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RESEARCH ARTICLE **(Open Access)**

Modeling of Rainfall Factor in Soil Erosion Risk in Albania

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Abstract

Area of the Republic of Albania is characterized with high soil erosion rate. Each year nearly 60 million tons of sediments are deposited by Albanian rivers into the Adriatic Sea. Soil erosion and other associated pollution, are critical problems affecting the economic welfare, food security, and public health of Albania. In last decades, faster economic growth of the country and lack of soil resources, fresh water, forests etc., reinforce the need for soil protection and soil conservation. That increases the interest for erosion research, especially in the areas highly affected by soil erosion.

The objectives of this paper are to quantify the magnitude of soil erosion affected by climatic conditions to identify high-risk areas for immediate soil erosion control.

Keywords:Soil erosion, land use, rainfall factor.

1. Introduction

Soil erosion especially from rainfall is a very important factor that affect negatively in soil degradation. Land and climatic conditions of our country, relatively steep relief and very steep relief, with vegetations that in most of surface is degraded or destroyed, are indicators that evidence for the presence of one strong erosion from rainfall everywhere and very aggressive **[1] [9] [10] [11] [13] [14].** According to data from different Albanians authors levels of soil corrosion are 10-100 tons / ha / year and in some regions up to 520 tons / ha / year **[11] [13] [14].** To evaluate erosion in Albanian territory and determining of areas affected from erosion are raised up four experimentally stations where are measured corrosion values of lands in standard conditions. Exploration and experimental work is performed in Kallmet (Lezha), Vithkuq (Korça), Radhima (Vlora) and Qaf – Shul (Librazhd). Their selection was made taking into account climatic and soil conditions. A very effective method in predicting soil erosion losses in function of climatic and soil conditions is using Universal Losing Soil Equation, that takes into account Erosion index (R), Erosion factor (K), Crop factor (C), The length and slope of the terrain (LS) and Management factor (P) **[7] [15] [16].** According to this equation the assessment is made in tons / ha / year **[2] [3].**

Based on data on the amount of eroded land in experimentally stations, in meteorological data, in the ground characteristics of these stations the information was updated according to Universal Losing Soil Equation methodologies. The results have been processed and presented in this presentation.

2. Materials and Methods

The methodology is based on quantitative assessment of the parameters of Universal Losing Soil Equatio:

A = R *x* K *x* LS *x* C

A – The amount of eroded soil tons / ha / year

R – Rainfall Factor

LS – Elevation Factor

C – Plant coverage factor

This equation although valid, it must be adapted for local conditions, especially rainfall factor **R** (aggressiveness of rain) and **C** (plant coverage) for the area that we be aplied.

R factor, represents the effect of rainfall on erosion **[16].**His calculation with recommended formulas from the literature is difficult to be calculated with actual data that metereological stations

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give to us and that are conected with experimental stations. Becouse of the fact that is one very important factor to predict erosion in approximate climatic regions we choose one indirect method to determine that. This consist using datas from experimental stations and where other factors of USLE are known. For this we will use this formulas:

$$R = \frac{A}{K\ x\ LS\ x\ C}$$

To calculate the factors mentioned before, experimental datas for the erosion of soil are collected for 4 stations build up for monitoring of erosion in our country.

This stations are in Kallmet (Lezha), Radhimë (Vlora), Qaf – Shul (Librazhd) and Vithkuq (Korca). Experimental stations rapresent and part of six basins for collecting water of hydrographic network of Albania and rapresent different, areas with different altitudes from sea level. This altitude start from 55 m in Kallmet and Radhime, until 1300 m in Qaf-Shul and Vithkuq.

Table 1. Geographic data from experimental stations

Nr	**Monitoring point**	**Coordinates**		**Altitude (m)**	**Zones and sub climaticzones**
		V	**L**		
1	Kallmet	41°51’05’’	19°41’48’’	55	Central Mediterranean Hilly
2	Radhime	40°25’31’’	19°29’29’’	200	Hilly Southern Mediterranean
3	Qaf – Shul	41°16’05’’	20 ° 26’34’’	1300	The pre Eastern Mediterranean
4	Vithkuq	40°31’39’’	20°35’09’’	1250	Mediterranean South Mountain

Terrestrial, climate features and plant cover in permanent stations where is monitored surface erosion, rapresent more characteristics areas of our country. Characteristics areas with “*soft*” clime without ore litlle frost (numerous rain showers and snow without cover the surface) as for example in Radhime and Kallmet. Characteristics areas with "*hard*” clime, with too much frost, few rainfall but with snow that cover the surface as in Vithkuq (Korca) and Qaf-Shul(Librazhd).

