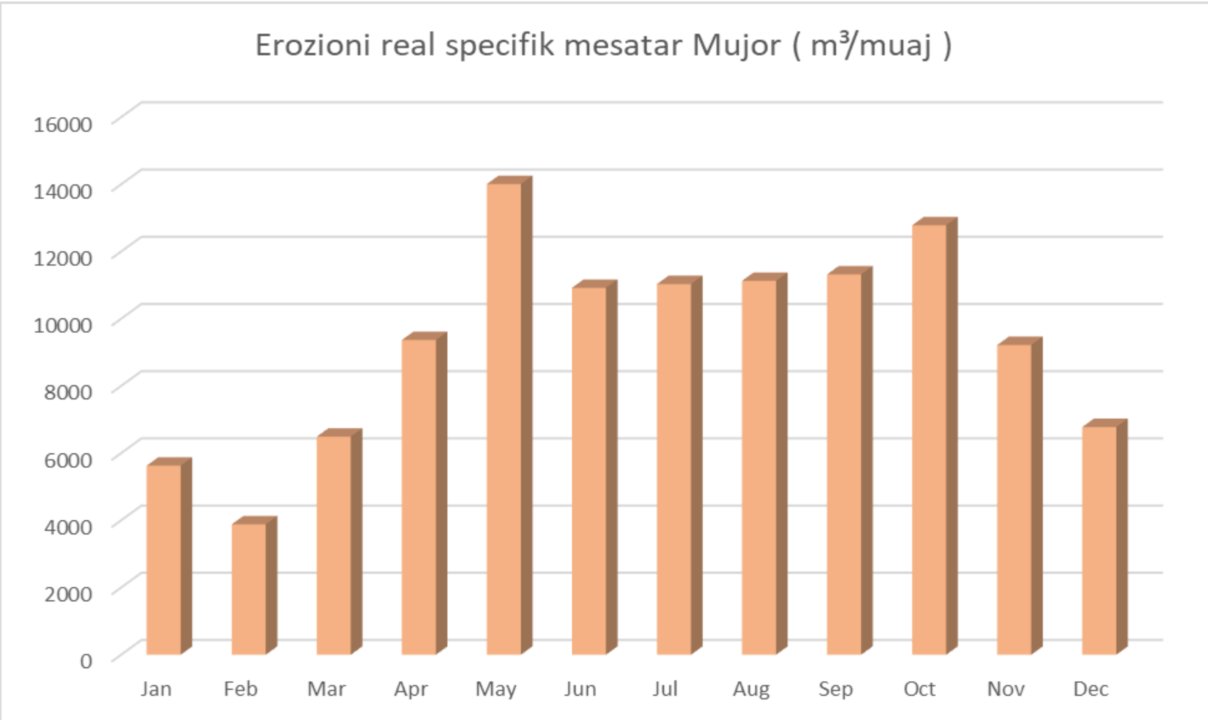
Month	Rainfall	Temp.	Temp. Coef.	Relative Erosion coef.	Eroded material		Sediment Delivery Ratio	Specific Real Sediment Production
	(mm)	(˚C)	(--)	(--)	(m3/month)	(m3/ha/month)	(--)	(m3/month)
	h	t	T	Z	W	E	Dr	(G)
Jan	50.31	4.1	0.71	0.66	6,303.08	0.60	0.89	5627
Feb	34.69	4.1	0.71		4,346.13	0.42		3880
Mar	46.33	7	0.89		7,269.77	0.70		6490
Apr	54.59	11	1.10		10,491.00	1.01		9366
May	66.12	17.3	1.35		15,691.76	1.51		14009
Jun	47.11	20.9	1.48		12,230.62	1.17		10919
Jul	45.56	22.9	1.55		12,356.51	1.19		11032
Aug	45.86	23	1.55		12,463.87	1.20		11128
Sep	50.11	19.8	1.44		12,678.54	1.22		11319
Oct	68.24	13.3	1.20		14,315.95	1.37		12781
Nov	57.16	9.6	1.03		10,324.25	0.99		9217
Dec	54.51	5.3	0.79		7,590.31	0.73		6777
Annual Total =					**126061.8**	**12.1**		**112,545.83**



Graph. 1. Average monthly rainfall



Graph.2. Average monthly erosion(m^3/month)



Graph.3.Real specific erosion monthly average(m^3/month)

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