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Analysis of Analytical Hierarchy Process Method to Prioritize and Determine the Most Important Factors Influencing Sediment Yield in Semi-arid Region of Iran

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ABSTRACT: In order to evaluate the Analytic Hierarchy Process (AHP) method to prioritization and determines the most important factor on sediment yield the results were compared with Linear regression analysis (LRA). For this purpose selected 18 experimental erosion plots with an area of 40 m^2 in control and sample sub-catchments of Kakhk experimental catchment located in the Gonabad region of the Khorasan Razave Province in the northeast of Iran. than was selected topographical, hydrological, soil texture, land cover and rainfall factors and determine the most important factor on sediment yield have been used of both AHP and LRA. In AHP weighting the selected factors and ranking them based on their weights. By LRA was assessed the relationship between sediment yield and each of selected factors. Then were prioritized and ranked them based on their correlation coefficient. The results showed that only both AHP and LRA reports runoff depth as the most important factor on sediment yield. But because of the non-linear relations and complex interactions between the criteria that influnce on sediment, AHP method only able to identify the most important factor and Ranking criteria based on may be different with fact on land. Therefore in sediment yield AHP method can only provide a general overview of the subject.

***Keywords*:** AHP, experimental erosion plots, Iran, Linear regression analysis, Sediment yield

INTRODUCTION

Manage sediment problems in rivers and reservoirs mainly dependent to sediment yield produced in the watershed. Understanding the effects of watershed management activities on sediment yield generated from the watershed is necessary to comprehensive watershed management.

In many developing countries, sustainable land management and water resources development are threatened by soil erosion and sediment-related problems. In response to such threats, there is an urgent need for improved catchment-based erosion control and sediment management strategies. The design and implementation of such strategies require data on erosion rates and understanding of the factors that control the delivery of sediment through the catchments system (Tamene ., 2006).

Sediment yield is defined as the total sediment outflow from a catchment, measurable at a point of reference and for a specified period of time (Vanoni, 1975). Sediment yield depends on the erosion processes at the sediment source and on the efficiency of the system that transports the sediment to the point of measurement.

Scientists have attempted to explain the global pattern of sediment yield in terms of climatic factors (Langbein and Schumm, 1958; Fournier, 1960; Douglas, 1967; Wilson, 1973; Ohmori, 1983; Walling and Webb, 1983), the role of relief and elevation of drainage basins (Ahnert, 1970; Pinet and Souriau, 1988; Milliman and Syvitski, 1992;

Summerfield and Hulton, 1994), vegetation as controlled by climate (Douglas, 1967; Jansen and Painter, 1974), and land use (e.g. Trimble, 1975; Dunne, 1979; Verstraeten and Poesen, 2001).

Plot-scale experimental studies are generally part of broader research projects aimed at improving the understanding of interrelations between processes involving hydrological, climatic and biological factors (Wainwright ., 2000). In a global environmental change and degradation context, plot-scale studies may provide information about runoff mechanisms, soil erosion and vegetation dynamics processes that result from these changes (Abrahams ., 1995; Parsons ., 1996). Plot scale studies may focus on water fluxes and sediment transport processes at controlled conditions (Wainwright ., 2000; Rickson, 2001). It is important to note that process control generally involves simplifying a complex system that is highly variable in time and space (Wainwright ., 2000; Abrahams ., 1998; Parsons ., 1998).

Plot-scale studies often include topographic survey, analysis of soil surface characteristics such as roughness, crusting, cracking, and soil as an environment of biological activity (Moreira ., 2011).

Defersha and Melesse (2012) discusses the results of laboratory analysis to evaluate the effect of rainfall intensity, slope steepness, soil types and antecedent moisture content on sediment concentration, runoff coefficients, and sediment enrichment ratios. They indicated that the actual effect of slope as well as rainfall intensity on sediment concentration and sediment yield vary with soil types and moisture contents.

Zabaleta . (2007) studied the factors controlling suspended sediment yield during runoff events in small headwater catchments of the Basque county and reported that Linear and curvilinear relationships are exist to estimate the sediment yield.

Restrepo . (2006) in analysis of sediment load and morphmetric, hydrologic and climatic variables from 32 tributary catchments in the Megdalena River indicates that the main physical control explaining most of the variation in observed sediment yield is mean annual runoff.

Dedkov & Mozzherin (1996) reports a global scale analysis of erosion processes, based on data on suspended sediment loads from 3763 stations and bed load data from 295 stations. Within plain regions a distinct maximum of erosion and sediment yield occurs in the tropical and subtropical zones. Statistical analysis indicates that the principal factors controlling the zonal distribution of erosion are runoff amount and land cultivation.

