RESEARCH ARTICLE **(Open Access)**

Risk assessment of potential and actual soil erosion ot the territory of Albania via SystemGeographical Information (GIS) and its combination of technology assessment according to Corine Land Cover

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Abstract

This paper presents soilerosion situation, is based on the study of erosion as one of the most widespread forms of physical degradation of the soil. It focuses on several factors, natural and anthropogenic most significant impact on this phenomenon, as texture of the soil, precipitation and their intensity, the degree and length of slopesAs well as, through their environment analysis from a GIS program, gives a spatial distribution and the values of this phenomenon for the Albanian territory. The results are reflected in the creation of two maps with a scale of 1: 200 000, which shows a spatial distribution of the values of current and potential erosion based on a predetermined scale evaluation according to the project methodology. This methodology combines in an innovative way the study of traditional elements that affect the erosion phenomenon with a new element; - the coverage of land under the CORINE program. Maps clearly show areas where erosion is presented at low levels and "hot - spots" where the situation is more problematic.

Keywords: erosion,soil,texture,slope, erodibility,cover.

1-Introduction

Erosion is the process during which the soil and rock remove from the soil surface by exogenous processes such as wind or water leaks and then transported and deposited in other spaces. While erosion is a natural process, human activity has increased by 10-40 times the rate at which erosion is occurring on a global scale.[7;9] Agriculture based on the technology of pesticides, deforestation, construction of new roads, climate change and urban extensions are among the most distinguishing factors of this activity that stimulates erosion. In some cases, the result is complete and space desert. Effects "off-site" include sedimentation and eutrophication of water leaks water like lakes, reservoirs, watersheds, etc. and related sedimentation damage to roads or settlements. Erosion caused by water and wind today constitutes the main cause of land degradation thus turning erosion as one of the most dangerous environmental problems on a global scale.[3]

Use of land in Albania continues to be so intense that 44% of it is used for agricultural purposes including pastures and 22.3% is arable. The soil, according to [8;9] is in the maximum of physical limit and extension of this limit in the near future seems unlikely. According to this author approximately 20% of the soil has a slope of over 25%, forming erosion hot spots. But threatened by erosion are and 6-25% of soil, especially when their use is not associated with protective and for more these are used for mostly crops. Recent years as a result of privatization of land, massive construction and uncontrolled urbanization has been a major fragmentation of agricultural and non-agricultural land. Such a phenomenon has caused disorientation of surface water flows cousing the formation of landslides spots of land at about 115,000 hectares. Also as a result of breaking water flows regime is established physical damage , deposits and transport of solids and sensitive nutrients from the soil. Lack of discipline of surface water flow during construction have caused damage to the road infrastructure in urban areas in the network system of canals, irrigation water and higher [5].

According to the study "Monitoring of land and water use in Albania"[5;10] carried out by a group of authors erosion is classified as geological (natural) or influenced by human and accelerated (anthropogenic), where besides natural factors,influence and the economic and social activity of human.

Visible forms of natural erosion are: a) runoff, which depending on the nature of land formations and climatic conditions affecting the movement of soluble materials via groundwater and surface water. b) surface erosion affecting soil erosion mainly hilly and mountain massifs and storage of the material in the lower quotas. This is the kind of erosion referred to our study. c) erosion in the form of landslides which have as origin the presence of underground formations impermeable or partially permeable.

Anthropogenic erosion forms: a) layer erosion where soil erosion is uniform and depends on the amount and intensity of rainfall b) linear erosion which is characterized by the creation of lines, streams, rivers and stream beds. This form is a continuation of the flat erosion and occurs in soils with steep relief c) internal erosion where corrosion begins in the summer and usually operates for a short period.

2-Materials and Methods

The methodology has been applied in this article is recommended by the Food and Agriculture Organization of the United Nations - Food and Agriculture Organization of the United Nations (FAO) - to the Programme Coordination of Environmental Information: Corine (Coordination Information Environment Programme) - promoted by the European Community, DGXI.

