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Research on the possibilities of determining the degree of soil erosion in the low mountains of the shirvan zone of the greater Caucasus using aerospace methods in Azerbaijan

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Abstract

Soil erosion is one of the major environmental problems in terms of soil degradation in the Shirvan plain of the Republic of Azerbaijan techniques have been implemented for the assessment of the data, applying the Revised Universal Soil Loss Equation (RUSLE) for the calculation of the risk of erosion. Thirty soil samples were randomly selected for the calculation of the erodibility factor, based on calculating the .

Keywords: *ecosystem, erosion, slopes, cross country, topography, soil type, climate, land productivity, sediment, remote sensing, soil degradation etc.*

Introduction

Evaluating soil erosion risks

Evaluating soil erosion risks is a difficult under taking task due to several concurrent processes, which affects individually other multifaceted interactions and continues at amounts that vary in both time and space [2]. Soil erosion is caused by the erosive forces of wind or water. In this publication, we focus our attention on concepts surrounding water-induced soil erosion. This type of erosion threatens our ability as humans to sustain our global population with food and fiber, and is closely linked to economic vitality, environmental quality, and human health concerns. Roughly 75 billion tons of fertile topsoil is lost worldwide from agricultural systems every year.

Erosion in the Republic of Azerbaijan the total area of affected lands was 3144.7 thousand hectares, which is 36.4% of the country's territory. 38.8% (1220.1 ha) of eroded lands of the republic are weak, 29.4% (924 ha) are medium, 31.8% (1000.6 ha) was severely eroded. According to researchers, in the watershed and transit areas of river basins located in mountainous areas 70-80% of the soil cover is eroded under complex geomorphological conditions. [1].

Soil erosion occurs when parts of the soil are shifted around due to rainfall, wind, and ice melt. This is a natural process, but human activity can speed it up. The best way to combat soil erosion? Preventing it in the first place. Luckily, there are some additional methods that can also help you reverse the impacts of soil attrition. [8].

With the presence of GIS competencies, the efforts have been directed to be based on spatially distributed models simulating erosion dynamics and surface runoff of more complex and larger catchments [14, 10]. Several models have been developed and used for either research or operational purposes. Some of the most known soil erosion models are USLE (Universal Soil Loss Equation, 1965), EPIC (Erosion/Productivity Impact Calculator, 1984), EUROSEM (European Soil Erosion Model, 1993), RUSLE (Revised Universal Soil Loss Equation, 1997), Rill Grow (a model for rill initiation and development, 1998), SEMMED (Soil Erosion Model for Mediterranean Regions, 1999), EGEM (Ephemeral Gully Erosion Model, 1999), PESERA (Pan-European Soil Erosion Risk Assessment, 2003), and so forth. Soil erosion models can be distinguished as mechanistic (or process based) when they simulate the physical erosion processes by specific formulas or empirical when they calculate erosion based on regression of soil loss based on the physical properties of land and climate features [11, 12]. They also can be characterized as dynamic when the time is a contained parameter. Long-term models are based on accumulated temporal data while event-based models describe single events [13, 10].

The soil erosion estimation models are focused on the identification and quantification of the erosion processes and the controlling factors, resulting in the sequential erosion models development beginning with the universal erosion equation (USLE) realized by Wischmeier and Smith [15], followed by a modified equation (MUSLE) for the quantification of the alluvium resulting from erosion following each rainfall realized by Williams [16], and eventually computerized and more complex equation (RUSLE) developed by Renard et al. [17].

The most important climatic variable in soil erosion processes is rainfall erosivity, which is related to rainfall amount and rainfall intensity [18, 19]. Plants vegetative cover in addition to crop residues reduces soil erosion potential, due to the fact that the vegetation cover protects and leads to slowing down surface runoff movement and enhancing surplus surface water infiltration [20–21]. Type, extent, and quantity of the vegetation cover are the limiting factors of soil erosion effectiveness [22, 23].

The main aim of this research is to quantify the soil erosion in the Shirvan plain, which is the main agricultural zone in the Republic of Azerbaijan through examining the soil erodibility K-factor under different levels of soil data availability using the RUSLE model.

Materials and Methods

Shirvan steppe is part of the Kur-Araz Low land of Azerbaijan and is located on the left bank of the Kura river, in the area between the Kura river and the Caspian sea. It is one of the areas where flat mud volcanoes are spread. It has Chala lakes fed by the Upper Shirvan canal. The elevation of the steppe ranges between 16 m and 100 m. The steppe has grey desert soil. Its vegetation is halophytic and wormwood, with estuary meadows. The upper Shirvan water channel was directed from the Mingachevir reservoir in order to irrigate the land. X= 165672.168, Y= 4523537.932and X= 327493.967, Y= 4423734.657 located between the coordinates. Summer is very hot and dry. On some days, the temperature reaches 36-400C. The second is the temperate hot semi-desert and dry steppe climate with dry winters. The annual number of sunny hours in the area varies between 2100-2400. The average annual temperature in the area varies between 14-150.

