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Evaluation of land sensitivity to desertification

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ABSTRACT

Today one of the crisis ecological affecting the world is the phenomenon of desertification. We require a proper understanding of causes and processes of desertification to control the huge phenomenon on the global and regional situation. Desertification is more related to social and anthropogenic issues than natural causes and it becomes more important over the time. Human effects on desertification could be classified as direct and indirect factors. We used ICD method to estimate and assessment of desertification in 456 km^2 of Koohdasht basin lands. This method was introduced in 1995 by Ekhtesasi and Mohajer , checking human and environment factors that contributing to desertification of the area, at the end will be introduced the intensity of desertification. The first we collect the data of area then we used ILWIS software to separate the facies in basin and value the parameters of ICD method, we attain the intensity of desertification for each facies and whole basin. The analysis indicated that 35.2 % of land in basin located in low class, 31.99 in medium class, 32.7% had high class and the total area is located in medium class. As well as recognized the most importance factor is human activity.

Introduction

Land degradation is a global process which ultimately leads to a reduction of soil fertility (Luca Salvati, 2012). In dry areas Land degradation coupled with extreme bio-physical and socio-economic phenomena, may turn into an irreversible process of environmental degradation that is desertification (Montanarella, 2007).

In the Mediterranean basin, sensitivity to Land degradation has generally been associated to ecological conditions (e.g. climate aridity, soil characteristics and erosion, slope, vegetation cover) together with specific aspects of drought, human pressure (e.g. population density), and unsustainable land use management(Salvati, 2012).

Desertification was initially defined as the change of productive lands into desert, caused by human activity, as suggested by Aubreville in 1949 (Herrmann and Hutchinson, 2005); later as the development of barren mobile sand dunes as described by Le Houérou in 1968 for the northern edge of the Sahara (Dregne, 1977); and also as an aggravation or extension of deserts (Hare et al., 1977). The United Nations Environment Program in 1977 defined desertification as "the diminution or destruction of biological potential of land which can lead ultimately to desert-like conditions"; UN member countries have ratified the United Nations Convention to Combat Desertification (UNCCD) which provides international guidelines for responding to desertification. According to the definition in this Convention, desertification is "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities" (Abubakar,1997; Warren, 2002; Singh, 2009; Verstraetel et al.,2009; Andrew,2010; Dawelbait and Morari, 2012; D'Odorico et al., 2013).

It is widely recognized that desertification is a serious threat to arid and semiarid environments which cover 40% of the global land surface and are populated by approximately 1 billion humans. Given the potential relevance of this problem, it is surprising that there is no consensus on the proper way to assess the desertification status of a piece of land. During the last 70 years, conflicting definitions have produced both different assessment methodologies and divergent estimates (veron et al., 2006). Desertification is regarded as one of the most serious social–economic–environmental issues in arid, semi-arid and dry sub-humid areas (Sepehr and zucca, 2010). Finally, several studies have been conducted to assess desertification which many regional models are present. The most important offered models are UNEP-FAO (FAO/UNEP, 1984; Grumblat, 1991; Harahsheh, 1998;), TAXONOMY (Babaev et al., 1993: Kharin, et al. 1985) ESAs[1] (Basso, F. et al. 1999; Giordano, et al. 2002; Ladisa, 2002;), MEDALUS (European Commission, 1999; Kosmas, et al. 1999; Zehtabian, Gh., et al. 2005, 2008), ICD[2] (Ekhtesasi, M., M. Mohajer, 1995), MICD[3] (Ahmadi, et al. 2005), IMDPA[4] (Ahmadi, 2004; Zehtabian, et al. 2009).

