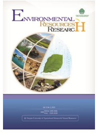

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Soil erosion and sediment mapping in Aidoghmoush watershed using MPSIAC model and GIS and RS technologies

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Abstract

Soil erosion is among the most important and worldwide environmental issues in watersheds. Sediment accumulation behind dams requires attempts to minimize their negative effects. Quantitative data is needed to recognize critical areas which require urgent measures. Since conventional procedures are time consuming and costly and usually provide point-based data, there has been a growing tendency towards applying remote sensing (RS) and geographic information system (GIS) for quantifying soil erosion at large scales. The current research was carried out in Aidoghmoush watershed to map soil erosion and sediment using MPSIAC model and RS and GIS technologies. Several information layers including geology, lithology, topography, soil, land cover and land-use maps and field data plus prior investigations and satellite imagery were applied in ArcGIS to map soil erosion in the study area. The results showed that 251 million kg soil per year is washed out form the watershed by water erosion. In other words, 475 tons of soil per square kilometer per year get eroded. The results also revealed that slope and land cover were the most important controlling factors in sedimentation. HU1 and HU4 hydrological units (sub-watersheds) showed the highest sediment per area and were thus recognized as the most critical areas of the watershed. Conversely, HU3 had the lowest sediment rate per area.

Keywords: Remote sensing, GIS, Satellite image, Soil erosion, Sediment, Aidoghmoush watershed.

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Introduction

Increasing population and food demands, agricultural expansion, land-use changes and consequent intensive utilization of the natural resources are the main reasons of the several social and environmental issues which usually are demonstrated by soil erosion (Morgan, 2009). Soil erosion is now one of the most important and worldwide environmental and economic issues which limits utilization of the natural resources such as soil and water and causes high costs and damages to structures such as dams. Soil quality loss, rural areas depletion, high rates of immigration from rural areas to big cities and consequently the higher urban and social anomalies, the high flooding risk, filling of reservoirs etc. are the most important consequences of soil erosion. Filling of reservoirs and reduction of their useful storage are very harmful and usually cannot be compensated by sediment dredging and costs a lot. Systematic and logical planning to achieve the principles of the sustainable development and overcome these problems requires investigations to recognize the critical and high risk areas and to find appropriate strategies for prioritizing soil conservation practices. Also, temporal and economic assessments of soil erosion highlights necessity of the systematic investigations of the factors affecting soil erosion.

The annual sediment yield prediction is needed to implement soil conservation programs and choose the best strategy for soil erosion prevention. Conventional evaluation and measurements of the sediment yield are costly, time consuming and have low accuracy. Therefore, in the past years, application of the GIS and RS technologies have led to faster, more comprehensive, accurate and reliable prediction of the soil erosion and sedimentation (Roslinah and Norizan, 1997; Hazarika and Honda, 2001; Tangestani, 2006; Ghaderi *et al.*, 2010; Roustaei *et al.*, 2010; Shabanlou, 2010; Ghanbarzadeh, 2012; Shirani *et al.*, 2012). Additionally, applying RS technology makes temporal prediction of the soil erosion practical due to availability of newly acquired satellite images.

Several investigations have been carried out to zone soil erosion using different models and RS and GIS technologies. For example, Hazarika (2001) investigated the soil erosion and its economic effects on crop yield in North of Thailand using RS and GIS technologies. His results showed that inappropriate agriculture, higher annual precipitation, higher surface random roughness and the type of the vegetative covers were the most effective factors on soil erosion. He also found out that cropping pattern alterations decreased soil erosion rate from 1.24 mm in 1992 to 0.91 mm in 1996. Ghanbarzadeh (2012) applied GIS to evaluate watershed soil erosion and reported that the less accuracy in structures selection and combination, biological amendments and their maintenance and conservation not only did not prevent soil erosion but also resulted in more soil deterioration. Shirani *et al.* (2012) also applied GIS technology to evaluate and classify soil erosion rate at different sub-watersheds of Maroon watershed. Their results revealed that soil erosion in Aghajari and Mishan sub-watersheds were high, in Gachsaran and Bakhtiari sub-watersheds were medium and in Asmari sub-watershed was low. Their results also showed erosion had more exposure in Gachsaran and less in Asmari. Ghaderi *et al.* (2010) applied MPSIAC model using RS and GIS technologies to evaluate and assess the soil erosion and sediment rates at Shahid Rajei watershed and reported that the watershed had low to medium soil erosion and sediment rates. They also identified that land-use factor among the nine effective factors on soil erosion in MPSIAC model had the highest effects on watershed's erosion and sediment rates. Therefore, they suggested that watershed's erosion and sedimentation can be prevented by improving land-use quality of the watershed.

Regarding the capabilities of the GIS and RS technologies beside the MPSIAC model's higher accuracy in soil erosion prediction at different watersheds (Ghaderi *et al.,* 2010; Shabanlou, 2010; Ilanloo, 2012), the current research was aimed at using RS data and GIS tools through MPSIAC model to investigate and map soil erosion and sedimentation at Aidoghmoush Watershed.

Materials and Methods

Study area

Aidoghmoush river basin is one of the sub-basins of the GhizilUzan watershed which connects to Gharangho and Shahrchai Rivers near Miyaneh city and then connects to GhizilUzan River. The Aidoghmoush River discharges a watershed with an area of more than 1625 square kilometers. The main branch of the river with the approximate length of 30 kilometers originates in mountains 2120 m high and ends to outlet with 1320 m elevation.

The study area is located between the latitudes of the 37º 20' 00" N and 37º 50' 00" N and the longitudes of the 47º 10' 00" E to 47º 37' 00" E. Figure 1 depicts the location of the Aidoghmoush watershed in East Azerbaijan Province, Iran.