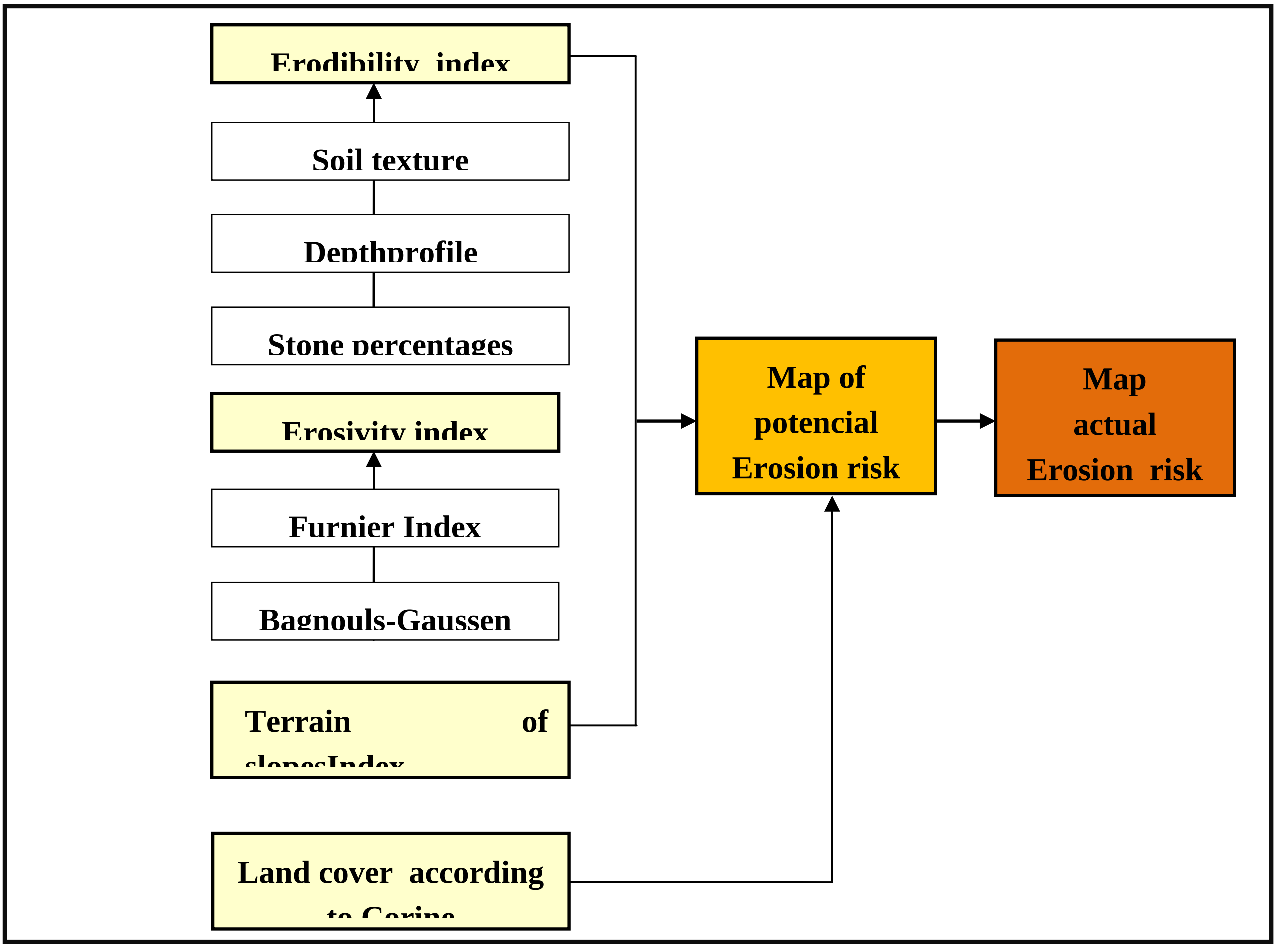

Figure 1 schematically and generally summarizes work methodology that is followed to conduct the study.

The methodology followed in this study included three main phases:(1) The collection of data necessary for the risk of soil erosion and soil quality (2) Integration of data in an information system based spacewhich enables analysis data in space and their presentation in the form of maps (3) presentation of the results of the methodology and evaluation methodology and results on the ground to determine the need for deeper study in the future assessment of the risks of erosion based on the principles and parameters defined in Equation Universal [3] Losing earth - Universal soil Loss Equation (USLE) - according to which: (i) land erodibility (K factor) is itself a function of the parameters of soil as texture, composition and organic, permeability and structure (Wischmeier, Johnson and Cross, 1971).(ii) Erozivityby precipitation (R). (iii) the topographic factor, the slope of the surface in% (S) multiplied by the length of the slope m (L). (Iv) land cover (C), which takes into account the density of vegetation and its structure. (V) Practices of land management (P). Results integrated into the equation: E = K.R.SL.C.P [3;12]to calculate soil erosion (E). However, this model can not be used in its original form, for many reasons including: a) first model developed only for conditions occurring within the territory of the United States and for use abroad should be made modifications b) the model was also developed for use at the local level, such as aid to farmers and therefore its use in global scale requires modifications. For these reasons the article we worked is based on the modified methodology and proposed by the European Community and specially for Southeast European territories where Albania is locate

2.1.Erodibility Indext

Land erodibility refers to land erosion sensitivity. Erodibility of land associated with its ability to resist the erosion process according to its physical characteristics of its components. Based on the methodology chosen for the article, pedologic elements that will be studied to assess land erodibility are: a) texture of the soil b) the depth and c) The content of the rocks in the surface layer.