From studies conducted in Iran Ouri and Ghorbani (2011) various catchments properties were analyzed in order to recognize the effective factors controlling suspended sediment yield. Selected effective factors were mapped and classified in geographic information system (GIS). Relationships among different geo-environmental and climatic factors and suspended sediment yields using multiple regressions were derived the most effective controlling factors. they showed that the main factors controlling suspended sediment yield in central Ardabil included: catchment area, mean annual discharge, peak discharge, geological resistance of formation to erosion, mean slope of catchment, mean slope of main channel and mean annual temperature.

The Analytic Hierarchy Process (AHP) is a technique that combines data with expert judgment and applies this information to large data sets consistently, allowing decision makers to evaluate alternatives based on multiple criteria. AHP was developed by Saaty and is used in fields such as business and operations research (Coulter, 2005). AHP has used in varous studies in Iran. Eshghizadeh and Noura (2013) AHP and Expert Judgment to determine and prioritize the most appropriate site to underground dam construction on qanat. The results of this study showed that the AHP is capable to determine suitable sites with the use of quantitative and qualitative criteria for construction of underground dams on the qanats.

Therefor AHP has been applied to natural resource decision making and this is a traditional use of AHP where a small number of distinct alternatives are compared in order to determine the preferred alternative (Coulter, 2005). Expert judgment is necessary in cases where science has not determined quantifiable relationships between cause and effect. While these informal approaches are able to capture expert judgment, there is no way of ensuring this judgment is applied consistently.

The purposes of this research have been compare result of AHP method with actual data and determine the efficiency and accuracy of it in natural resources. In order to evaluate the results of AHP method by linear regression analysis, prioritized and determined the most important factor on sediment yield in semi-arid region of Iran. For this purpose selected slope and hill-slope aspect of topographic factors, runoff depth and infiltration of hydrologic factors, sand, silt and clay content of soil texture factors, canopy, bare soil and litter of land cover factors and depth, mean intensity, max intensity and duration of rainfall factors. This paper was based on both fieldwork data and conceptual data. That provided both by continuous record of rainfall-runoff-sediment production field monitoring data at plot scale and administrative and academic experts.

MATERIALS AND METHODS

Study area

The study area is located within the experimental watershed of Kakhk in the Gonabad County of the Khorasan Razave Province in the northeast of Iran. Experimental plots were established in Kakhk paired catchment (Coordinates 34°4'34",N; 58°35'37",E). This catchment includes control and sample sub-catchments. These sub-catchments are similar almost in all aspect and differ only based on watershed management operations. Measurements of runoff and erosion under diverse conditions of management of the erosion plots in 2 sub-catchments have been carried out since 1998. The sample sub-catchment area is 106.5 hectares that different types of watershed operations (mechanical, biomechanical, biological, and management) have been implemented. The control sub-catchment area is 110.6 hectares that no types of watershed operations have been taken in it. Location of study area is shown in Fig. 1. Table 1 showed the physical characteristics of control and sample sub-catchments (Eshghizadeh, 2012).