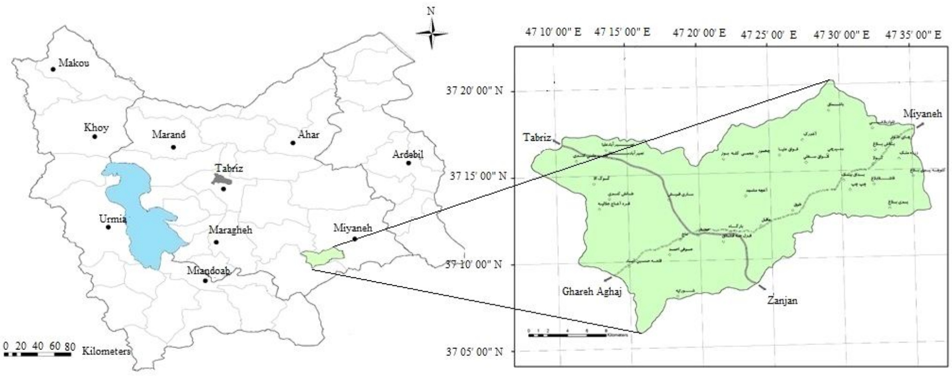

Figure 1. The location of the Aidoghmoush watershed in East Azerbaijan, Iran.

Hydrological units are the smallest area which are responsible for watershed runoff. Therefore, the study area was divided into its hydrological units in ArcGIS using DEM and hydrology maps. Figure 2 depicts DEM and hydrology maps of the study area.

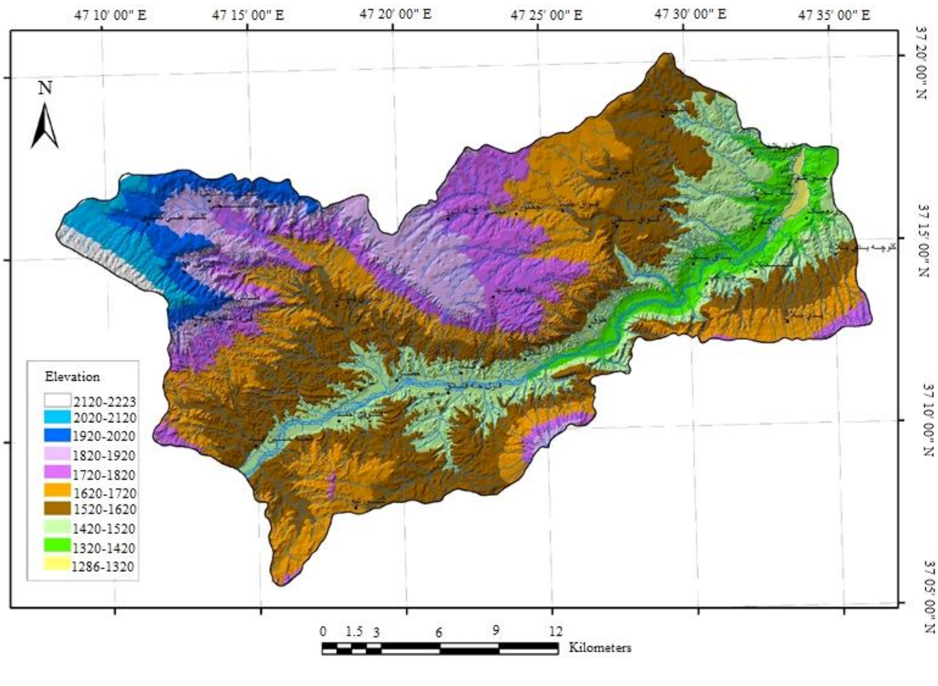

Figure 2. Digital elevation map (DEM) of the study area.

Data

Several data including DEM, topography, geology and soil maps as well as climatic, hydrologic and satellite data were required. DEM was supplied by National Mapping Agency, meteorological and hydrological data were supplied by Regional Water Authority and other required maps including geology, soil, geomorphology, land cover and etc. were drawn from prior investigations (Anonymous, 1996). In addition, several field assessments were carried out to identify natural features of the watershed, adjust the available maps in the study area, identify current soil erosion types, evaluate the status of the vegetation and to take ground control points using GPS. ETM+ data acquired from Landsat 7 was applied to create land-use and vegetation density maps. ETM+ data were downloaded from http://earthexplorer.usgs.gov/. Several software including ENVI, ArcGIS, PCI-Geomatica were applied to assess and analyze data. During preprocessing stage, all systematic and nonsystematic errors in satellite data including radiometric, geometric and atmospheric errors were corrected. Ground control data were also used for geo-referencing.

MPSIAC model

Regarding the prior investigations showing higher accuracy for MPSIAC model (Ghaderi *et al.,* 2010; Shabanlou, 2010; Ilanloo, 2012) beside its wide application for erosion assessments in the country, this model was selected for our research. Quantification of the sediment rate besides considering the highest numbers of the effective factors on soil erosion are the most important advantages of the model. In fact, the model predicts soil erosion according to nine factors including geological characteristics, soil, climate, runoff, topography, vegetation cover, land use, present soil erosion and riverbank erosion (PSIAC, 1968). MPSIAC is believed to be appropriate for environmental conditions in Iran (Bagherzadeh, 1993; Sadeghi, 1993). In order to map sediment by MPSIAC model, first, data evaluation was carried out using several software and then a layer was prepared for each effective factors in the model. All layers had 30×30 meter pixels and finally, sediment yield map of the study area was created through ArcGIS. Figure 3 illustrates the steps taken for sediment mapping in the study area.

