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Desertification Hazard Zonation by Means of ICD Method in Kouhdasht Watershed

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Abstract

In recent years, the topic of desertification has been discussed in different ways in scientific areas. This event occurred globally, regionally and nationally and many steps were taken to stop it. Desertification is challenged universally and its destructive effects are unavoidable and its consequences do endanger the life of inhabitants. The identification of sensitive regions and prevention and avoidance from damages resulted desertification is the first step. Then various methods are used to preparation of plans and maps as well as to recognize the zones. Among these, ICD method was chosen for the area. Finally the plan of the present status of desertification was provided. In this plan anthropogenic causes as well as environmental cause, the kind of process, the determining criterion and sub criterion, the class and the severity of desertification were indicated. The results show the fact that desertification phenomena with average severity took place in the area and it is extending.

Keywords: Desertification; Anthropogenic causes; Environmental causes; Desertification map; Kouhdasht basin

1. Introduction

Along with the extreme erosion in the various recurring natural resources such as water soil vegetation in different section of the universe specially in arid – semiarid , and semi humid areas, the term desertification has appeared in a modern and more complete form. It is obvious that it is indicating the wide problem which most part of the world has been engaged in. the problem which erodes water supplies and soil and causes swampy as well as alkalescent, destruction in vegetation plant and animal species and changes in climate. This theoretical idea in the mind has come in to being recently in the earth and nowadays as one of the most critical problems threatens the residents of the world. In order to fight with desertification, it is required to do some scientific researches and assessments in different parts of the world the results may surely help to control and reduce the damages resulted from this phenomenon(Babaev et al., 1993).

Wind is a main factor of the soil erosion in arid region. Due to limitation of vegetation in this region, it can affect on the soil grain and transport them. Wind erosion is one of the most important processes that it is used on the different desertification models. FAO/UNEP and ICD were the best current methods that they have analyzed. The effective indices and sub factor of wind erosion criterion and its human and natural factors were identified, and there where selected the most suitable of them (Ekhtesasi, 1995), (FAO, 1998).

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2. Material and Methods

2.1. Study Area

Kouhdasht Catchment lies in altitude 33˚ ,15´ to 33˚ 38´ North and 47˚ , 27´ to 47˚ , 49´ length east the area is 456 square kilometers which lies in middle Zagros. It includes two parts plane and mountainous the highest altitude in this basin is 1936 meter in the northern part and the lowest altitude is 1140 meter in the outlet section. The precipitation regiment is Mediterranean which means the dry season coincides with summer and the precipitation season coincides with winter (Figure 1).

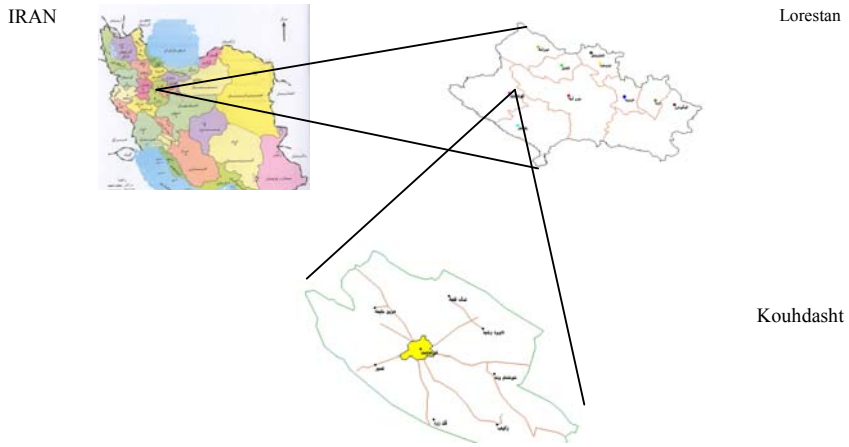


Fig. 1. Position of study area

3. Methodology

The first step in map preparation for present status of desertification is to collect the data related to the factors playing major roles in the occurrence of desertification. Based on the steps taken such factors as human and environment were recognized as the most influencing ones. For assessment the potentiality of desertification in the area, the basin was divided into 12 geomorphological facies using the combination of data related to topography and geomorphology maps and aerial photos and field visit Each of the facies, was closely regarded as the main unit for desertification assessment. After evaluating and comparing various methods and procedures used for desertification assessment, the ICD method was selected as appropriate ones in the basin. The reasons for select ICD method: a) it is partly comprehensive and step by step. b) conform with studied area. c) it is easy for separating of desert type inclusive in human and environment factors. d) it has accuracy for determining factors of desertification via average weight method) it is suitable for assessment and mapping in studied area.