Table 2. Climate indicators for experimental stations

Stacionet	***Altitude (m)***	***Annual precipitation in mm***	***Number of days with precipitation > 10 mm***	**Zone and sub climate-zone**
Kallmet	55	1500 – 2000	45 – 55	Central Mediterranean Hilly
Radhime	200	1000 – 1500	35 – 45	Hilly Southern Mediterranean
Qaf – Shul	1300	1000 – 1300	45 – 55	The pre Eastern Mediterranean
Vithkuq	1250	800 – 1000	25 – 45	Mediterranean South Mountain

a) Experimental scheme

Evaluation of soil loss, is made in experimental surfaces with length of 10 m, width 1,2 m dhe sloping 8 - 40%. Each scheme have 4 variants to asses the effect of vegetation (**“C”** Factor) in soil erosion.

Version 1. Uncultivated land (Factor **“C” = 1),**
Version2. Land planted with perennial pasture crops.
Version 3. Land planted with hoe crop (corn)
Version 2. Land planted with wheat

b) ***Calculating the amount of soil that eroded***

At the end of each option are installed bins that collect surface flow. This flow contain eroded particles from the surface. This stream contains and eroded particles from the soil surface.Weighing the eroded/lost soil is done after totale sedimentation and after leaving the water in measuring vessels. Meassurements are done every in May for the period from Jan uary-May, and in August for the period from June-August and in decembre for the period from September- Decembre.

The amount of soil that eroded (**A factor**) during the year is calculated as amount of every single meassurements converted for 1 ha land:

$$A = \frac{(P_1 + ...P_n)\, x\, 10000}{(L + Gj)\, x\, 1000}$$

where :

A = *the amount of land calculated (*Ton/ha/year)

P = *Weight of soil collected in measuring vessels (kg).*

L = *Length version (m)*

Gj = Width version (m)

10 000 = Surface m^2 of 1 hectar

1000=factor to convert in ton/ha

With data from experimental stations, indicators required in USLE, **R and C Factor** are defined experimental way. Whereas **LS** and **K** factor are defined using models proposed in literature**[2] [5] [6][8] [12] [15].**

To determine the value of **LS** factor we have used this formulas that is more recomanded in specialized literature of this scientific field.

$$LS = \left(\frac{x}{22.13}\right)^{0.6} \left(\frac{s}{9}\right)^{1.4}$$

K factor that rapresent soil contribution in erosion in our study is taken from literature recomandations based on particles indicators of soil particles composition and the content of organic matter. It should be noted that the recommended values for this indicator by different authors are very approximative. For **K** factor are used values showed in the next table.

Table 3. K Factor Values by textural class and OM contents

	OM(%)		
Textural Class	**<0.5**	**2**	**4**
Sand	0.06	0.04	0.03
Loamy sand	0.16	0.13	0.10
Sandy loam	0.35	0.31	0.25
Loam	0.49	0.44	0.37
Silt loam	0.62	0.54	0.43
Silt	0.78	0.67	0.54
Sandy clay loam	0.35	0.32	0.27
Clay loam	0.36	0.32	0.27
Salty clay loam	0.48	0.41	0.34
Sandy clay	0.18	0.17	0.16
Salty clay	0.32	0.30	0.25
Clay		0.17-0.26	

3. Results and discussion

Measurements in experiments presented show for a large variation of values related with climatic variation that experimental stations represent (Table 4).

Table 4. The amount of soil eroded in experimental variants without vegetation (tons / ha / year)

Years	*Vithkuq*	*Qaf - Shul*	*Radhime*	*Kallmet*	*Average*
2010	22.07	23.04	35.2	32.88	28.30
2011	11.5	12.0	18.3	17.1	14.7
2012	13.67	14.07	26.23	25.14	19.78
2013	9.12	9.89	12.43	15.68	11.78
Average value	14.09	14.75	23.04	22.7	18.64

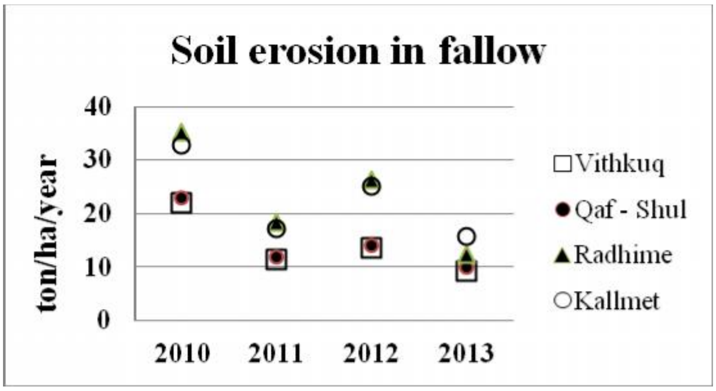

Figure 1. The amount of soil eroded in experimental variants without vegetation (tons / ha / year)

a) Determination of the impact of land ("K" Factor) in the erosion of the regions under study

To assess quantitatively the impact of salt composition in soil erosion, as "K" factor value in USLE equation, we have used datas for granural composition of soils where are builded experimental stations. For this purposse, using datas from literture we have values in the next table.

