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The effect of vegetation degradation, erosion and sedimentation in the Navrood watershed in Asalem

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Abstract: Erosion is a process in which particles of soil are removed from their bed and transported to another location by a transfer agent. In collecting research, basic documents and statistics were provided from relevant organizations. Then, data classification, data analysis, preparation of required maps by GIS, preparation of tables and charts were done through Excel software and field operations. In the Navrood basin, the higher the altitude, the lower the precipitation, but the percentage of ground area has a lower coverage, and finally, more runoff and more erosion are observed, and the coverage is scattered throughout the basin area and Ultimately, erosion occurs throughout the basin and, if desired, in the second priority of soil erosion, altitude levels can be considered as a factor in increasing runoff and erosion. In the vicinity of the river, we have more vegetation in the heights, but at lower elevations and at the outlet of the river at the edges of the river, erosion has increased. One of the erosion factor in the low altitude of the Navrood Basin is the conversion of forests to fields. Another factor in erosion at high altitudes is the excessive slaughter of livestock in low altitude areas. in general, in moderate to massive forests, we see less erosion. In the end, it was suggested to prevent the extensive use of forest vegetation cover, restoration and restoration of damaged forests by planting native species in order to preserve vegetation in the studied basin.
Key words: Navrood watershed, vegetation, destruction, erosion, sedimentation

Introduction

Soil is one of the most important natural resources and factors of production in each country. The erosion process in various forms causes the loss of this national capital. Therefore, soil erosion is a threat to human well-being and even its survival. In areas where erosion is not controlled, soils are gradually eroded and lose fertility. Erosion not only causes soil degradation and abandonment of farms, and in this way causes great and irreparable damage, but also causes significant losses due to the deposition of materials in drains, reservoirs, dams, ports and reduction of their drainage capacity (Refahi,Hosseinqoli, 1375). As noted, we observe through observation that erosion is used continuously and at all moments of its development, it uses a set of initial processes. Of course, through joint interference in the application of weathering and destruction (mechanical destruction, dissolution and decomposition), the outcrop of hard and hard rock is attacked (Mahmoudi, 1999). Soil erosion and loss of fertility and resource degradation are among the issues that make it difficult to achieve sustainable agricultural development and environmental protection.

In this research, the main objective is to investigate the effect of vegetation destruction on erosion and sedimentation of Navrood watershed in Islam.Ahmadi, in 1995, in comparing the efficiency of EPM and MSIAC models in estimating erosion and sedimentation of Saghechai Basin in Namin points out that erosion is a continuous process that has existed since the formation of drought and human being involved with livestock breeding and agriculture. Pishdad et al., In 2008, studied the effects of land use change on soil erosion in the Cheragh Weis catchment area using the GIS, and in the Journal of Agricultural Sciences and Natural Resources, first, using EPM model, the amount of erosion and specific sediment in the studied basin was calculated in GIS environment and the erosion intensity map was plotted. In 2012, Khatibi and his colleagues examined and evaluated the areas at risk of erosion in the basin of SarEskandar Chai, the eastern slopes of the Sahand Mountains, using the USLE and IS model, Geography and Planning Tabriz University. The USLE model and GIS technique have been used to investigate the causes and factors of water erosion and identify the areas at risk of erosion. In 2006, Stego and his colleagues reported on the extent of soil erosion and sedimentation of Shakin Chai watershed by EPM method. The geomorphology of the land is changing with time, and erosion is one of the most important phenomena affecting the morphological changes of the surface of the earth. Many experimental models have been used during the past two decades to study soil erosion. These models are a tool for estimating sediment in catchment areas. Recently, many researchers around the world, using GIS and remote sensing techniques, estimate the erosion and sediment quantitatively using these models. Mohammad Ghasemiinvestigated in 1999, modeling of erosion of surface formations and sediment production in the Hana catchment area in Isfahan province, using modified P.S.I.A.C method. Maghsoudi and Habibi in 2010 investigated the zoning of soil erosion and estimation of sediment in Mariyamnegar watershed using experimental models. Using the ILWIS software environment and earth-reference them, the required digital layers and databases were created for them. Finally, using the tables presented in each of the studied models, proportional scores were extracted for homogeneous regions. By combining the mentioned layers, according to the relationships presented in each of the models, the zoning map related to the severity of erosion was prepared for the region. Mohammad Reza Nikjou in 1994 evaluated the application of P.S.I.A.C in the estimation of erosion and sediment in the DaryanChay watershed and he conducted his research. Mashhadi, Nasser, in his 2000 article entitled "Study of quasi-karst forms, with emphasis on the erosion of piping (a case study of southern Semnan)", points out that the most interesting quasi-karst phenomenon in the region, which can be considered considerably as an indicator, isthe water fracturing phenomenon with a substructure that has formedearth face with different forms and dimensions. The most important studies on the Navrood basin are as follows: RafaatShahmariArdjani, 2012, "Feasibility study of the road from Asalem to Khalkhal, a step toward development of tourism activities" (A case study of the area of the Navrood basin),Mohammad Reza Servati, 2012 , "Studying and ehequantitive estimation of erosion in geomorphic faces by FAO method in Navevud Basin". In Kouwen (1997) studies, Manning values estimated using the proposed model are agreed with Manning values reported by Chow and Arcement. The manning roughness coefficient increases with the second root of the depth of immersion and inversely, innon-submerged conditionsis decreases with increasing velocity. By disregarding the tree type and the shape of the foliage and its distribution, the difference in manning coefficient with depth is due only to the increase in the area of absorption of the momentum. Smith and Morgan (1980) examined the effect of vegetation on ground forces and showed that vegetation decreases the destructive effect of destructive forces with direct absorption of forces from soil surface caused by pedestrians, livestock and vehicles and maintains soil consistency. Vegetation density is always considered as a parameter for non-submerged conditions. AbiCyma and Rizidgosu (1995), while studying the effect of vegetation on Manning roughness coefficient and flow velocity, have provided recommendations on the spatial location and type of planting. Nail Urila (1994) plotted the root tensile strength of different trees in relation to their root diameter, and showed that with increasing root diameter of the tree, its resistance decreases.