Also the erosion class for each of the parameters was identified based on the criteria and the process affecting desertification. After assessing numerical values for each facies, the present status of desertification was prepared. Which indicates the kind of desert region, the agent the kind of process the manipulating criterion or sub criterion and the intensity of desertification. For obtaining, The unity in desert map units, the maps of physiographic, geology and erosion facies maps were utilized (Table 1).

3.1. Slope map

To prepare the slope map GIS capabilities were used. First vertical lines of 100m and in some parts line of 20m from topography map were digitalized by ILWIS software. Then these data were analyzed and the elevation model of DEM was prepared. After the preparation of digital elevation model and using it the slope map (percent) was prepared. The slope map was divided in to four class (Figure 2).

Table 1. Assessment and classification of present desertification in Kouhdasht

Desertification severity	Land use type	Quantity value of environmental factor(sum)	Process the determining		Quantity value of desertification	Quantity value of environmental factor	Quantity value of human factor	Slope (%)	Type of geomorphologic facies	Code of facies
			Quantity value	Type of process						
Aver age	III	Forest with agriculture	34	9	Led (chi)	9	20	0-5	Regular slope with water erosion(rill and surface)	1
Aver age	III	agriculture	43	10	Wad (up)	11	22	0-5	Waterway erosion	2
Low	II	agriculture	29	10	Wad (up)	7	19	0-5		3
High	IV	agriculture	49	10	W.d (pu) S.e (wa) h.s	9	24	0-5	Waterway erosion	4
	-	Residential	-	-	-	-	-	0-5	Residential	5
Aver age	III	Rang and forest	35	7	P.d (cu-gr) L.d (ch)	12	20	5-12	Regular slope with water erosion(rill and surface)	6
High	IV	Forest with agriculture	52	10	P.d (cu) W.d (pu) L.d (ch)	11	30	5-12	Waterway erosion	7
Aver age	III	Rang and forest	33	8	P.d (cu)	11	17	12-20	Regular slope with water erosion(rill and surface)	8
High	IV	Range degradation	46	7	A+I	11	21	12-20	Waterway erosion	9
Aver age	III	Range degradation	41	9	P.d (cu)	13	23	>20	Regular slope with water erosion (rill and surface)	10
Aver age	III	Rang and forest	38	8	P.d (cu)	11	17	>20	Waterway erosion	11
Low	II	-	29	8	Q (qt)	14	9	>20	rock	12

3.2. The maps of lithology units

For the preparation of litho logy units, the available geology maps were utilized. First the litho logy units in the basin were digitalized. Then visiting the basin, the map and the litho logy units were controlled and some corrections were accomplished. It is noted that a number of seven litho logy units cloudily (Cu, Am, Tzu, Kn-As-Sb-Gs-Qt) were specified. Among there the share determined for QT unit alone is more than other units (Figure 3).

3.3. The maps of erosion facies

For preparing erosion facies map, we have used aerial photos (1:50,000), used air photos (1:50000) for the primary map. Then the boarder for each facies was drawn, revised and digitalized using color composite in ILWIS and TM image. Finally, the erosion facies maps including six facies in the basin (extreme erosion in waterway, regular slope with water erosion, rock, surface erosion, waterway erosion and residential) were identification.

Based on the studies done mountain units as well as plain unit was specified. The mountain unit placed above the knick line involves water erosion with three facies as regular slope with the onset of water erosion, water way erosion and rock facies. The plain unit under study includes, pediment erosion, appendage and covered. Each of the types mentioned contain different facies which are reflected in the geomorphology map (Figure 4).

3.4. The coordinated units map

With the combination of base maps as litho logy structure and slope and erosion facies map, a desert unit map was obtained. This map has an important role in the natural resource studies. Based on the characteristics of each unit, specific planning for conservation and revival was done only as bed and base studies.

Totally, 12 geomorphologic facies in the basin under study were distinguished (Figure 5). There were facies place in mountain unit and plain unit. In plain unit, three types of plain (erosion, appendage and covered) were specified. In each type, various facies were recognized and their summary is listed (Table 2).