Table 5. Some terrestrial indication of erosion stations

Experimental points	Texture is %			Texture class	K factor
	sand	*Loam*	*clay*		
Kallmet (Lezhe)	13.28	35.96	50.76	Clay	0.25
Radhime (Vlore)	46.4	21.16	32.44	Clay Loam	0.32
Qaf – Shul (Librazhd)	60,8	18,4	20,8	Sandy Clay Loam	0.32
Vithkuq (Korce)	47,28	26,48	26,24	Sandy Clay Loam	0.32

b) ***Determination of the influence of slope and steep slope length ("LS" factor) in the erosion of the regions under study***

Based on the data obtained in the analysis of stations in **Table 6** we present the values of the LS factor for 4 experimental stations of monitoring of erosion.

Table 6. Some terrestrial indication of erosion stations

Experimental points	slope (%)	Height of slope (m)	**SL factor**
Kallmet (Lezhe)	8 %	10	0.526
Radhime (Vlore)	30 %	10	3.350
Qaf – Shul (Librazhd)	40 %	10	5.011
Vithkuq (Korce)	14 %	10	1.153

It should be emphasized that the experimental stations to assess erosion surface and exploiting data in USLE function should have been brought to the same standard for indicators of slope and slope length. Standart slope is 9% (**Factor S=1**) and height of slope 22,13 m (**Factor L=1**). Despite these suggestions calculated values are very close to the truth and can be used to predict potential risk of erosion in agricultural lands with different slope and height slop from experimental stations.

c) Determination of the impact of rainfall ("R" Factor) in the erosion of the regions under study

R factor is the most important element of USLE equation. The value of this factor that determind notably the potential risk of the soil to be eroded, usually is defined from the intensity of rainfall and their duration in time. For this is neccessary to have data for intensity of rainfall, but in reallity is difficult to have them. So many researchers have been trying to find a relationship between Factor R with average annual rainfall **[7] [4] [3] [12].**

To define **R factor value** for this article we have used one combination between experimental method and datas that we have from specialized literature that come from USLE. For each factor we know where we are based on for presented values. In our case for R factor values we have calculated them using USLE formulas:

A = **R***x* K *x* LS *x* C

From this formulas come out **R factor**.

$$R = \frac{A}{K\ x\ LS\ x\ C}$$

The data calculated using the formula above are presented in Table 7.

Table 7. The value of the R factor in experimental stations

Naming	R coefficient	Average rainfall mm
Kallmet	172.6	2115
Radhime	21.5	1362
Qaf – Shul	9.2	1221
Vithkuq	38.2	1230

R factor values calculated above shown high correlation between average rainfall measured in stations near our experimental stations.

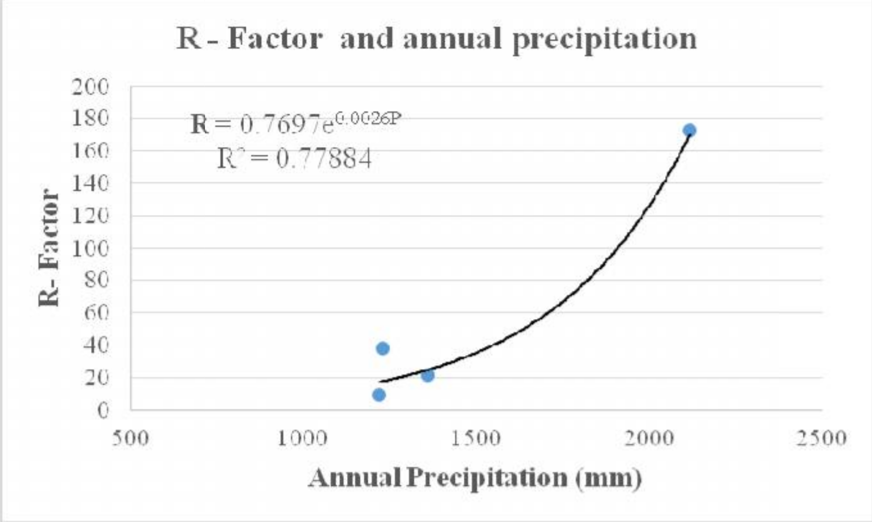

Figure 2. The value of the R factor in experimental stations

4. Conclusions

Precipitation in regions of the Central South and Mediterranean area are characterized from one aggressive erosion higher then in Central and East areas. R factor in central and south mediterranen areas are in seguent interval from 21,5 – 172,6 whereas in other areas from 9,2 – 38,2.

Erosion monitoring centers and experimental stations established for this purpose provide a basic information for using USLE equation as a tool to assess the risk of erosion potential in our country.

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