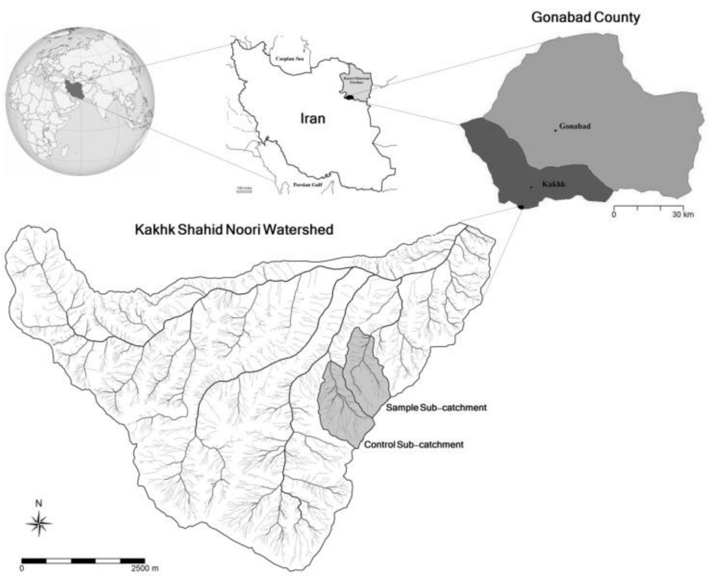

Figure 1 Location of the study area

Table 1. Physical characteristic of control and sample sub-catchments

Characteristic	sub-catchments	
	Sample	Control
Area (km^2)	1.065	1.106
Perimeter (km)	4.6	4.8
Maximum altitude (m) above sea level	2521	2623
Minimum altitude (m) above sea level	1997	2048
Mean altitude (m)	2171	2325
Weighted mean slope (%)	52.9	55.4
Main channel length (km)	1.8	1.8
Mean annual precipitation (mm)	243	
Distribution of rainfall	October, November, December, January, February, March, April, May, June	
Mean annual temperature (ºc)	14.2	
Dominant geological formations	Shemshak Js, Js vb	
Annual evaporation (mm)	1645	
Climate	Semi-arid	
Soil Texture	loamy sand, loamy	
Dominant vegetation	Lactoca orientalis, Poa bulbosa, Seratulla orientalis, Ferula ovina- Gundelia tourneforti, Artemesia sp, Astragalus sp	

Method to prioritization and determines the most important factor on sediment yield

In order to evaluate the Analytic Hierarchy Process (AHP) method to prioritization and determines the most important factor on sediment yield the results were compared with Linear regression analysis (LRA). In AHP weighting the selected factors and ranking them based on their weights. While in the Linear regression analysis was assessed the relationship between sediment yield and each of selected factors. Figure 2 shows the methodology for this purpose.

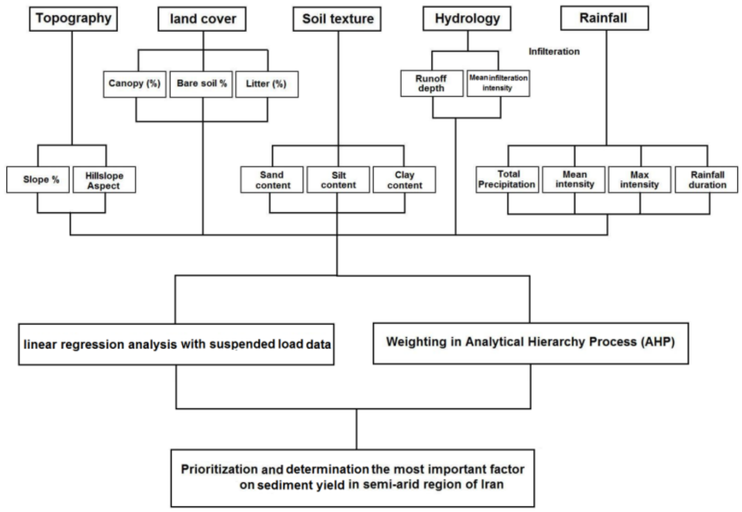

Figure 2. prioritization and determination the most important factor on sediment yield

1-Prioritization and determination the most important factor on sediment yield by AHP

The following steps were performed to prioritization and determination the most important factor on sediment yield by using Analytical Hierarchy Process.

Step 1: Build a hierarchical

After identifying the factors and criteria affecting on sediment yield that mentioned on top. Hierarchical structure was created as Figure 3.

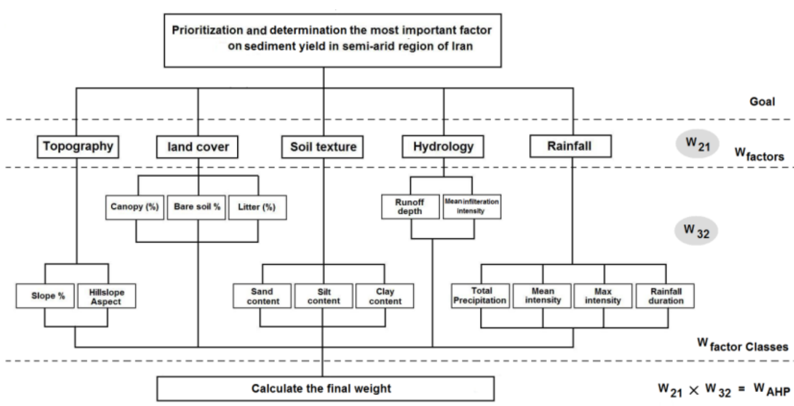

Figure 3. prioritization and determination the most important factor on sediment yield by using Analytical Hierarchy Process

Step 2: Making pairwise comparison matrixes and determine importance factors

At first in AHP, the elements were compared two by two and were formed pairwise comparison matrix. In the comparative judgment phase, elements of one level of a hierarchy are compared pairwise as to the strength of their influences on an element of the next higher level. To make such comparison, Thomas Saaty developed the scale shown in Table 2, which allows measuring the strength of the judgments (Saaty, 1980). Based on the ratings obtained through the questionnaire, matrixes are formed and the priorities are synthesized using the methodology of AHP.