Texture with 12 types of soils are named based on the size of the diameter of the soil particles separated in to fractions in mm and ratio that occupy these fractions to the total. Soils with particles <0.002 mm named Clay (C) - clay, particles with a diameter of 0.002 - 0.05 mm named Silt (S) and soil.particles with a diameter 0.05 – 2.00 mm named Sandy (S).Based on the fractions ratioagainst the fractions total is made the naming of soil types in total 12. The title of each group is made depending on the resistance that particles of soil water to rinse. The first group include highly resistant lands and are considered as indifferent to soil erosion . This includes lands C (Clay), SC (Sandy- Clay).

The data for the texture of the soil were collected in two ways: a) by the project INTERREG II - Italy / Albania , where were obtained data for 209 profiles and 2) field-work to 104 other profiles, with a total of 313 profiles. In this way it is provided a database that have sufficient measurements density and also a comprehensive geographic representation,that enables the creation of a data layer in GIS, covering the entire territory of the study.

Depth of soil is a very important factor to land erodibility[12] for two reasons: first, deep soils absorb and hold larger volumes of water than shallow soils and as a result generate less flooding; secondly they represent a greater tolerance to erosion and cause less soil loss. This factor is estimated by the depth of the soil profile. At surface erosion is taken into account only the firsthorizon of profile. Based on the depth of this horizon which is estimated at three levels <25cm, 25 - 75cm and> 75 cm is determined the degree of sensitivity to erosion. To collect data on soil depth are using the same profiles as the soil texture.

The content of the rocks is the factor that is assessed through coverage level of ground with stones in percentage. Its effect on the index of erosion can also be quite prevalent depending on the circumstances, so a surface covered with stones can protect land from run off but when that starts to happen the presence of stones can cause turbulence and as a result encourage the formation of a water line (source water).

2.2.Soil erozivity Index

Erozivity is mainly a result of climatic conditions. Traditionally, the intensity of rainfall is considered as the main determinant of erozivity and therefore USLE (Universal Loss Equation Soil) is determined on the basis of the maximum 30 minutes of rainfall intesintety. This definition, however, depends very much on the available data, and in most cases it is not possible to carry out. For this reason, FAO-UNEP-UNESCO (1987) use Fournier index to measure the risk of land erozivity. Consequently, based on CORINE methodology, and in this article are used two alternative indexes to characterize erozivity.Index Fournier [11] and Bagnouls-Gaussen Index

2.3.The terrain of the slopes Index

Topographic factor is the third element for determining of potential and actual erosionrisk of surface erosion. The sloper and longer will be the terrain the more is the risk of erosion. USLE element in this index reflects the angle of slope of the terrain and the length of the slope and reflects the circumstances in which soil run off speed increases with the increases of the terrain slopes while the run off volume increases with the length of the slope. Considering the scale of the map, in which it is performed article, topographic factor is called insignificant and as a result is only working with the slope index of terrain.

2.4.The index of land use by CORINE

Potential risk of erosion is increased if soil has little or no vegetation cover. Vegetation protects the soil from the impact of raindrops and runoff and also reduces the intensity of runoff and water infiltration.Inhibitory effect of vegetationagainst to erosion depends on the type and extent of vegetation cover in space. When vegetation cover is dense and completely covers the space is becoming an obstacle for precipitation and as result this area is more efficient in controlling erosion. Land cover factor is the fourth element for determining the potential and actual risk of erosion. He can be considered as one of the most essential elements in the design of erosion because it is the only factor to which human activities have impacts. As a basis for determining the land cover for the Albanian territory during the period 2010-2013 served work for reclassification and verification of land cover mapping according to Corine method in 2006 through: a) the processing of satellite images 2010 and a comparison with land covermap “Corine Land Cover” taken from the project CORINE 2006 b) verification of the data on the land cover from work done for the updated land cover map for year 2013.