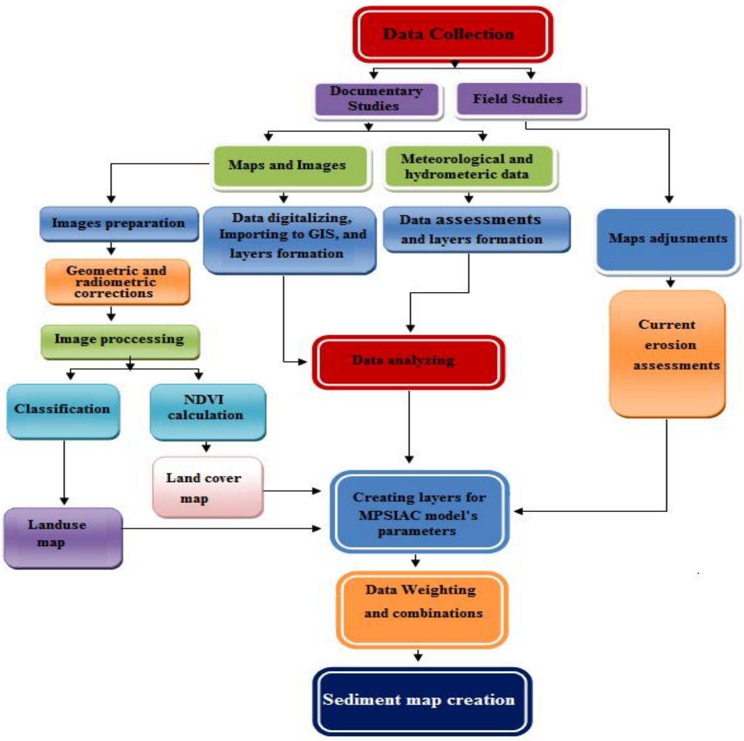

Figure 3. Flowchart of the sediment mapping through MPSIAC model.

Geological characteristics

The following equation is used to calculate the score for surface geology factor (Y_1) in MPSIAC model:

$$Y_1=X_1 \quad (1)$$

where, X_1 implies surface geological erosion index which is determined based on the lithology, hardness, fracture and weathering. Watersheds are usually divided into different classes regarding their lithological erodibility. Our study area falls into three lithological groups including partially resistant, relatively resistant and non- resistant (Anonymous, 1996). The Y_1 always lies between zero and 10 meaning that the more resistant the lithology, the less the score of Y_1 and vice versa. The Y_1 is usually determined through weighted arithmetic mean of the occupied area by each lithological classes and their scores. Figures 4 and 5, respectively, depict geological and lithological maps of the study area and Table 1 reports the characteristics of each map units.

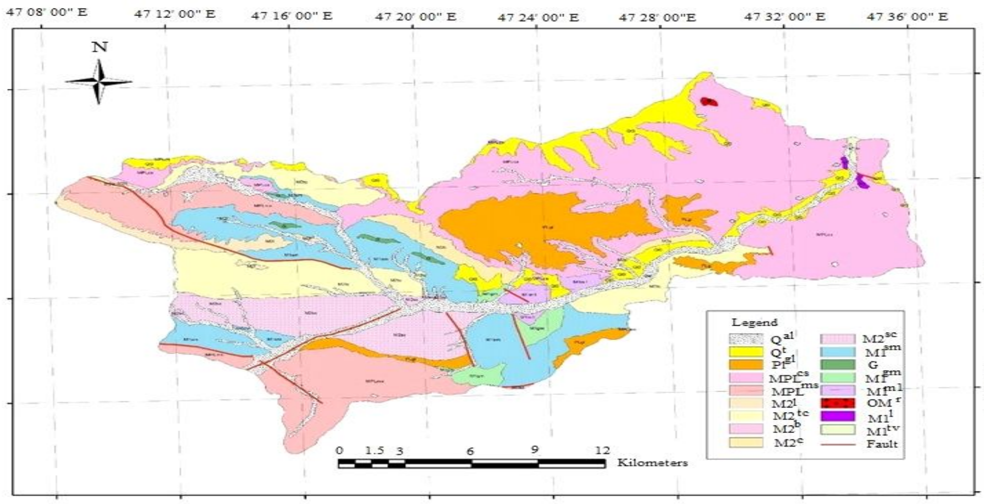

Figure 4. Surface geological map of the study area.

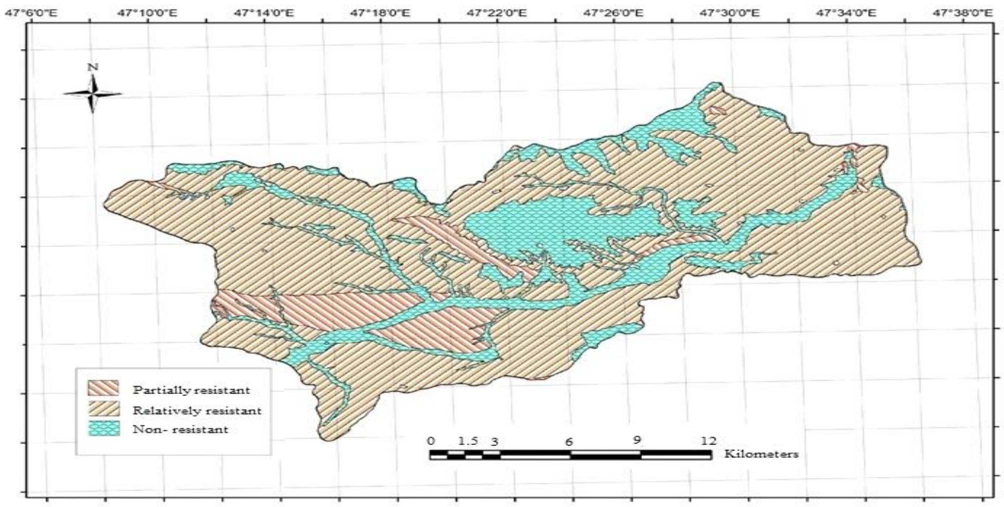

Figure 5. Lithological map of the study area.

Table 1. Charactristics of the geological units of the study area.