Table 2. Saaty's fundamental scale (Saaty, 1980)

Intensity of importance	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values

Then by use of these matrixes were calculated the relative weights of the elements. Figure 4 shows the relationship between criteria and their classes on sediment yield by using Analytical Hierarchy Process. The primary unweighted matrix according to Figure 4 was presented in Table 3.

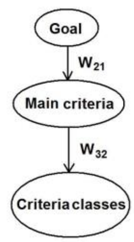

Figure 4. the relationship between criteria and their classes on sediment yield

Table 3. Structure of the primary unweighted matrix in hierarchical model on suspended load

	Goal	Main criteria	Criteria classes
Goal	0	0	0
Main criteria	W_{21}	0	0
Criteria classes	0	W_{32}	0

In this method for pairwise comparisons were used of comparative judgments by administrative and academic experts. For this purpose each of the administrative and academic experts expressed his personal opinions about relative importance criteria and as well as for their classes by pairwise comparisons on sediment yield according to Table 2. Then were entered these matrixes numbers into the Expert choice (EC) software. So after entering each pairwise comparison matrix, the software presents a graph of the weights and rates showed inconsistency.

In general, if the inconsistency rate less than 0.1, the inconsistency is acceptable and if more than this amount, must review the judgments (Saaty, 1980). So were calculated the relative importance of the main criteria ($W_{factors}$) and criteria classes ($W_{factors\ Classes}$) by determine the W_{21} and W_{32} importance vectors. Finally, to calculate the final weight of criteria (W_{AHP}) were multiplied relative weight of the main criteria ($W_{factors}$) and criteria classes ($W_{factors\ Classes}$) together.

2-prioritization and determination the most important factor on sediment yield by Linear regression analysis (LRA)

Field installation

The field studies were carried out at plot scales with an area of 40 m^2 in control and sample sub-catchments of Kakhk experimental catchment. In each sub-catchment were established nine experimental erosion plots on three sites. The plots were studied under natural rainfall events. The plots have 22.1 m length and 1.83 m width. They were established by a 0.2 m high surrounding cement and metal wall. The runoff and the eroded sediments were directed into a 1 m^3 capacity tank. The erosion plots is shown in Fig. 5. In all 18 erosion plots were installed and equipped for the determination of the total runoff and total sediment yield for each of the recorded precipitation events. Table 4 provides the characteristics of the erosion plots in both sub-catchments.

