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ENVIRONMENTAL ASSESSMENT OF SOILS RISK TO WATER SURFACE EROSION IN CATCHMENT BASIN OF SHKODRA LAKE OF ALBANIA TERRITORY

Përmbledhje: Erozioni i tokës është dukuri natyrore dhe rezultat i tendencave dhe i prirjeve të forcave të ndryshme të natyrës, që shkakton deformime të kores së tokës. Intensiteti potencial i shfaqjes dhe format e veprimit të erozionit janë në vartësi të faktorëve klimë, tokë dhe bimësi. Veprimtaria e njeriut është një tjetër faktor, i cili ndikon në përshpejtimin ose minimizimin e tij. I vlerësuar në kohë normale gjeologjike, erozioni përbën fillesën e krijimit të tokës me shumëllojshmëri tipesh dhe nëntipesh, duke vendosur njëherësh edhe ekuilibrat natyrorë midis tokës së gërryer dhe tokës që formohet rishtas. Nga ana tjetër, faktorët klimatikë, tokësorë dhe biologjikë tjetërsojnë rrjedhën normale të shfaqjes dhe zhvillimit të erozionit duke dhënë ndikimet e tyre. Njeriu si një faktor 'ekstra" nëpërmjet veprimtarisë së tij ka ndikimet e tij në përshpejtimin dhe minimizimin e erozionit të tokës. Në këtë aspekt, referimi që po paraqesim anashkalon aspektet teorike të fenomenit të erozionit, duke i dhënë përparësi teknikave e metodologjive të vlerësimit potencial dhe aktual të erozionit, si dhe masat për parandalimin dhe minimizimin e tij. Në rastin konkret, erozioni në tokat e basenit ujëmbledhës të Liqenit të Shkodrës, pjesa e teritorit shqiptar përbën një rrezik potencial dhe aktual jo vetëm në humbjen e tokës, por edhe në aspektin e transportimit dhe depozitimit në kupën e Liqenit të Shkodrës dhe mjedisin për rreth, të elementëve të tjerë ndotës fizikë dhe kimikë. Në referat pasqyrohen teknikat dhe metodologjia për vlerësimin potencial dhe aktual të erozionit të tokës sipas metodes CORINE të përdorura nga FAO dhe të aplikuara në një zonë pilot të Shqipërisë. Njëherësh përdoren edhe rezultatet e arritura nga studimi CLC–2006 (Corin Land Cover), i kryer nga ana jonë në bashkëpunim me European Environment Agency. Vlerësimi potencial dhe real i erozionit sipërfaqësor dhe ndikimet që ky erozion ka në basenin ujëmbajtës të Liqenit të Shkodrës, do të bazohet në Erodibilitetin e tokës, Erozivitetin, relievin dhe mbulesën bimore. Për llogaritjen e elementit sintezë të erodibilitetit janë tekstura e tokës, thellësia e profilit të tokës, përmbajtja e gurëve. Për Erozivitetin janë indekset Fourner dhe Gaussen. Për relievin janë pjerrësia dhe këndi i pjerrësisë së terenit, ndërsa për mbulesën bimore është shkalla e mbulimit të tokës. Në pjesën e

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fundit në referim, jepen dhe masat për parandalimin dhe pengimin e erozionit, si dhe pengimi i materialeve të ngurta, që mbarten në rrymat ujore të përrenjve dhe lumenjve të vegjël.

Fjalë kyçe: *erozioni i tokës, erodibiliteti, eroziviteti*

Abstract: Soil erosion is a natural phenomenon and a result of trends and tendencies of the different forces of nature causing distortions in the earth crust. Potential intensity occurrence and action forms of erosion depend on some factors such as soil type, vegetation and climate. Human activity is another factor having an impact either on acceleration or minimization of soil erosion activity. Appreciated in the normal geological time, erosion is of a great impact in the creation of soil types and subtypes variety settings process and at the same time natural balance between eroded soil and newly formed one. On the other hand, soils, biological and climatic factors, alienate the normal flow of displaying and development of erosion. Consequently, this paper skips theoretical aspects of erosion phenomenon giving the priority techniques and methodologies of potential and actual risk assessment of soil erosion and measurements for its prevention and minimization. In this case, soil erosion in the catchment basin of Shkodra Lake, part of Albanian territory, is an actual potential risk not only to soil loss but also in terms of transportation and deposition in the expanse and surrounding environment of physical and chemical pollutants. This paper presents the techniques and methodology used to assess the potential and actual risk of soil erosion according to Corinne used by FAO. Assessment of potential and actual surface erosion risk as well as impacts that this phenomenon has on the catchment basin of Shkodra Lake are based on soil erodibility, erosivity, relief and land cover. At the end, references are given to measurements needed to prevent the solid materials carried out from water currents of the streams and small rivers from erosion and precluding process.