Erodibility rate	Unit name	Age	Description	Area	
				Km^2	%
Non-resistant	Q^{al}	Quaternary	New alluvial	41.5	7.94
	Q^{t}	Quaternary	Young alluvial plains deposits	32.92	6.30
	Pl^{gl}	Pliocene	Horizontal gravel area	45.27	8.66
	G	Oligocene- Miocene	Plaster layers and lenses	1.40	0.27
			Sum	121.09	23.17
Partially resistant	MPL^{cs}	Miocene -Pliocene	Light gray conglomerates and sandstones	160.95	30.80
	MPL^{ms}	Miocene -Pliocene	Pink Marl and silt	59.11	11.31
	$M2^{l}$	Oligocene- Miocene	Limestone	8.94	1.71
	$M2^{tc}$	Oligocene- Miocene	Light gray tuff conglomerates and sandstones	50.53	9.67
	$M1^{sm}$	Oligocene- Miocene	Light gray Marl and silt, Sandstone	61.04	11.68
	$M1^{gm}$	Oligocene- Miocene	Multiple layers of red, dark and light Marls with interlayers of plaster	7.44	1.42
	$M1^{m1}$	Oligocene- Miocene	Light gray sandstone, silt and Marl and sometimes plaster	5.40	1.03
			Sum	353.41	67.63
Relatively resistant	$M2^{b}$	Oligocene- Miocene	Lava flow of olivine basalt	0.51	0.10
	$M2^{c}$	Oligocene- Miocene	Light brown conglomerates, sandstones and silt	9.28	1.78
	$M2^{sc}$	Oligocene- Miocene	Multiple layers of red, pink and gray conglomerates and sandstones	36.84	7.05
	OM^{2}	Oligocene- Miocene	Rhyolite and rhyodacite	0.36	0.07
	$M1^{l}$	Miocene	Limestone Reef	0.56	0.11
	$M1^{tv}$	Oligocene- Miocene	Multiple layares of lava flow of andesite, basalt and volcanic	0.55	0.11
			Sum	48.10	9.20
			Overall	522.59	100

Soil

Soil effects on erosion rate is described by its resistance against detachment and transport which is called soil erodibility (K). The higher the erodibiltiy, the more sensitive to erosive agents. The score (X_2) for soil factor in MPSIAC model lies between zero and 10 which is calculated by the following equation:

$$X_2=16.67K \quad (2)$$

where, K is soil erodibility in USLE model. The K factor in our study area was calculated using Wischmeier Smith (1978) monograph regarding soil physical properties including silt + very fine sand (%), sand (%), organic matter (%), soil structure and soil infiltration rate (Anonymous, 1996). Figure 6 shows K map for different hydrological units of the Aidoghmoush watershed. For those hydrological units which have several soil units, the K factor was calculated using weighted arithmetic mean of the occupied area.

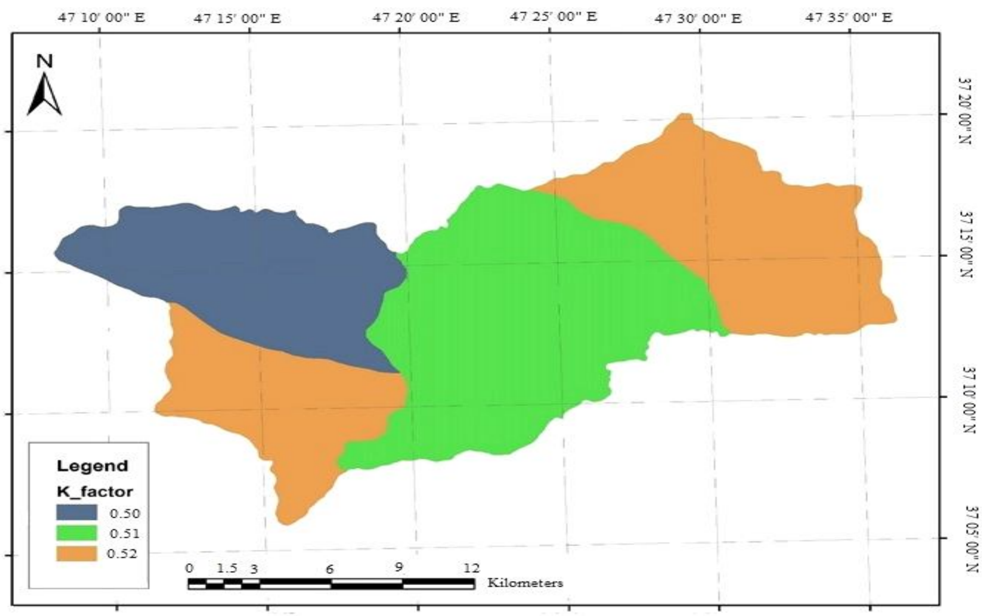

Figure 6. Soil erodibility map of the study area.

Climate

Climate is one of the important factors in soil erosion prediction. The following equation is applied to determine its score (X_3):

$$X_3=0.2P_2 \quad (3)$$

where, P_2 implies 6-hour-precipitation amount (mm) with a return period of 2 years. The following equation was used to determine 6-hour-precipitation amount (I, mm) in Aidoghmoush watershed which is suggested by analyzing time series data of the meteorological records of the watershed (Anonymous, 1996):

$$I=15.83+0.0049H \quad (4)$$

where, H is mean height of the hydrological units (m). The equation shows that the mean 6-hour-precipitation amount in the whole watershed is equal to 24.42 mm and the highest 6-hour-precipitation amount is obtained in HU4 showing I of 24.85 mm.

Runoff

The score (X_4) for the runoff factor in MPSIAC model is determined based on hydrological data and lies between 0 and 10. The zero denotes watersheds with higher infiltration rates and lower runoff and 10 shows those watersheds which turn the majority of the rainfall into runoff. The following equation is used to determine the X_4:

$$X_4=0.006R+10Q_P \quad (5)$$

where, R is the annual surface runoff height (mm) and Q_p is specific peak discharge (m^3/ s. km^2).

It is important to consider that the measured runoff height at the outlet of the watershed is not an appropriate measure for this calculation because runoff height at upstream will differ from that in the downstream. Therefore, in order to overcome this issue, first runoff coefficient (C) was calculated for all hydrological units using empirical relations and then the annual runoff height (R, mm) in each hydrological unit was determined using annual rainfall amount (P, mm) through the following equation:

$$R=CP \quad (6)$$

Specific peak discharge was also calculated by Diken method:

$$Q=C.A^{0.75} \quad (7)$$

$$Q_p=\frac{Q}{A} \quad (8)$$

where, Q is peak discharge (m^3/s), C is runoff coefficient, A is watershed area (km^2) and Q_p is specific peak discharge (m^3/s km^2). Therefore, by calculation of the Q_p and R for all hydrological units, the X_4 was calculated. Table 2 reports the calculation results for the watershed and its hydrological units.