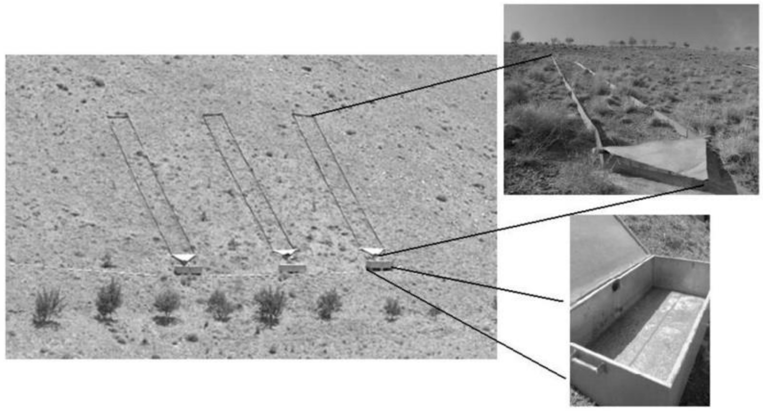

Figure 5. rosion plots were established Kakhk paired catchment

Table 4. Physical characteristics of installed erosion plots

Sub-catchment	Site	Plot No.	Altitude above (m) sea level	Slope Aspect	Slope (%)	Mean infiltration intensity (mm/hr)	Surface cover			Soil Texture		
							Vegetation canopy (%)	Bare soil %	Litter (%)	Sand %	Silt %	Clay %
Sample	A	1	2065	W	37	3.3	27	48	5	71.3	18	10.7
		2	2065	W	37	3.3	20	50	6	71.3	18	10.7
		3	2065	W	37	3.3	25	55	4	71.3	18	10.7
	B	4	2112	N	45	3.1	35	56	6	50	36	14
		5	2112	N	45	3.1	40	48	10	50	36	14
		6	2112	N	45	3.1	38	50	7	50	36	14
	C	7	2115	E	60	3	40	33	7	62	24.5	13.5
		8	2115	E	60	3	35	40	5	62	24.5	13.5
		9	2115	E	60	3	30	51	5	62	24.5	13.5
Control	D	10	2160	W	54	3.2	20	50	4	62	25.8	12.2
		11	2160	W	54	3.2	23	49	5	62	25.8	12.2
		12	2160	W	54	3.2	25	45	3	62	25.8	12.2
	E	13	2105	N	37	2.3	14	60	2	59	23.8	17.2
		14	2105	N	37	2.3	17	57	3	59	23.8	17.2
		15	2105	N	37	2.3	20	55	2	59	23.8	17.2
	F	16	2085	E	45	2.8	12	70	2	73.3	16	10.7
		17	2085	E	45	2.8	20	60	3	73.3	16	10.7
		18	2085	E	45	2.8	17	65	4	73.3	16	10.7

Collection of data

The study was carried out for four rainfall events occurred in 2011 and 2012 years. Table 5 shows characteristics of these rainfall events. The main interest was the volume of the total runoff and the total weight of the sediments carried off from the surface plots and collected at tank for each of this rainfall events. For sediment content analysis produced at each plot after the event, sampling one litre the sediment-water mixture and dried in oven at 60ºC until all water had evaporated. Samples were then reweighed and the sediment concentration for each sample was determined. Also the depth of water level at tanks after the each rainfall events was measured. Table 6 shows data obtained from four rainfall events in 2011-2012.

Table 5. Characteristics of rainfall event occurred in 2011-2012

Date event	Rainfall duration (hr)	Characteristics of rainfall event		
		Mean intensity (mm/hr)	Max intensity (mm/hr)	Total Precipitation (mm)
2 May 2011	4	3.67	38.4	14.7
2 February 2012	16	4.03	31.4	80.7
26 February 2012	18	3.34	33.3	60.1
17 April 2012	5	2.86	30	14.3

Table 6. Data obtained from four rainfall events occurred in 2011-2012

Sub-catchment	Site	Plot No.	2 May 2011		2 February 2012		26 February 2012		17 April 2012	
			Sediment yield (gr/m^2)	Runoff depth (mm)	Sediment yield (gr/m^2)	Runoff depth (mm)	Sediment yield (gr/m^2)	Runoff depth (mm)	Sediment yield (gr/m^2)	Runoff depth (mm)
Sample	A	1	2.775	4.16	3.141	4.71	1.049	1.57	3.663	2.2
		2	2.737	6.21	3.397	10.19	1.134	3.40	0.735	0.91
		3	1.102	3.3	2.179	6.34	0.728	2.12	1.338	1.33
	B	4	2.855	4.28	29.351	14.68	9.804	4.90	3.315	1.03
		5	1.68	5.04	17.412	14.51	5.816	4.85	1.977	1.23
		6	2.569	2.57	9.551	14.33	3.191	4.78	0.686	1.03
	C	7	2.119	6.35	4.361	6.38	1.457	2.18	1.177	0.88
		8	4.525	10.8	3.024	1.91	1.013	1.10	0.534	0.2
		9	2.687	8.05	4.734	7.10	1.581	2.37	1.848	1.84
	D	10	3.35	4.466	7.646	11.47	2.553	3.83	1.756	1.31
		11	3.82	2.551	19.9	15.50	9.72	6.2	0.632	0.94
		12	7.55	7.555	16.845	13.07	5.625	5.62	2.95	1.89
Control	E	13	8.122	6.09	131.272	15.75	43.836	5.26	17.57	16.1
		14	6.195	6.19	508.587	15.89	169.834	5.31	18.0	14.1
		15	15.924	7.96	149.290	15.67	49.853	4.99	13.026	11.1
	F	16	17.26	13.04	8.87	10.85	1.207	3.62	2.39	1.3
		17	6.195	6.19	10.880	16.32	3.633	5.45	2.271	2.27
		18	15.924	9.06	14.079	8.45	4.701	6.82	1.373	2.06

Data analysis

Normality test was performed on data by Kolmogorov-Smirnov test. The normality test showed that data were not normal. At first based on field surveys was determined an over estimate on sediment in 2 and 26 February 2012 plot No, 13, 14 and 15 because of snow accumulated on plot area and destruction of the upper wall of plot, so these data were excluded from statistical analyzes. Later data were normalized with taking log of them. Then to prioritization and determination the most important factor on sediment yield a Linear regression analysis was used to assess the relationship between sediment yield and each of slope, hill-slope aspect, runoff depth, infiltration, sand, silt and clay content, canopy, bare soil, litter, rainfall depth, mean rainfall intensity, max rainfall intensity and rainfall duration factors. Then were prioritized and ranked them based on their correlation coefficient

RESULTS AND DISCUSSION

Results

AHP

The relative importance of main criteria (W_{factor}) and relative importance of main criteria classes ($W_{factor\ Class}$) calculated in the Expert choice (EC) software and then were calculated final weights (W_{AHP}) and prioritization factors on sediment yield based on them. The results showed that the hydrology factor has the highest relative importance with value of 0.464 among the other main criteria and the runoff depth with final weight 0.371 is the most important factor on sediment yield. Table 7 shows the results.