3-Result and Discussions

Obtaining a continuous surface which represents the distribution in space of a particular attribute (precipitation, temperature, environmental pollution, etc.) is one of the keys to success in the use of geographic data in a GIS environment. Geostatistics analysis in GIS is the type of analysis which uses data obtained from several points measured and distributed in space not uniform and via some techniques of interpolation creates continuous surface using the obtained measurements and obtained new predictive value for all locations in the area in question. There are several interpolation techniques but in this study is used the method of interpolation, using inverse distance: IDW - Inverse Distance Weighting. This method is based on the law of addiction in space (Tobler) which means that objects that are geographically close to each other are more alike than those that are far away in space.

Work for creating of the geostatistics model in this article has gone through several stages, which are:

1) establishment of thematic data base for erodibility indixes, erozivity, slope and land cover slopes

2) reclassification of thematic base data values according to the erosion rating scale,

3) interpolation method with IDW. (Inverse Distance Weighting)

4)reclassification of raster data generated byinterpolation according to the erosion rating scale

5) carrying out analysis of overlap with the raster data reclassified.

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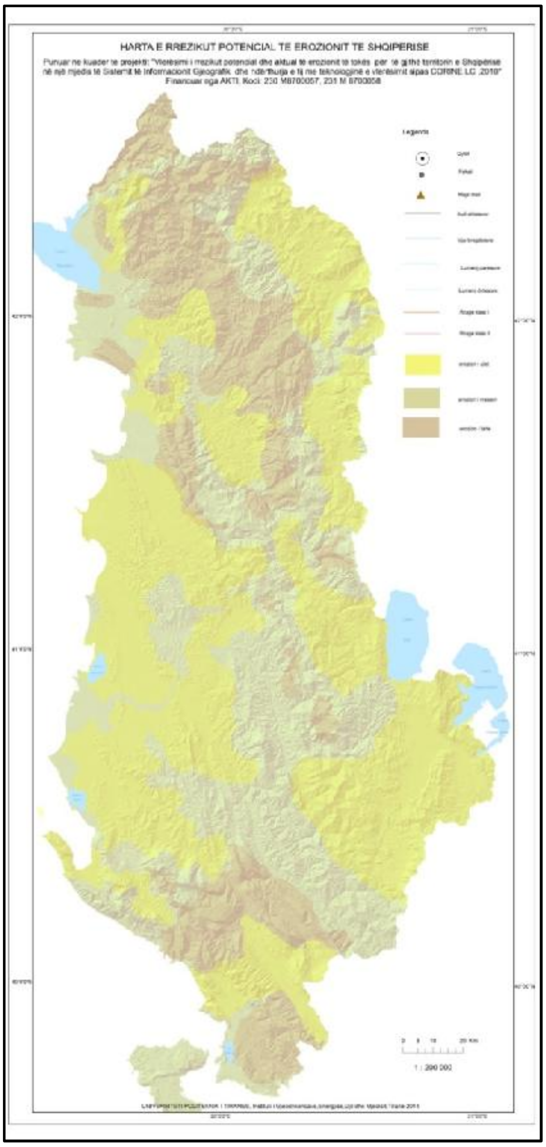