Table 2. Hydrological charactristics of the study area and results for runoff factors' score calculation.

Hydrological units	HU1	HU2	HU3	HU4	HU5	HU6	watershed
Area (km^2)	76.08	57.50	85.16	129.55	94.94	80.74	523.97
Mean Elevation (m)	1563	1539	1640	1840	1674	1809	1754
Annual rainfall (mm)	338.71	335.74	348.26	373.06	352.48	369.22	362.40
Runoff coefficient	0.275	0.277	0.273	0.257	0.267	0.257	0.260
Annual Runoff (mm)	93	93	95	96	94	95	94
Discharge (m^3/yr)	80375	48149	98794	212892	120540	89613	2746178
Peak discharge (m^3/s)	12.93	9.78	13.63	19.43	15.19	8.88	80.34
Q_p (m^3/ s km^2)	0.17	0.17	0.16	0.15	0.16	0.11	0.15
X_4	2.26	2.26	2.17	2.08	2.16	1.67	2.10

Topography

Among the several characteristics of the topography, slope is considered for sediment prediction by MPSIAC model. Given the importance of slope, the score range of zero to 20 is taken into account for this factor with zero assigned to flat areas lower than 3% and 20 assigned to mountainous areas with steep slope (>30%). In order to calculate the score for topography factor (X_5) at Aidoghmoush watershed, first the slope map (Figure 7) of the study area was extracted in ArcGIS using DEM file. Then, the X_5 was calculated through the following equation:

$$X_5=0.33S \quad (9)$$

where, S implies mean slope (%) of the area.

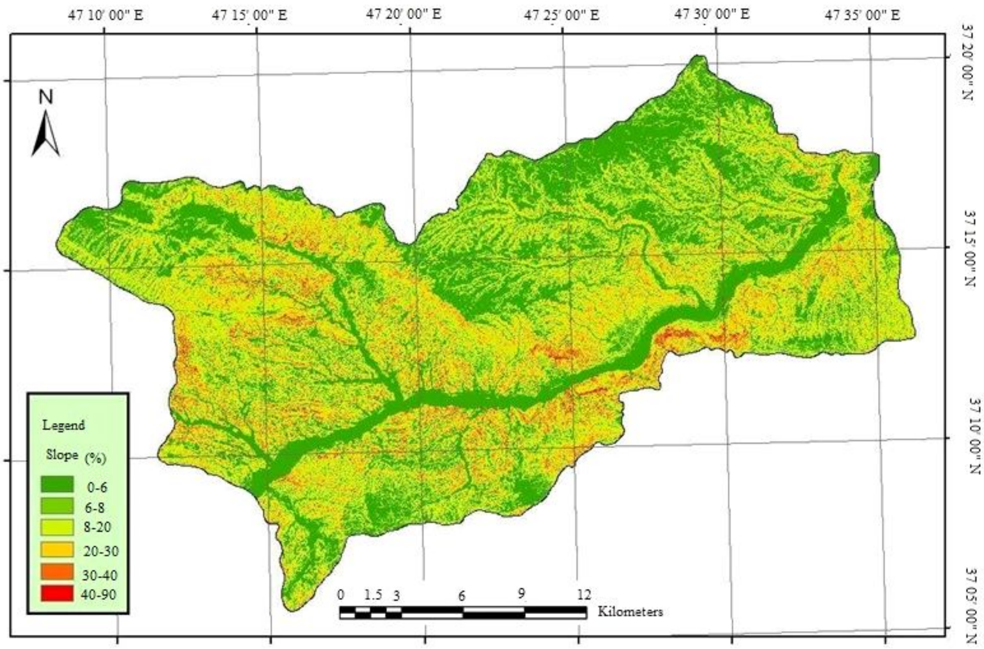

Figure 7. Slope map of the study area.

Ground cover

Ground cover in MPSIAC model refers to vegetation, stone and litter which conserve soil surface against erosive agents including raindrop impacts, wind and runoff. The score range for land cover in MPSIAC model is between -10 and +10 and -10 is assigned to areas having good vegetation, litter, or stone covers and +10 is assigned to unprotected areas. The following equation is used to determine ground cover's score (X_6):

$$X_6=0.2PB \quad (10)$$

where, PB is the percent of the bare and uncoverd soil. In this research, first, ETM+ data of landsat sensor were used to generate the vegetation density map and then, the percent of the bare and unprotected soils in each hydrological unit was calculated through overlaying vegetation density map and lithological map with hydrological units map. Finally, the score was calculated for each hydrological unit using Eq. 10. Figure 8 shows vegetation density map for the study area.

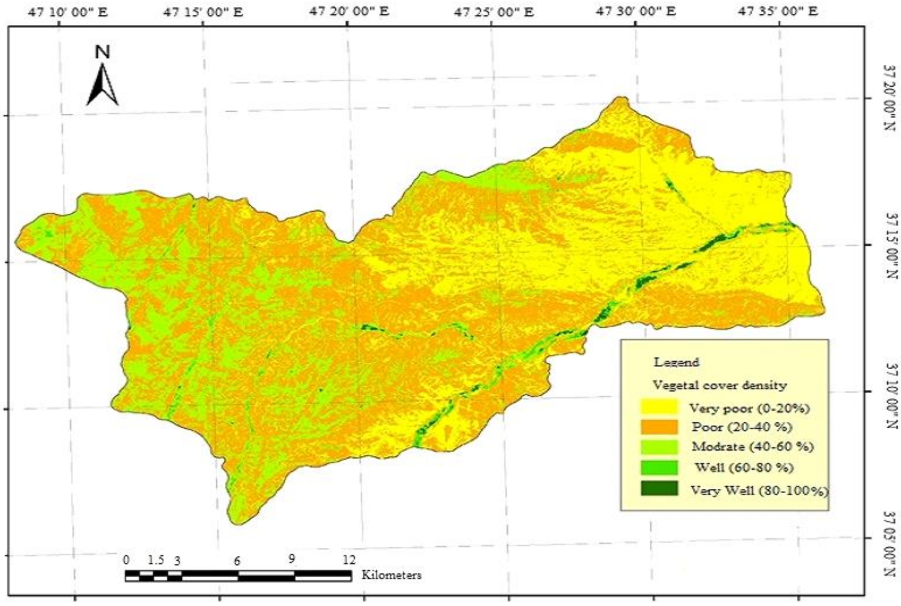

Figure 8. Vegetation density map of the study area, acquired from ETM+ data.