Table 7. prioritization and determines the most important factor on sediment yield by AHP

Main criteria	Relative importance of main criteria (W_{factor})	Criteria classes	Relative importance of main criteria classes ($W_{factor\ Class}$)	Final weight (W_{AHP})	Rank
Topography	0.037	Slope	0.8	0.030	7
		Hill-slope aspect	0.2	0.007	13
Land cover	0.159	Conopy cover	0.081	0.013	11
		Bare soil	0.784	0.125	3
		Litter	0.135	0.021	9
Soil texture	0.091	Sand content	0.06	0.005	14
		Silt content	0.231	0.021	10
		Clay content	0.709	0.065	6
hydrology	0.464	Runoff depth	0.8	0.371	1
		Mean infiltration	0.2	0.093	4
Rainfall	0.249	Rainfall depth	0.094	0.023	8
		Mean intensity	0.307	0.076	5
		Max intensity	0.562	0.140	2
		Rainfall duration	0.037	0.009	12

Linear regression analysis:

The results of linear regression analysis were used to prioritization and determination the most important factor on sediment yield the following is expressed.

Topographic factors:

Nonparametric correlations between hill-slope aspect and sediment yield was observed that correlation was significant at 5 percent level (sig=0.023) and a negative correlation with Spearman correlation coefficient R=0.28. fig 6 was shown mean of sediment yield on North, East and West of hill-slope aspect.

Result showed that correlation between slope and sediment yield is not significant (sig=0.497). Table 8 shows the correlation sediment yield and topographic factors.

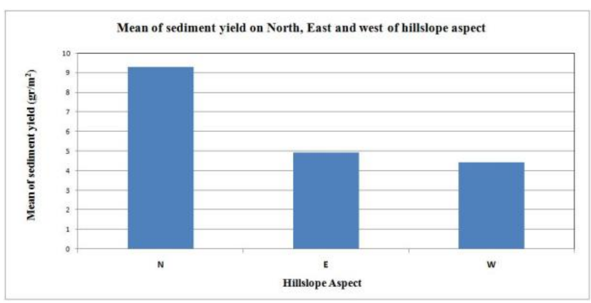

Figure 6. mean of sediment yield on North, East and west of hill-slope aspect

Table 8. correlation sediment yield and topographic factors

		Log sediment yield
Log. Hill-slope aspect	Spearman Correlation	- 0.28*
	Sig.	0.023
	N	66
Log. Slope	Pearson Correlation	- 0.085
	Sig.	0.497
	N	66

**. Correlation is significant at the 0.05 level

Hydrologic factors:

Correlation was strongly significant at 1 percent level (sig=$5*10^{-18}$) between runoff depth and sediment yield so the Pearson correlation coefficient was 0.832 and a positive correlation. Result shows that correlation between mean infiltration intensity and sediment yield is significant at 1 percent level (sig=0.0003). Pearson correlation coefficient was 0.431 with a negative correlation (Table 9).

Table 9. correlation sediment yield and hydrologic factors

		Log sediment yield
	Pearson Correlation	0.832**
Log. runoff depth	Sig.	0.000
	N	66
	Pearson Correlation	- 0.431**
Log. mean infiltration intensity	Sig.	0.000
	N	66

**. Correlation is significant at the 0.01 level

Soil texture factors:

Result showed that correlation between sand content and sediment yield is not significant (sig=0.188). Also correlation between silt content and sediment yield is not significant (sig=0.411). Only correlation between clay content and sediment yield is significant at 5 percent level (sig=0.022). Pearson correlation coefficient between clay content and sediment yield is 0.281 and a positive correlation (Table 10).

Table 10. correlation sediment yield and soil texture factors

		Log sediment yield
	Pearson Correlation	- 0.164
Log. sand content	Sig.	0.188
	N	66
	Pearson Correlation	0.103
Log. silt content	Sig.	0.411
	N	66
	Pearson Correlation	0.281*
Log. clay content	Sig.	0.022
	N	66

*. Correlation is significant at the 0.05 level

land cover factors:

In this study a negative correlation was observed between canopy cover and sediment yield with Pearson correlation coefficient 0.527, and the correlation is significant at 1 percent level (sig=0.001).