Key words: *soil erosion, erodibility, erosivity*

INTRODUCTION

Soil erosion is a natural phenomenon and a result of trends and tendencies of the different natural forces causing distortions in the earth crust.

The way soil erosion is created and sprouts up; consequences of its activity depend on the pedological and topographical characteristics of the soil, climate, hydrographic network and land cover. Human activity is another basic factor influencing the acceleration, minimization and elimination process of the impact and consequences of the erosion. Appreciated in the normal geological time, erosion is of a great impact in the creation of soil types and subtypes variety settings process and at the same time natural balance between eroded soil and newly formed one. On the other hand, climatic, biological and soil factors are of a great impact in the transformation of the normal course of erosion development.

Human activity, an „extra" factor in erosion phenomenon, is of an undisputable role of ongoing changes in soil and environment components.

This paper describes both the theoretical aspects of water erosion phenomenon and the techniques and methodologies used to assess the actual potential erosion risk. In the end some measurements to prevent and minimize soil erosion are given.

Soil erosion in the catchments basin of Shkodra Lake, part of Albanian territory, is an actual potential risk both either to soil loss or to transportation and deposition in the expanse and surrounding environment but also elements of physical and chemical pollutants.

In this paper, both the techniques and methodology used to assess the actual potential erosion risk according to CORINE are described.

Assessment of erosion in Basin of Shkodra Lake is based on soil erodibility, erosivity, relieve and land cover. Syntheses elements to calculate erodibility are soil texture, soil depth and content of stone. For erosivity the element are Fourner and Gaussen index. For relieve are slope angle.

Finally, are given measurements for erosion prevents and obstruction of solid materials carried out through the water currents of streams and small rivers.

MATERIAL AND METHODS

Methodology used to assess the actual potential risk from soil erosion is based on the known system CORINE. This method is widely used by FAO in many Mediterranean countries (Giordano *et al*, 1992).

In Albania this methodology was firstly used in a part of Lezha area and then to the watershed of coastal area in the south-western part of Albania (Kovaçi *et al.,* 2008). Application of this method is simple to use. To estimate actual and potential erosion risk in the CORINE model, the required database parameters are soil erodibility, erosivity, topography (slope), and land cover. Every index is the product of synthesis elements for each factor separately. (Giordano, 1987).

Erosivity is calculated combining two climatic indexes, the Fournier index and Bagnouls-Gaussen aridity index (BGI).

The slope data layer is generated in GIS environment from topographic maps and digital terrain models. In this study, the digital topographic maps with the scale of 1: 25000 were used to generate a Digital Elevation Model (DEM) of the study area. To the land cover the data of Corine Land Cover Albania, 2006 are used. (Kovaçi *et al*., 2006).

The geostatistical analysis was performed using ArcGIS (v. 8.3.) and the extensions of Geostatistical and Spatial Analyst. Application and analyses of factors is done through Geographical Information System (GIS) refers to soil type data and its compound elements, climate, topography and land cover.

RESULTS AND DISCUSSION

Morphological characteristics, pedoclimatic, hydrographic and biodiversity

The study area is located in territory of Kelmend, Shkel, Kastrat, Shala, Guemire, Rrethnat and Postribe commune and Koplik municipality (Fig. 1).