Fig 2. Map of potential erosion risk

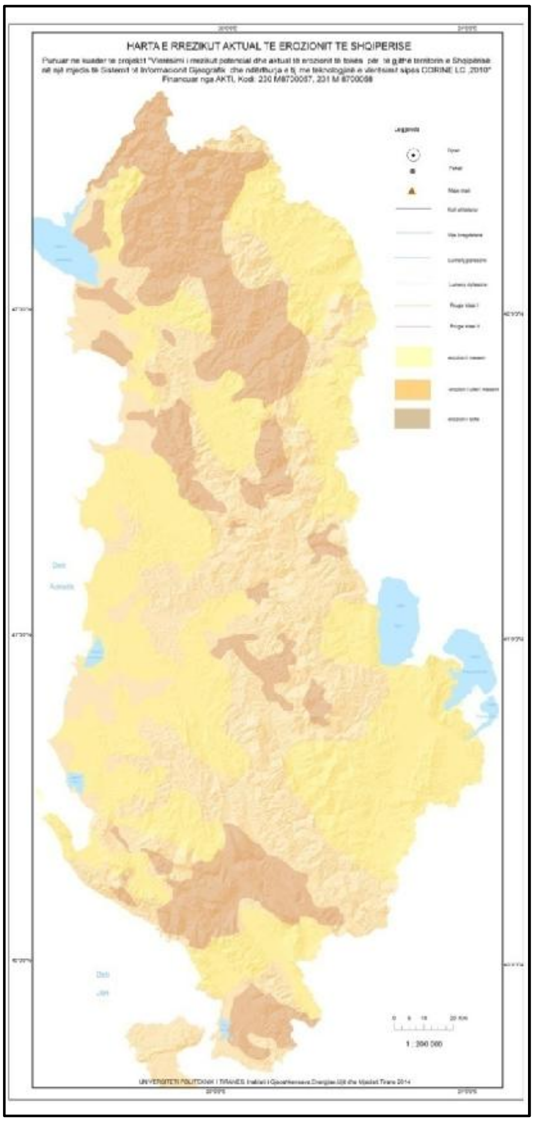

Fig 3. Map of actual risk erosion

Erosioni actual	**The erosion rate**
	2 - Low
	2/ 3 - Low / Medium
	4/5 - High
Erosion potential	**The erosion rate**
	1 - Low
	3 - Medium
	5 - High

Figure 4. Erosioni potencialand actual erosion

Geostatisticsmodel results are the creation of two maps; of actual and potential risk of erosion. The analysis in this model with data from measurements of 313 profiles,as texture indexes,soil depth and presence of stones, has created the map ofland erodibility . Then iscontinued with work for creation oferozivitity map which is the product of the analysis carried out with data of precipitation and temperature indexes by interpolation of values in 65 measurement places. Work has continued with the creation of the model DEM (Digital Elevation Model) and the slope gradient map as one of the most important topographic elements in the process of erosion. By modeling the results of the above values with weighted overlay method is achieved mapping of potential risk of erosion (a) which reflects the values of the spatial distribution of natural indexes described above to Albanian territory

Based on the results obtained from the analysis of the relevant indexes , the characteristics of the potential erosion areas are as follows:

Area 1. This zone represents a low risk of potential erosion as natural factors here are favorable. This is reflected in the indexes analyzed where the soil texture is predominated by clay which resists maximum to erosion. At the same time this area is characterized by a small slope gradient where most of the occupied areas are plains and lowlands. The average annual amount of precipitation goes to minimum values and in these regions are not created conditions for the development of erosion.

Area 3. This area shows a high degree of potential erosion. Geographically it occupies territory areas where the slope of the terrain goes to 30% and soil resistence against run off has average value.

Area 5. This area shows a high degree of potential erosion extending into the more mountainous parts of the country. As a result of a higher grade of slopes and high level of rainfall erosion potential in these areas continues to be high.

Current erosion danger contains additional anthropogenic factor, the way how the area of land is used by human activities. To realize a modeling of such data in this study as the basis are used land cover maps under the nomenclature CORINE 2006 and the work was done to update the data to create a map of the land coverwith the same methodology for year 2010. Thus the processing in ILWIS 3.1 of satellite images of year 2010 combined with numerous checks at field trips to all locations where the type of coverage was unclear or represent changes compared with year 2012 is made possible modeling data on land cover for year 2015. These data are added to the map of potential erosion risk,using the overlay method, resulted in the mapping of the actual risk of erosion (b).

To map the actual risk of erosion except natural factors are taken into acount and analysis of anthropogenic factors related to land use. Based on the results achieved by analyzing of the respective indexes the actual characteristicsof erosion zones are as follows:

Zone 2 The index of land use for this area seems to be "partial protection" by categorizing it as an area where the current erosion level appears to be at scale 2. Although other indexes used in the methodology of this study classify the area as first for potential erosion, fact that it lies in an area with partial protection as a result of anthropogenic activities,classifies it as an area with second-degree erosion.

Zone 2/3 Because index values for land use, for the area, associated with its complete protection from anthropogenic activity and this area is increased with the degree of erosion assessment, being classified as 2/3 with erosion low to medium.

Zone 4/5 This is the area with the highest erosion in which are harmonized index values of potential erosion of fourth degree with a weak defense by anthropogenic factors, classifying the area with the actual erosion of the high degree

4-Conclusions

Erosion as one of the most common forms of physical soil degradation causes significant environmental impacts, social and economic at regional level and beyond. Among the most important influences can mention decrease of soil productivity, food insecurity, migration of population, damage to ecosystems and loss of biodiversity (F. Rybak, 2012). The aim of this article was that by assessing several important indexes that provide condition for erosion to give in the form of maps the spatial distribution of its values showing the most problematic areas, also called "hot spot -s where this phenomenon is at alarming levels. However the scale at which is working article and the results achieved are at a generalized level,studies with scale more detailed will better show erosion at the level of Albanian territory.

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