Materials and Methods

Study area

Kouhdasht watershed has 456 square kilometers area is one of the basin river Kashkan that located in the south-western Lorestan province. This river during the course of the river meandering lead to Karkheh river. These basins located between 33°15′ to 33°38′north latitude and 47°27′ to 47°49′ east longitude. It is the highest point at 1936 meters above sea level in the northern watershed Kouhdasht, and the lowest is 1140 meters in the output. Rainfall regime is Mediterranean and

[1] Environment Sensitive Areas to Desertification

[2] Iranian Classification Desertification

[3] Modified Iranian Classification Desertification

[4] Iranian Model of Desertification Potential Assessment

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Average annual rainfall is 557 mm, annual volume of water is estimated 254311200 Cubic meters. Mainly in the area between 6 to 11 degrees Celsius temperature curve is enclosed and the average annual temperature also changes following the topography, The coldest area is located on the northern margin With the move to the south and central areas are generally added to the temperature Then the far field, the maximum value is achieved. Southwest winds from different directions, with 9% of the maximum winds are abundant throughout the year. Tectonic segmentation of the study area in the old part of Iran's Zagros Folded, Geological structure is simple and gentle with a series of near-field and the anti- Klynal compressed along the North West - South East and limited from down to plains of Khuzestan and high to Zagros Thrust. The oldest geological formations belong to the Gurpi formation, And the youngest deposits is related to Quaternary sediments in the geological. Alluvial and colluvial in plains and foot slopes will take the mountains. The total area of 456 square kilometers catchment area of about 216 square kilometers are forest and range lands, 240 square kilometers of agricultural land cover. The dominant type of Kouhdasht aquifer is sulfated. In an overall assessment of water quality in the Kouhdasht aquifer water was useful and almost no limit for drinking and agriculture. Hydrological studies show that the runoff coefficient is 11.4%, Actual evapotranspiration coefficient of 71.2%, Penetration rate of 17.4%.

Methodology

This method is done in 4 phases that are: determination and separation of desert homogenization environments, major and minor factors influencing on desertification, assessment of land desertification, mapping of Desertification. We make detail of ICD model in tab1, tab2 and tab3 and eventually we quantitative factors and classification Desertification intensity in region.

The class of desertification intensity, type of desert, major causes, minor causes are as follows:

Desertification intensity	Type of desert
Major causes	Minor causes

Results

After Field and laboratory studies 12 facies were identified in the region, according to the tables of parameters related to human factors, environmental factors and desertification intensity was calculated for each facies. And the overall environment of the desert, desertification class, major and minor elements were made separately for each facies and are listed in Tab4. The software ILWIS different facies were coded separately and can be seen in Figure 1.

Conclusion and discussion

There are criteria and appropriate Standards that consistent with the region term, and consider the various aspects of land degradation; this led to a fairly accurate estimate of the current state of desertification and Determining factors to land degradation. Consider Geomorphological various factors in this approach led to severe land degradation be estimated. The review weight average of the quantitative value of desertification emphasized that human factor is dominant to environmental factors, the quantitative value of the human factor is 21.25(high class) the quantitative value of environmental factor is 9.65(medium class) and the quantitative value of desertification intensity was 8.35(medium class). Among human factors the most important process in desertification was be water damage of pumping and falling water table that due to indiscriminate exploitation and wells drilled over to agricultural use; and then land degradation and destruction of plant resources because of range and forest land converted to urban and agricultural, cut brushes and overgrazing trees are important. According to studies done by the distribution of classes and current status of land degradation to the dominant process was determined that now in all the lands land degradation has occurred with varying degrees. In recent years to keep pace with population growth and industrial development, conversion of grassland to agricultural lands as well as intensive exploitation of water resources to drilled wells and water pumping are the main causes of desertification in arid and semi-arid areas. Unsustainable agricultural and livestock development in these areas, despite their temporary economic and prosperity have more difficult future than today. The analysis indicated that 35.2 % of land in basin located in low class, 31.99 in moderate class, 32.7% had high class and the total area is located in moderate class. As well as recognized the most importance factor is human activity. With emphasis the result of this research and consistent with the area; it seems that in addition to the ICD method is a suitable method for the whole province, but with slight variations of this technique can be used to estimate the severity of damage across the Zagros.