Materials and research methods

The study area is located in Navrood watershed in Asalem, which is located in the north of Iran, GuilanProvince,in Talesh. From a geological point of view, it is one of the oldest formation of Precambrian era, which is a two-part transformation formation of the Shanderman-Asalem and the Gashtseries, respectively, are seen in the north and south.The Navrood River sediments include alluvial terraces and fans, with the highest concentration of population and agricultural activities in this unit.The average rainfall at the station is 1300 mm. The major soils of the area can be classified as follows: hydromorphic soils (wet), coastal sandy soils, white and glay soils, red soils and podzolic soils and, in some cases, there are gray-brown podzolic soils.Vegetation is known as a major factor in reducing the effects of floods. The results of the study on the relationship between height and vegetation in the watershed of Navrood showed that as the altitude increases, the forest cover is gradually reduced and rangeland species are replaced. Of course, this phenomenon is in proper interaction with the natural conditions of the area, so that rainfall and the type of atmospheric precipitation with a vegetation type are always in equilibrium.Two first-rate hydrometric stations are installed in this catchment area, one of Khalian's hydrometric station located near the basin center, and the other is the hydrometric station of the Kharjgil which is located at the outlet of the basin. The highest flow rate was 144 cubic meters per second. The volume of the flood is 373.11 mcm, which is about 7.4% relative to the annual flow rate of 153.054 mcm.

RESEARCH METHOD

In scientific research, there is usually a special way to present results, and this particular method for presenting results requires a specific path and a nearly uniform process, which in the first place is to determine the purpose of the research. After that, some initial information must be collected to achieve the goal, and finally, desirable results can be achieved by analyzing the information.According to the subject, the goals and hypotheses of the research, the method of this research is descriptive-analytical. The methods used in the various stages of the current research include the following: The first step in this research is library and theoretical studies, which include the following: collecting books, articles, pamphlets, journals and studies conducted on the studied area, the relevant departments and agencies; the preparation of meteorological data and statistics related to the meteorological and hydrometric stations in and around the area; topographic maps of 1: 50,000 and geology and soil and land use 1: 100,000 of the studied area; Providing aerial and satellite photos of the region. This is done to examine the studiedarea. The terrain of the studied area wasobserved in the study area and photographs were taken from geomorphologic forms and terrain as well as erosional landscapes.

Data classification

Data analysis
Preparingthe required maps by GIS
Preparing of tables and charts through Excel software
Arranging information and presenting it in written form, tables, graphs and images, and writing the final report of the research, integrating and concluding the above data and analyzing the information and data collected from the studied area in order to obtain the results of the research.