Land-use

The score (X_7) for this factor in MPSIAC model is set between -10 and +10 due to its increasing and decreasing effects. The X_7 is calculated by the following equation:

$$X_7=20-0.2P_c \quad (11)$$

where, Pc is the percent of the vegetation cover. First, landuse and land cover density maps of the study area were extarcted using ETM+ data and pancromatic image of the IRS. Then, vegetation cover percent for each hydrological unit was determined through overlaying of the landuse and land cover density maps with hydrological units map. Figure 9 depicts lanudse map for the study area.

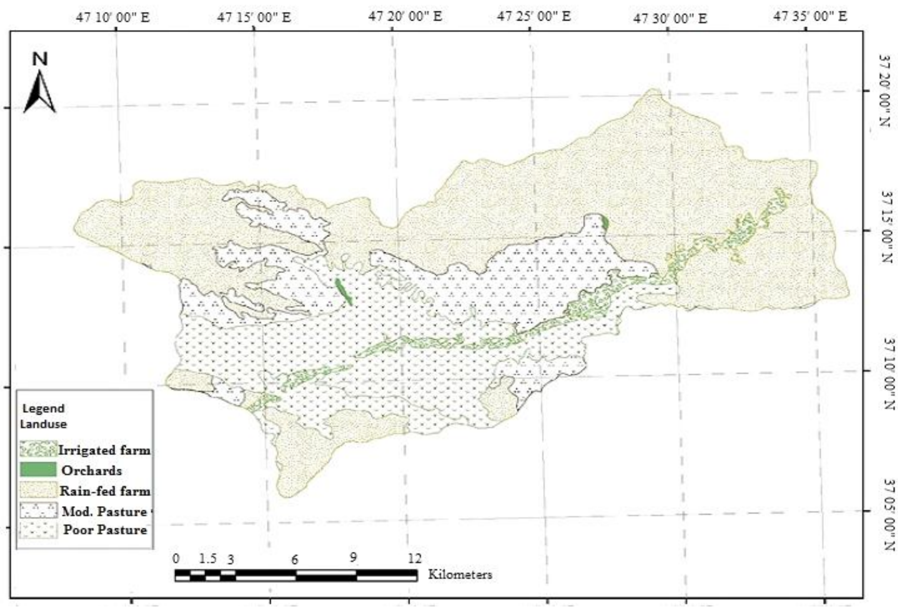

Figure 9. Landuse map of the study area, extracted from ETM+ and IRS data.

Present soil erosion

In order to assess current status of the soil erosion, surface erosions in watershed including rainsplash, sheet, rill and gully erosions were evaluated. Given its importance in sediment yield, its score (X_8) is settled between zero and 25 which is calculated by the folowing equation:

$$X_8=0.25S.S.F \quad (12)$$

where, S.S.F implies soil surface factor as defined by Bureau of land Management (BLM) model. In order to determine S.S.F factor, several parameters including soil massive erosion, litter and stone cover, pedestalling, surface rills, rill forms and gully erosion development are considerd. The parameters were detemined by field studies. Table 3 reports the results for X_8 calculations.

Table 3. Determination of the soil surface factor's and current status of erosion scores in BLM model at different hydrological units and the whole watershed.

Parameters	HU1	HU2	HU3	HU4	HU5	HU6	Watershed
massive erosion	8.5	8	9	11.3	11.5	12	10.05
Litter cover	7.5	7	8	10.6	11	12	9.35
Stone cover	8	8	7	9.3	9	9	8.38
pedestalling	9	9	7	9	8.5	10	8.75
surface rills	8	8	8	11	11	12	9.67
rills froms	7.5	7	7	10.6	10	10	7.80
gully erosion	6.5	6	6	9.3	9	10	7.80
Overall	55	53	52	71.1	70	75	62.68
X_8	13.75	13.25	13.00	17.78	17.50	18.75	15.67

Chanel erosion

Chanel erosion is one of the other effective factors in soil erosion rate and sediment yield in MPSIAC model. The score (X_9) range for this factor is settled between zero and 25 which is calcultaed by the following equation:

$$X_9=1.67SSFg \quad (13)$$

where, SSF.g is calculated with the principle of the BLM model using several parameters.

Finally, after determination of the scores for all factors, sediment yield for each hydrological unit was calculted using the following equation:

$$Q_s=38.77e^{0.0353R} \quad (14)$$

where, Q_s is sediment yield (m^3/ km^2 yr) and R is the sedimentation rate which is the summation of the scores for the 9 effective factors in sediment prediction by MPSIAC model.

Results and Discussion

The current research aimed at predicting and mapping soil erosion and sediment yield using empirical MPSIAC model applying GIS and RS technologies at hydrological units (HU) of the Aidoghmoush watershed. Therefore, in the first step, the watershed was divided into its HU's using DEM and hydrograph maps through ArcGIS tool. The study area consists of 6 different HU's which are depicted by Figure 10. Physical and hydrological properties of the HU's are also reported by Table 4.

As shown in Figure 10 and Table 4, HU4 is the largest hydrological unit in Aidoghmoush watershed consisting of around one quarter of the watershed area. The HU4 unit has the longest main stream, as well, resulting in the higher concentration time (T_c=161 min), too. Regarding Gravelius index (R_I), all hydrological units have R_I between 1.30 and 1.60 showing elongated shapes rather than round ones.