In the Shirvan plain, soil temperature is unevenly distributed depending on air temperature, soil history and vegetation cover. The lowest average monthly temperature is 1-3. 50 and the highest is 30-350C on the soil surface of the plain. Precipitation is unevenly distributed in the Shirvan plain. The amount of precipitation in the area varies from 250 to 510 mm. Most precipitation falls in spring and autumn. It snows very little. The thickness of snow cover is 20-25 cm, the settling time is 10-13 days. Winds blowing in the Shirvan plain are formed under the influence of local conditions and incoming air masses. These winds often change direction due to the change of seasons. [3]

The rivers entering the Shirvan plain are of transit nature. These rivers belong to the Kura basin and start from the altitude of 2000-3500 m on the southern slope of the Main Caucasus Range. Alijanchay, Turyanchay, Goychay and Girdimanchay are divided into a number of branches after rising from the lowlands to the Shirvan plain.

Garasu rivers are formed from the water that flows underground from the surface of the supply cones and rises to the surface in the form of boils in the outer parts. The Turyanchay River begins at the foot of the Bazarduzu and Tufan peaks of the Main Caucasus Range, at an absolute height of 3,680 m, and flows into the Kura at a height of 3.5 m, west of the city of Zardab. In the upper reaches, the catchment area of the Turyanchay is 1,842 km2, water consumption is 15.6 m^3 / sec, and the annual flow is 491,000 m3. The Goychay river began at an altitude of 2,500–3,000 m at the foot of the Savalan Pass and Babadag Peak and flowed into the Garasu at an absolute height of 9 m.In connection with the subsequent reclamation measures, it was connected directly to the globe. The catchment area is 1770 km2, the average annual water consumption is 12.5 m^3 / sec. The length of the river is 50-60 km.Girdimanchay flowed into Garasu at an altitude of 9 m, starting from 3000 m at the foot of

Babadag Peak. Later, it was discharged into the Kura River through an artificial bed. The catchment area is 232 km2, water consumption is 2.34 km3 / sec. The length of the Shirvan plain is about 25.2 km. The density of the general river network of the Shirvan plain is 0.46-0.5 ka / km2. The flow in the rivers of the Shirvan plain is uneven throughout the year. In addition to the rivers with a constant flow mentioned above, there are many dry valleys and ravines of different lengths, starting from the low mountains and having a temporary flow during heavy rains. The largest lake in the Shirvan plain is Hajigabul. [3]

Water is discharged from the Kura River to keep the water level stable in the lake, which has an area of about 16 km2. The lake is currently drying up. The dry, arid climate of the Shirvan plain requires maximum use of irrigation. The Upper Shirvan canal, which starts from the Mingachevir reservoir and stretches for 123 km, allows to irrigate more than 47,000 hectares. The Shirvan plain rivers have rich groundwater resources. groundwater. The food source of groundwater is rainwater, river water and irrigation leaks. The groundwater level in the 5-6 km wide strip along the Kura River is 1 m deep, and in the Goychay ground cone it is 1.5-2 m. The flow of groundwater in the Shirvan plain was very weak, mainly due to the general inclination of the plain. Mud volcanoes in the lowlands are also relatively affected by the mineralization of groundwater in the eastern part of the Shirvan plain. [2]

Soil erosion from irrigated fields has been discussed previously (7, 8); this article focuses on unique aspects of irrigation-induced soil erosion that are important when managing and simulating soil erosion on irrigated lands. Soil erosion mechanics can be divided into three components: detachment, transport, and deposition. Water droplets and flowing water detach soil particles; flowing water then transports these detached particles downstream; deposition occurs when flowing water can no longer transport the soil particles because flow rate decreases as water infiltrates or as rill slope or roughness changes. Some particles are deposited within a few meters although others are transported off the field with runoff water. These mechanisms are the same for surface irrigation, sprinkler irrigation and rainfall; however, there are some systematic differences between irrigation and rainfall erosion and especially between surface irrigation and rainfall.

Erosion rates as high as 145 Mg/ha in 1 h (9) and 40 Mg/ha in 30 min (10) were reported in some early surface irrigation erosion studies. These extreme losses do not represent a sustained seasonal rate. Within field erosion rates on the upper quarter of a furrow irrigated field can be 10-30 times more than the field average erosion rate (12). Some soil eroded from the upper end of a field is deposited on the lower end, whereas some soil leaves the field with runoff. Losing topsoil from the upper end of the field can decrease crop yields by 25% when compared with the lower end of the field (13). Sediment cannot be transported without runoff. Runoff is planned with many surfaces irrigation schemes in order to irrigate all areas of the field adequately. [25]

2.2. Methodological Framework. The methodology is implemented through several steps which led to the intermediate and the final results. Initially, the

Results and Discussion

In order to assess the soil erosion risks in the study area, several applications and analyses were implemented. Each generated factor was thus fully described and processed. regression was found between the mean annual precipitation 2010-2020 (mm/year) and the elevation to be read as

Conclusion

Erosion risk values are ranked into classes, which is in accordance with RUSLE standards as it provides better identification of the area most prone to erosion. GIS and Remote Sensing are inevitable technological environments when implementing RUSLE for assessing soil erosion risk in the spatial domain. The adopted approach was based on mapping procedures, such as conversion of categorical into numerical polygons, interpolation of point samples, map algebra, and raster map reclassification. Data quality is a crucial parameter in soil erosion modeling and those errors and uncertainti esarepropagatedto the final erosion results. Denser grid of sampling sites for the soil survey approach would produce a better

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