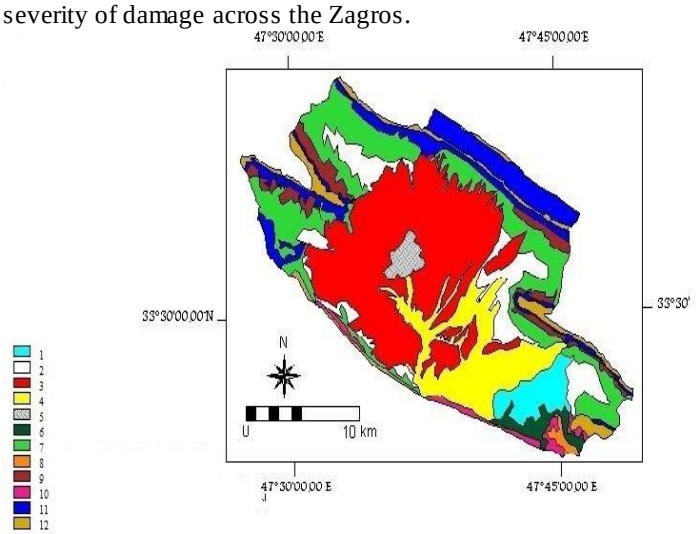

Fig 1. Facies differentiation in software

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Table 1. Classification and symbols of natural landscapes in ICD method

Type of environment	Landscape			Symbol
1	Lands covered with vegetation	Natural vegetation	forest	P/F
			Range land	P/R
		Forest plantations	Forest	Ap/f
			Range land	aP/R
2	Bare lands	Mountain		m/B
		Salty		s/B
		Clay		c/B
		Hamada		B
		Bad land		b/B
		Active sand dune		s.d/B
3	Agricultural land	Irrigation		I/A
		Dry-farming lands		Ni/A
		Habitat & building		A/b

Table 2. Separate of Factor in ICD model

Factor	Criteria	Symbol
Environmental factors	Climate	C
	Geomorphology	G
	Quality and quantity of water and soil	Q
Human Factors	Degradation of plant resources	P.D
	Degradation of water resources	W.D
	Degradation of land and soil resources	L.D
Severity of desertification land	The rate of erosion and deposition areas	S.D
	Possible reversal ecosystem	C.D

Table 3. Quantification the intensity and Class of desertification in ICD model

Desertification intensity	Score	class
Quiet	0-15	1
Low	15-30	2
Medium	30-45	3
High	45-60	4
Very high	60-80	5

Tab4. Facies classification and separation rates for each facies

Class	Land use	quantitative value of desertification	The dominant process		Quantitative value of desertification indicators	quantitative values of environment	Quantitative value of human factors	Steep grade (%)	Type geomorphologic	Facies codes
			Type of process	quantitative value to the process						
Medium	Forest	34	9	Ld(ch)	5	9	20	0-5	Flank regular with water erosion	1
Medium	Agriculture	43	10	W.d(pu)	10	11	22	0-5	Liner erosion	2
Low	Agriculture	29	10	W.d(pu)	3	7	19	0-5	Weak erosion	3
High	Agriculture	49	10	W.d(pu) S.e(wa)	16	9	24	0-5	Serious erosion	4
-	-	-	-	-	-	-	-	0-5	Residential	5
Medium	Forest-range	35	7	P.d(cu-gr) L.d(ch)	3	12	20	5-12	Flank regular with water erosion	6
High	Forest	52	10	P.d(cu) W.d(pu) L.d(ch)	11	11	30	5-12	Liner erosion	7
Medium	Forest-range	33	8	P.d(cu)	5	11	17	12-20	Flank regular with water erosion	8
High	Range degradation	46	7	A+I	14	11	21	12-20	Liner erosion	9
Medium	Range degradation	41	9	P.d(cu)	5	13	23	>20	Flank regular with water erosion	10
Medium	Range-forest	38	8	P.d(cu)	10	11	17	>20	Liner erosion	11
Low	bare	29	8	Q(qt)	6	14	9	>20	Rock mass	12

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