The Basin of Shkodra Lake has a surface of 5180 km^2 and the mean elevation is 770 m over the sea level. This area has a different relieve with the big changes in slope and elevation. Watershed of the lake rises above the limestone formations, partly

flysch (clay, marls and sandstone) and quaternary deposits. The centre part of basin is a karstic zone. Basin surface is characterized by local areas which are endangered by avalanches. Also, along all length, the basin is characterized from active movement of soil. (Shkupi *et al*., 2000). In this basin, the main soil types according to FAO are as following: Humic Cambisol 50 %, Eutric Regosol 30 %, Luvic Phaecozem 15 %, and Calcaric Lithosol 5 % of total area (Gjoka & Cara., 2003).

Basin hydric network is weakly developed, whereas area around the lake is rich in groundwater. The typical flows of this basin are: Zeta and Cemit River, Dry Stream, Banushi and Rrjollit stream etc.

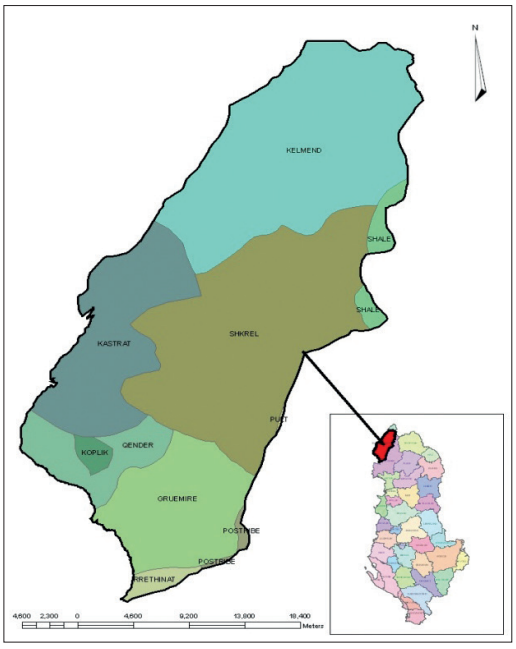

Figure 1: The location of studied area

Basing on the development process of relieve-formation and erosion intensity, the aforementioned area is part of youth cycle (early stage), dominating the severe erosion group. The way erosion phenomenon happens; the consequences and problems that arise are different, having environmental, social and economic consequences. The assessment of the erosion risk of the catchment basin of Lake Shkodra is determined the action to minimize it. Determination of measures for the soil protection and preservation help to the prevent soil and water in the lake basin from physical, physic-chemical and chemical pollution, improving this way the environment, increasing sustainable agricultural production, capacity of livestock and tourism in this area.

Climate

Depending on the climatic phenomena, designation of the catchment basin of Lake Shkoder area is as follows:

Field and hilly northern Mediterranean and North Mountain Mediterranean areas.

Mean annual precipitation in this area are 1750 mm close to Shkodra Lake area and 2500 mm close to Vermosh area. Rainfall in different period of years is different. During April – September period fall about 24 % of annual precipitation while, during October -March fall about 76 % (Table 1). Mean annual temperatures vary from 14 °C in Vraka to 6 °C close to Vermoshi area (Table 2) (Instituti i Hidrometerologjisë, 1981)

Table 1. Mean annual precipitation according to zones

Month	Jan.	Feb.	Mar.	Apr.	Ma.	Jun.	Jul	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Low zone	200	200	150	150	80	60	30	40	150	250	260	280	1810
High zone	250	250	200	200	150	100	80	70	200	300	400	400	2600

Table 2. Mean annual temperature according to zones

Month	Jan.	Feb.	Mar.	Apr.	Ma.	Jun.	Jul	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Low zone	+ 4	+ 4	8	12	18	20	22	22	20	16	8	+ 4	13.2
High zone	- 4	-3	0	4	10	12	14	14	8	4	4	- 4	4.9

Human activity

Different zones are of different human activity impact. The low zone is of a very intensive activity especially in terms of agriculture. While, high zone is limited as regards the human agriculture and livestock as a result of the economical and social changes as well as migration on the other parts of Albania.

In both low and high zones, land fragmentation has significantly reduced the impact of mechanics in agriculture. As a result normal function of agriculture mainly in soil digging, drainage and irrigation system is preventing. An important activity remains mountain tourism which despite its weakness is extended along all areas.

Analyses of soil, relieve, climate and vegetation indicators

Soils indicators are fundamental, because they are the syntheses of the class assessment and the sensitivity that they have towards erosion phenomenon. Soil texture with three classes is named after the fraction content with different measurements (< 0.002 mm up to 2 mm).