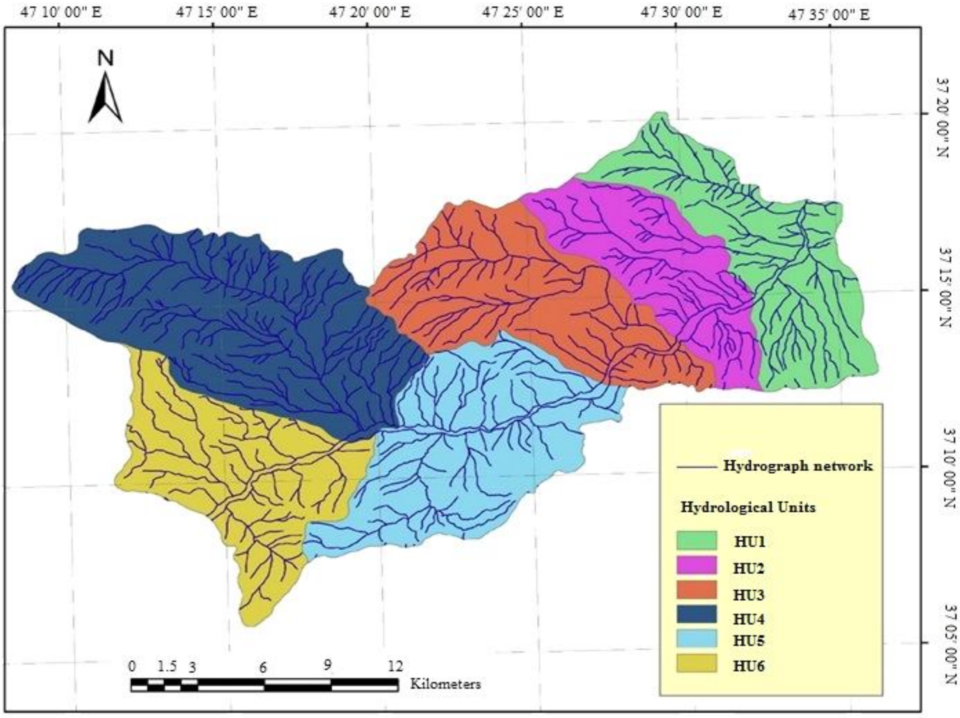

Figure 10. Hydrological units of the study area.

Table 4. Physical and hydrological properties of the Aidoghmoush watershed and its hydrological units.

HU	Area		P	Elevation (m)			L_{MS}	R_I	T_c
	Km^2	%	Km	Mean	Max	Min	Km	-	hr
HU1	76.1	14.5	49.9	1563	1841	1286	6.6	1.60	0.74
HU2	57.5	11.0	37.5	1539	1753	1326	5.2	1.38	0.62
HU3	85.2	16.3	46.0	1640	1922	1358	5.3	1.40	0.57
HU4	129.6	24.7	53.1	1840	2223	1457	20.5	1.31	2.41
HU5	94.9	18.1	47.8	1674	1961	1388	12.4	1.37	1.51
HU6	80.7	15.4	48.3	1809	2163	1456	9.7	1.51	1.05
Watershed	524	100	127.3	1754	2223	1286	33.2	1.56	3.89

P: perimeter, L_{MS}: main stream length, R_I: Gravelius index, T_c: Concentration time.

As described in the materials and methods section, the scores for all applied factors in MPSIAC model were determined. Table 5 reports the scores for the factors.

Table 5. The scores for factors in MPSIAC model in the study area and its hydrological units.

Factor	HU1	HU2	HU3	HU4	HU5	HU6	Watershed
Surface geology	1.93	1.98	1.43	2.89	2.68	4.50	2.57
Soil	8.67	8.65	8.50	8.36	8.50	8.66	8.56
Climate	4.70	4.67	4.77	4.97	4.81	4.94	4.81
Runoff	10.00	2.26	2.17	2.08	2.16	1.67	3.40
Topography	10.54	9.90	10.62	14.21	14.96	14.00	12.37
Ground cover	10.00	10.00	9.25	1.37	4.78	0.68	6.68
Lan-use	8.82	6.95	9.84	9.62	3.70	5.16	7.35
Pressent erosion	13.75	13.25	13.00	17.78	17.50	18.75	15.67
Chanel erosion	10.86	10.02	10.02	15.53	15.03	16.70	13.03
Sum (R)	79.27	67.68	69.60	76.81	74.12	75.06	74.44

Using Eq. 14 beside the reported scores by Table 5, sediment yield for the study area and its hydrological units was predicted. Finally, the predicted sediment yields was calssified into different classes using the following table. Figure 11 illustrates sediment yeild map of the study area and its hydrological units.

Table 6. Determination of the annual sediment yield and erosion classes in MPSIAC model.

Erosion class		Sediment Yield	Sedimentation Intensity
		m^3/km^2 yr	%
V	Very High	>1429	>100
IV	High	476-1429	75-100
III	Modrate	238-476	50-75
II	Low	95-238	25-50
I	Very low	<95	0-25