But correlation between bare soil and sediment yield was significant at 1 percent level (sig=0.01), and a positive correlation with Pearson correlation coefficient 0.425.

Result showed that correlation between litter and sediment yield was strongly significant at 1 percent level (sig=0.00002), with a negative correlation and Pearson correlation coefficient 0.642 (Table 11).

Table 11. correlation sediment yield and land cover factors

		Log sediment yield
	Pearson Correlation	- 0.527**
Log. canopy cover	Sig.	0.001
	N	66
	Pearson Correlation	0.425**
Log. bare soil	Sig.	0.010
	N	66
	Pearson Correlation	- 0.642**
Log. litter	Sig.	0.000
	N	66

**. Correlation is significant at the 0.01 level

Rainfall factors:

Result showed that correlation between Rainfall factors and sediment yield was significant only between mean rainfall intensity and sediment yield at 1 percent level (sig=0.000) with a positive Pearson correlation coefficient 0.455.

Correlation is not significant between rainfall depth and sediment yield (sig=0.069), between max rainfall intensity and sediment yield (sig=0.362) and between rainfall duration and sediment yield (sig=0.336). Table 12 shows the results obtained from correlation between Rainfall factors and sediment yield.

Table 12. correlation sediment yield and land cover factors

		Log sediment yield
	Pearson Correlation	0.226
Log. rainfall depth	Sig.	0.069
	N	66
	Pearson Correlation	0.455**
Log. mean rainfall intensity	Sig.	0.000
	N	66
	Pearson Correlation	0.114
Log. max rainfall intensity	Sig.	0.362
	N	66
	Pearson Correlation	0.120
Log. rainfall duration	Sig.	0.336
	N	66

**. Correlation is significant at the 0.01 level

Then based on the correlation coefficient of selected factors with suspended load, were prioritized and ranked them. The results have shown on Table 13.

Table 13. prioritization and determines the most important factor on sediment yield by Linear regression analysis

Factor	Correlation coefficient	Rank
Runoff depth	0.832	1
Litter	0.642	2
Canopy cover	0.527	3
Mean rainfall intensity	0.455	4
Mean infiltration intensity	0.431	5
Bare soil	0.425	6
Clay content	0.281	7
Hill-slope aspect	0.28	8
Rainfall depth	0.226*	9
Sand content	0.164*	10
Rainfall duration	0.120*	11
Max rainfall intensity	0.114*	12
Silt content	0.103*	13
Slope	0.085*	14

*correlation between this factor and sediment yield is not significant at 5 percent level

Discussion

The prediction of sediment yield is complicated by the interaction of controlling variables, human impact on the hydrological system, and by scale effects associated with different basin sizes (Walling and Webb, 1983). This complexity makes that the intensity and effects of factors on sediment yield change in time and place scales.

The results showed that both AHP and Linear regression methods reports runoff depth as the most important factor on sediment yield.

Restrepo . (2006) in examined sediment yield and its response to control variables in the Magdalena drainage basin were shown mean annual runoff is the dominant control and explains 51% of the observed variance in sediment yield. Many studies examining global sediment yields have explored this relationship. Also Summerfield and Hulton (1994) showed that for hydrological and climatic variables, only mean annual runoff, and to a lesser extent mean annual precipitation, were strongly associated with denudation rates. Also Dedkov & Mozzherin (1996) by statistical analysis indicates that the principal factors controlling the zonal distribution of erosion are runoff amount and land cultivation.

Generally the results of linear regression method in this study were confirmed an inverse relationship between infiltration and sediment yield so that by increasing the infiltration reduced the sediment yield. Soil infiltration capacity as a factor of crucial importance on runoff and soil erosion mechanisms (Moreira , 2008).

Also in this study correlation test confirmed an inverse relationship between canopy and litter with sediment yield was shown. While the there are a direct relationship between bare soil and sediment yield. Increased bare soil was strongly correlated with increased runoff, which is in agreement with comparable studies reported in the literature (Branson and Owen 1970; Reid . 1999).

Field observations pointed that the increasing canopy of plants increased infiltration and reduced both runoff and sediment yield (Moreira , 2008; Ludwig ., 2005).