Soil depth with three classes is named depend after the soil pit depth (< 25 cm, 25–75 cm and> 75 cm). Percentile content of surface stones with two class is based on percentile of stones in soils (>10% and ≤ 10 %). *(*Cara & Salillari, 2008). Assessment of soil erodiblity index is product of textural classes with soil depth and content of stones.

Climate indicators take into consideration the precipitation and temperatures and identified with erosivity. Erosivity is outcome/product of assessment to Fournier and Bognous-Gaussen indexes or variability index class and aridity classes (Wischmeier, 1976). Depending on the value of product of Erosivity indexes is classified in steeps (Dhima *et. al.*, 1998). A topographic indicator is identified using slope index with four steeps which identified slope angle and length of slope. Assessment of potential erosion risk is product of soil erodibility index with erosivity indexes (Fig. 2). The actual risk depends on land cover and soil erosion risk depends on the land cove and their indexes (Fig. 3).

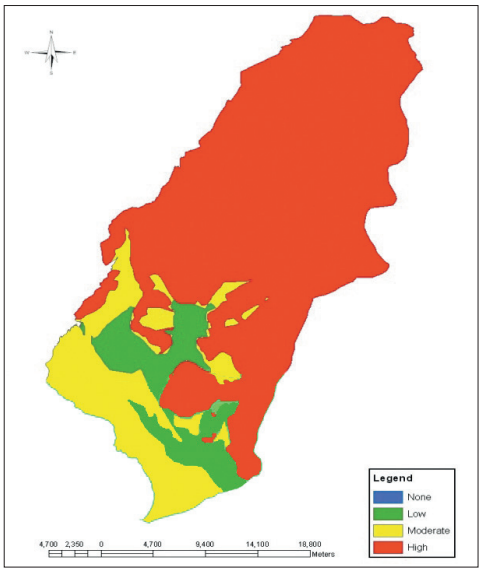

Figure 2. Potential soil erosion risk map

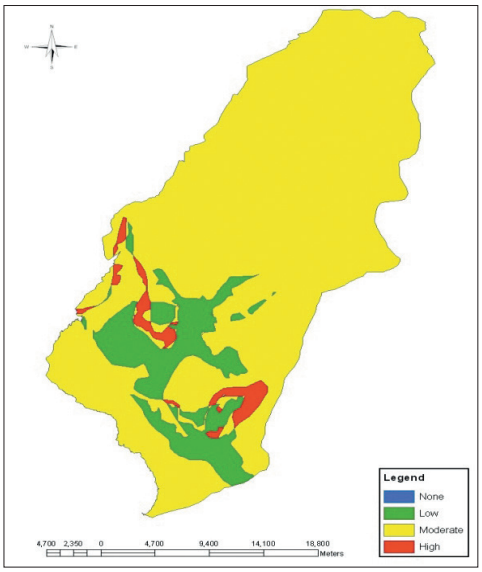

Figure 3. Actual soil erosion risk map

CONCLUSIONS

Determination of soil indicators, climate, landscape and vegetation in the catchment basin of Lake Shkodra, are the outcome of scientific research and a long-term study of the researchers of our scientific institutions.

Application of this methodology unified by many of Mediterranean and Europe countries showed that studied area is of a high potential and actual erosion risk.

The results showed that: i) soils with low potential erosion risk are 9%, ii) soils with moderate potential erosion risk about 17% and iii) soils with high potential erosion risk about 74% of the total percentage potential risk, while i) soils with low actual erosion risk are about 12%, ii) soils with moderate actual erosion risk are about 85% and iii) soils with high actual erosion risk are about 3% of the total percentage potential risk

This dissimilarity between the areas of potential and actual erosion risk stresses out the effects that land cover has on soil erosion. These areas classified as high erosion risk in the potential erosion risk map were reduced from 74% to 3% in actual soil erosion risk map, after overlapping the vegetation layer. This proved that the areas subject to high erosion risk are mostly covered by forest vegetation.

Important among the protective measures of soil from water erosion are: i) biological measures, ii) second-order measures hydro technic and, iii) measures structure.

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