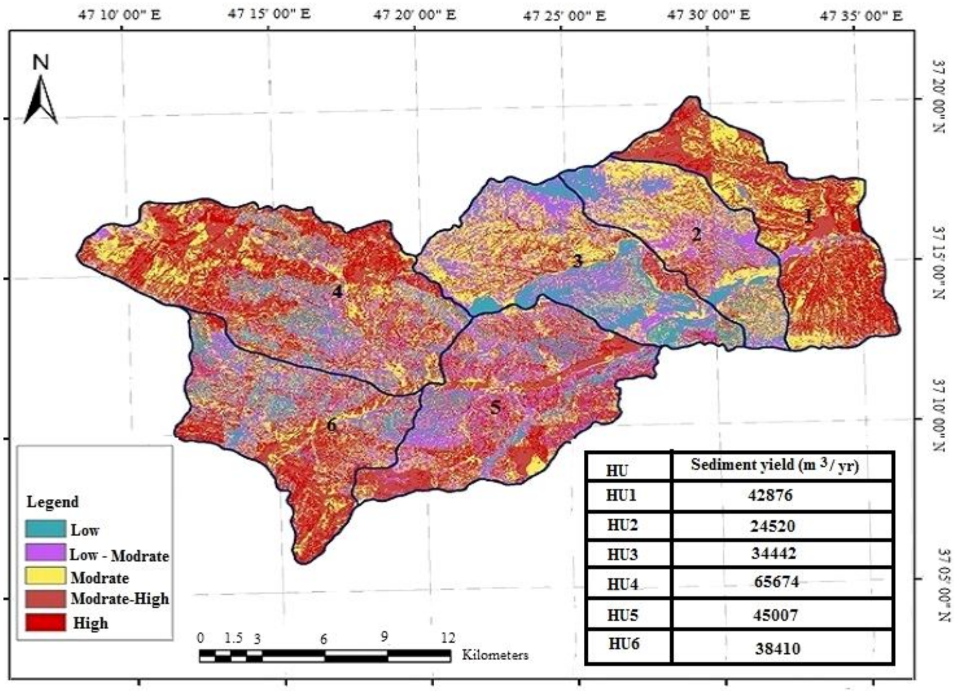

Figure 11. Sediment yield map for the study area.

For the sediment map of the study area, different hydrological units were evaluated on the base of the erosion rate.

HU1 covering 14.53% of the study area is mainly under rainfed farmland landuse. It has poor vegetation conditions where 66.04 and 27.97 percents of are covered by very poor and poor pastures, respectively. In this regard, this unit had the highest score (13.18) for the ground cover factor among the other factors. Regarding the poor vegetative cover, the unit had the highest sedimentation rate among the hydrological units where it generated around 42876 tons of sediment per year which was around 17 percent of the total sediment yield.

HU2 is the smallest hydrological unit which covers around 11% of the study area. The unit's vegetation is nearly poor where 54 percent of the unit is under poor pasture and only one percent of the unit has good vegetation. The present soil erosion had the highest score (13.25) among the applied factors in MPSIAC model. Generally, the HU2 generated around 24520 tons of sediment per year which was around 10% of the total sediment yield. Compared to other hydrological units, HU2 had the lowest amount of sediment yield.

HU3 covers 16.25% of the study area and its main landuse is rainfed agriculture. The condition for the unit's vegetation was also poor where 90 percent of the unit is covered by poor or very poor pastures. Regarding the sediment yield, around 14 percent of the total sediment yield in watershed belongs to this unit.

HU4 is the largest hydrological unit covering around 25% of the study area. Around 1 and 56 percents, respectively of the unit are under orchards and rainfed farmlands and the other parts are covered by poor or very poor pastures. Overall, around 36 and 57 percents of the unit has moderate and poor vegetation conditions, respectively. Generaly, around 65674 tons of sediment per year are generated from this unit which is around 26 percent of the predicted sediment yeild from the study area.

HU5 covers 18.12 percent of the study area and has poor vegetation condition where around 59 and 24 percents of the unit are under poor and very poor pastures, respectively. Overall, the unit generates 45007 tons of sediment per year which is around 18 percent of the total sediment yield.

HU6 covers 15.1 percent of the study area. Its vegetation condition is not good and 63 percent of the unit is under poor pasture class. The unit generates 38410 tons of sediment per year which is 15.31 percent of the total sediment from the study area. The unit stays in third rank regarding the amount of the sediment.

Regarding the sediment yields from all hydrological units, anually around 250929 tons of sediment is washed out of the waterhsed which is equal to 475.19 ton per square kilometer per year. Regarding the specific sediment yields, HU1 stays in the first rank among all the hydrological units. Conversely, comparing the total sediment yields from hydrological units shows that HU4 has the highest amount of the sediment yield.

Roslinah (1997) applied RS and GIS technologies to evaluate soil erosion in Bakun Dam Catchment Area. He evaluated catchment's soil erodibilties at different flooding situations using different image proccessing tools. Yazidhi (2003) using GIS technpology evalaued RUSLE and RMMF models in soil erosion prediction in Lom kao-phetchabun, Thiland. His results showed that there is a considerable difference between the two models. The predicted soil erosion rate was 6 ton per hectare per year for RUSLE vs. 2.1 ton per hectare per year for RMMF model. Roustaei *et al.* (2010) modeled soil eroison and sedimentation in Ghaleh Chai catchement in Ajabshir using satellite data and GIS technology. Their results revealed that RS and GIS technologies were accurate enough to predict soil eroion in the catchment. Therefore, they suggested that these technologies can be applied in other watersheds, too. Shabanlou (2010) predicted soil erosion and sediment yield of the Golestan catchment using MPSIAC model and GIS technology. Their results reavealed that MPSIAC model underestimated soil erosion rate compared to the measured soil erosion.

Conclusion

This research was carried out using raster layers with 30 × 30 meter cell size. The erosion and sediment maps of the study area were generated through overlaying different infromation layers using GIS technology. Regarding the previous investigations which have reported high accuracy for the MPSIAC model (Tangestani, 2006; Ghaderi *et al.,* 2010; Shabanlou, 2010; Ilanloo, 2012) and the facilitatory role of the RS and GIS technologies for a more accurate estimation of the model due to updated vegetation and landuse maps, these combinations were used in the crrent study. In addition, the prediction speed was high compared to the conventional procedures. Field studies also revealed that massive erosion is common in orchards or farmlands due to mismanagements. Plowing downward of the slope and intensive use of the pastures are the two other main reasons for soil detorioration in the study area. Based on the results and field studies, preventive measures should be conducted to conserve soil in Aidoghmoush watershed. Preventing massive movement of the soil, pasture improvement, building Gabion dams, banquettes and restoration of the river are the main effective strategies to prevent soil erosion in the study area.

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