RESULTS

The index of vegetation and soil erosion

Normalized vegetation differences index (NDVI) was used to prepare the vegetation cover map. For this purpose, satellite images of the ETM + Landsat satellite related to the spring season, the largest floods occur this season, have been counted in the GIS software using the NDVI index according to the following equation.
(ENVI User's Guide, 1999: 582)

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Where:
NIR: Near-infrared band (Band 4 ETM + Satellite Landsat 7)
RED: Red Band (Band 3 ETM + Landsat 7 Satellite)
The values obtained from the NDVI index are between -1 and 1, and the more vegetation and livelihood in the region are, the closer the magnitude of this index is to 1.
Vegetation index values of the Navrood Basin are between 0.36 and 0.64, which are divided into five sections based on these values.

According to the data and the percentage of vegetation area, Navrood Basin is desirable in terms of vegetation, and about 69% of the basin has favorable vegetation, and only 12% of the basin is free of vegetation, which is most of the altitudes and subsoil of rivers,and the land there is so rough and the penetration there is very low. Soil with vegetation is less exposed to erosion.

Table 1. The vegetation index (NDVI) values of Navrood basin and its relationship with surface runoff and soil erosion

The type of vegetation of the area	The categories of Vegetation NDVI index	The percentage of the area of the whole basin	Surface runoff and soil erosion
Low vegetation	0.333-0	12.23	Very high
Natural pastures with moderate vegetation	0-0.102	1.57	High
Natural pastures with good vegetation	0.102-0.215	2.67	Medium
Medium forest vegetation	0.215-0.380	2.68	Low
Good forest vegetation	0.380-0.618	69.33	Very Low

Effective factors in soil erosion

In relation to soil erosion at the surface of the catchment, it is important to obtain the height of runoff due to rainfall with a specified value. In the SCS method(US Soil Conservation Agency), the runoff height for the general conditions is derived from equation (1):
(Alizadeh, 1382: 736)

$$Q_d = \frac{(P - 0.2S)^2}{(P + 0.8S)^2} \quad (1)$$

Where Qd is the runoff height on the basin; p is the amount of precipitation in cm; s is the maximum or potential for storing rain on the ground (cm), which depends on the number of the CN curve and its value in a metric system is obtained from the following relation:

$$CN = \frac{2540}{25.4 + S} \quad (2)$$

The curve number (CN) indicates how the precipitation penetrates or how to convert to surface runoff.The high curve number means more runoff and less penetration, while the lower curve number means less runoff and more penetration.

For preparation of CN layer and runoff height of different parts of the basin, two layers of information were collected from the hydrological group and land use of the area. According to these two layers of information, and to identify the soil groups and vegetation types, CN of each section has been obtained and its plot has been drawn. Finally, using the isorain map in the basin, the runoff height has been calculated in different sections, and the map of the average runoff level has been specified in the section. In this article, some examples are mentioned at important heights for erosion.

Table 2.The runoff height of different parts of the basin and its relationship with soil erosion

Curve number (CN)	89	49	39	36	25
S	3.13	26.43	39.72	45.15	76.2
Precipitation (mm)			Runoff height		
550	0.989	0.910	0.868	0.859	0.766
600	0.990	0.917	0.878	0.863	0.783
650	0.990	0.923	0.878	0.873	0.797
700	0.991	0.928	0.894	0.881	0.810
750	0.992	0.933	0.901	0.888	0.821
800	0.992	0.937	0.907	0.895	0.931
850	0.993	0.940	0.912	0.901	0.840
900	0.993	0.943	0.917	0.906	0.848
1000	0.994	0.949	0.924	0.915	0.848
1100	0.994	0.953	0.931	0.922	0.873
1150	0.995	0.953	0.931	0.922	0.873
1200	0.995	0.957	0.937	0.928	0.883
1250	0.995	0.959	0.939	0.931	0.887

According to Table 2 and according to the isorain map of Navrood and the NDVI map for vegetation, we obtained the levels of runoff height in each section, which are separated in the following tables.

Table 3- Runoff height with 550mm precipitation in Navrood basin

Curve number (CN)	89	49	39	36	25
S	3.13	26.43	39.72	45.15	76.2
Precipitation (mm)			Runoff height		
550 mm	0.989	0.910	0.878	0.862	0.766
The area of the basin with rainfall of 550 mm	46.6	17.6	19	10.7	6.2
The type of land power	Low vegetation	Natural pastures with moderate vegetation	Natural pastures with good vegetation	Medium forest vegetation	Good forest vegetation