The results showed that although both of these methods were able to prioritization and determines the most important factor on sediment yield, but determine the rank of importance factors on sediment yield even at the plot scale is not same. Table 14 shows the ranks of factors on sediment yield by AHP and Linear regression analysis. Only in determine the first rank results of two methods are same. But because of the non-linear relations and complex interactions between the criteria that influnce on sediment, AHP method only able to identify the most important factor and Ranking criteria based on may be different with fact on land. Therefore in sediment yield AHP method can only provide a general overview of the subject.

Table 14. prioritization and determines the most important factors on sediment yield by AHP and LRA

Rank	Prioritize factors	
	AHP	Linear regression analysis
1	Runoff depth	Runoff depth
2	Max rainfall intensity	Litter
3	Bare soil	Canopy cover
4	Mean infiltration intensity	Mean rainfall intensity
5	Mean rainfall intensity	Mean infiltration intensity
6	Clay content	Bare soil
7	Slope	Clay content
8	Rainfall depth	Hill-slope aspect
9	Litter	Rainfall depth
10	Silt content	Sand content
11	Canopy cover	Rainfall duration
12	Rainfall duration	Max rainfall intensity
13	Hill-slope aspect	Silt content
14	Sand content	Slope

Attempts have been made to compare the results from AHP with actual preferences. Cheung . (2001) used a line of questioning that provided additional information about the criteria decision makers were using to make their decisions. This information could then be used to refine the analysis. In many cases the professional judgment required to structure the problem as a hierarchy and inform the model of preferences is the same professional judgment that determines if AHP is producing adequate results.

Conclusion

This study aimed to analyze prioritization and determination the most important factor on sediment yield by AHP and camper result with Linear regression analysis on data obtained during the 2011-2012 years in an hill-slope disturbed and natural plots established in Iranian semi-arid region.

The degree of protection offered by the various factors on sediment yield is not well known in semi-arid region of Iran. Field monitoring using an experimental plot allows to analysis of the mechanisms in sediment yield.

Runoff depth is the major role on sediment yield and negative correlation between litter and sediment yield can be justified by correlation between runoff and sediment yield. Litters have an important effect on infiltration and interception and enhance both soil infiltration and soil water storage capacity that reduces runoff depth on hill-slope. Also negative correlation between vegetation and sediment yield can be justified in the same way. So obtained results highlight the role of land cover in a positive feedback with soil properties in Iranian semiarid region. So the large protective influence of the vegetation against surface erosion is note worthy and decrees it may eventually lead to a total loss of surface soil.

it highlights the role of vegetative cover as a controlling factor on erosion and sediment protection management that is necessary the identification importance factors that influence on sediment yield.

AHP allows large complex problems to be refined into successively smaller problems using hierarchical decomposition. Once the hierarchy is structured, pairwise comparisons are performed between small clusters of attributes within each branch and level of the hierarchy with reference to the element above it. This allows the decision maker to focus on one small portion of the problem at a time. It should be noted that the structure of the hierarchy has an influence over analysis results. This provides a large amount of flexibility to ensure the results of an analysis match scientific findings and professional judgment. But the decision maker or analyst needs to understand these consequences when the hierarchy is structured.

Camper result of ranking factors by AHP and Linear regression analysis shows difference between them. Because of inconsistency in the pairwise comparisons of the objectives, ranks shifts occurred. Inconsistency should not be completely avoided but should be kept to a reasonable level. The reasons for this inconsistency and difference between result of AHP in this research and the actual values can be lack of information.

The most limiting factor in applying the AHP to a problem such as the prioritization of the most important factor is a lack of specific scientific data to inform pairwise comparisons. This means that these comparisons often must be made on the basis of professional judgment. but In the real world relationships between factors as a network and have not a linear structures. While in AHP the relationships is linear and one-way. So it seems that the Analytic Network Process (ANP) able to provide more acceptable results in natural resources.

Validation of the resulting weighting of alternatives in AHP is not possible or practical with traditional means, because AHP is based on the preferences of the decision maker and this one of the main deficiency of AHP for application it to determine and prioritize important factors in erosion and sediment studies.

The comparison of results from an application of AHP with historic results is not appropriate because it is assumed that past results are not based on consistently applied expert judgment, otherwise there would be no reason to implement AHP and this can be a another defect of using AHP in erosion and sediment studies. However, AHP is by nature designed to be used in situations where science has not yet been able to define quantifiable relationships and decisions rely, in large part, on professional judgment.

The management of sedimentation problems in rivers and reservoirs depend greatly on the sediment yield from the catchment land surface. Increasing pressure of population on land and water resources, such field experiments would be of great help in the proper understanding of the widespread problem of land degradation and soil erosion. AHP can be an important role for this purpose.

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