Results from the runoff height and the risk of erosion in the Navrood basin with a precipitation of 550 mm, with regard to vegetation, 46% of the surface area of the basin in this section has a low vegetation. If vegetation is the only factor in erosion, it can be said that lack of vegetation increases the risk of erosion.According to the above table, it can be seen that with a shortage of vegetation there is an increase in runoff.The results of runoff and the risk of erosion in the Navrood basin with a rainfall of 600 mm with regard to vegetation cover 29% of the surface area of the basin in this section are associated with low coverage.The highest erosion rate here is due to the high basin height in this section. Whatever the type of forest cover is improved and of better quality, the amount of runoff is also reduced. The results of the runoff height and the risk of erosion in the Navrood Basin with a precipitation of 1000 mm with regard to vegetation 53% of the surface area of the basin in this sectionare associated with good forest vegetation. Although annual precipitation has increased, we see the lowest amount of runoff erosion.The lowest percentage of natural grasslands with an average vegetation cover of 5.7% is the second priority of erosion. Results from the runoff height and the risk of erosion in the Navrood Basin with precipitation of 1100 mm,according to vegetation 76% of the surface area of the basin in this section are associated with good forest cover, which, although annual precipitation has increased, the lowest amount of runoff erosion is observed and the lowest percentage of natural pastures with average vegetation cover 2.7% of the area is in the second priority of erosion and after a low coverage of 5.9% of the area, is the first priority of erosion.Results from the runoff height and the risk of erosion in the Navrood Basin with a rainfall of 1150 mm, with regard to vegetation 73% of the surface area of the basin in this section are associated with good forest cover.Although the annual precipitation has increased, the lowest amount of runoff erosion is observed, and the lowest percentage of vegetation cover is 1.9% with the highest degree of erosion in itself. The results of runoff height and the risk of erosion in the Navrood basin with 1200 millimeter rainfall, with regard to 88% of the surface area of the basin, are associated with good forest cover. Although the annual rainfall is increased, the lowest amount of runoff erosion is observed, and the lowest percentage of natural pastures with an average coverage of 0.6% of the area is in the second priority of erosion. The results of the runoff height and the risk of erosion in the Navrood Basin with a rainfall of 1250 mm, with regard to vegetation cover 80% of the surface area of the basin in this section, are associated with good forest cover. Although annual rainfall has increased, we see the lowest amount of runoff erosion. 19.3% of the surface area of the moderate forest cover is in this section.

CONCLUSION

The effect of soil erosion on soil fertility degradation results in deterioration of soil and soil fertility. Second Effect of erosion on groundwater depletion: Plants cause rain drops to be absorbed easily on soil when they reach the ground. The roots of the plants, by absorbing some of the water, prevent it from wasting. Then, water is refined by passing through the openings of the soil and enters underground holes and reservoirs.

The effect of erosion on filling dams, ponds, aqueducts and water channels: As soil erosion increases, soil is easily transported to lower areas. Due to the lack of suitable vegetation, the sediments that are transported will fill dams, drains and water canals. As a result, these places will require dredging. Sometimes, due to the high cost of dredging, many dams and canals are left unused.

With regard to the general results of soil erosion in the Navrood Basin, when the altitude is higher, although the precipitation is lower, but the percentage of ground area with the lower coverage is higher, and eventually more runoff and erosion are also seen, the low coverageis scattered in the whole surface of the basin. Finally, erosion occurs throughout the basin, and if we want, in the second priority of soil erosion, altitude levels can be considered as a factor in increasing runoff and erosion.According to the overall results, in the vicinity of the river, we have more vegetation cover in the heights, but at lower elevations and in the outlet of the river on the banks of the river, the erosion has increased. One of the erosion factors at low levels of Navrood basin is the conversion of forests to fields. Agricultural fields have a good penetration due to plowing in short-term rainfall.But in the long run, they are saturated with flood and water flow along with mud. Ultimately, soils will move from one region to another, and we will see different erosion. Another factor in erosion at high altitudes is the excessive slaughter of livestock in low altitude areas. The results showed that when the vegetation cover is denser, the runoff is less and there is less erosion.For example, in precipitation of 1200 mm, with regard to vegetation, 88% of the surface area of the basin in this section is accompanied by good forest cover, which, although annual rainfall has increased, the lowest amount of runoff erosion is observed.The results showed that broad-leaved forests had the most permeability and more rapid permeability. The species of beech, hornbeam, alder, oak, walnut, olive, rainbow, walnut, ironwood, ladak, planer, box, and shadbush in the basin, due to the large leaf, prevent the effect of the intensity of rainfall before reaching the ground and their roots also prevent runoff and protect the soil. In general, in moderate to massive forest covers, we see less erosion. According to the general results obtained around the river, we have more vegetation in the heights, but at lower elevations and in the outlet of the river at the edges of the river, erosion has increased and the water network at the outlet of the river also influences thedetermination of the type of vegetation and rice is more common in those areas.

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