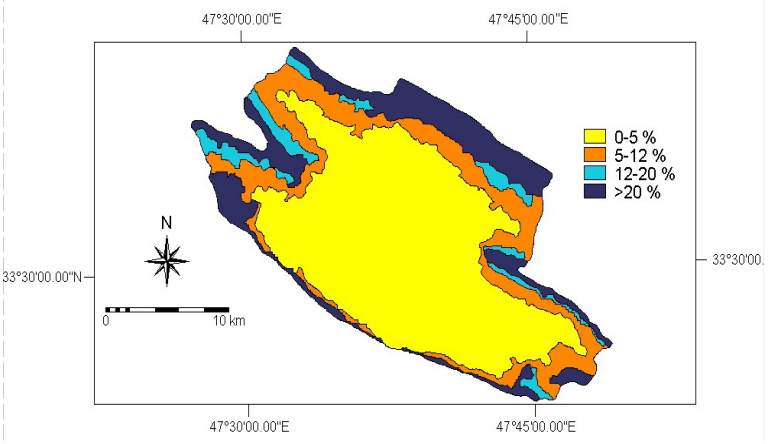


Fig. 2. Slope map of Kouhdasht (main scale is 1:50,000)

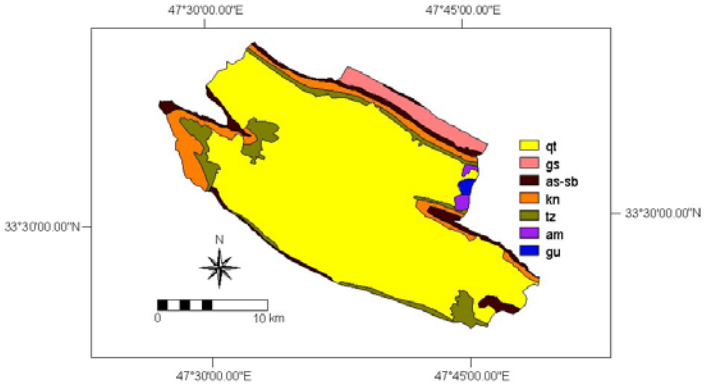


Fig. 3. The maps of litho logy units in Kouhdasht (main scale is 1:50,000)

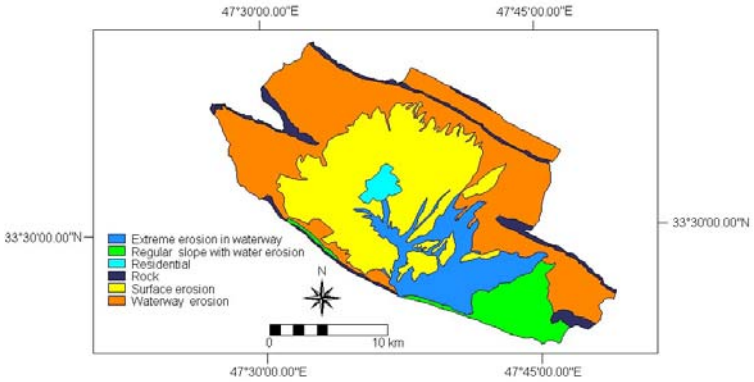


Fig. 4. The maps of erosion facies in Kouhdasht (main scale is 1:50,000)

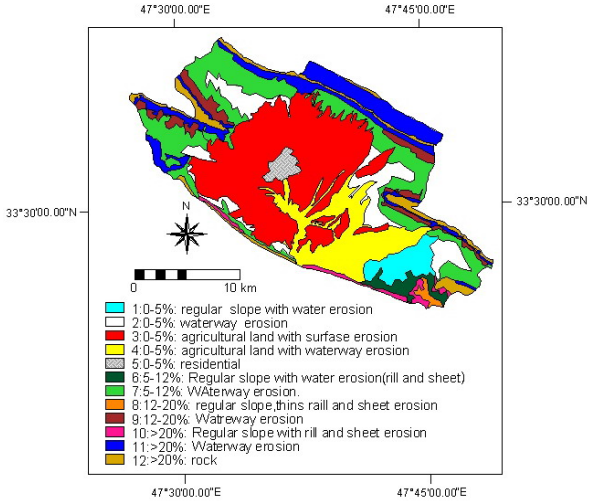


Fig. 5. The coordinated units map of Kouhdasht (main scale is 1:50,000)

Table 2. Units, types and geomorphologic facies

Geomorphologic facies and code				Type name and code		Geomorphologic unit code	
Slope (%)	Code on the map	name	code	Type name	Code	Unit name	code
>20	1	Rock	1-1-1	Asmari-Shahbazan	1-1	Mountain	1
	2	Regular slope with water erosion	1-2-1	Tale zang	2-1		
	3	Waterway erosion	2-2-1	Gachsaran-Kashkan			
12-20	4	Regular slope with water erosion	1-1-2	Plain erosion	1-2	Plain	2
	5	Waterway erosion	2-1-2				
5-12	6	Regular slope with water erosion	1-2-2	Plain appendage	2-2		
	7	Waterway erosion	2-2-2				
0-5	8	Regular slope with water erosion	1-3-2	Plain covered	3-2		
	9	Waterway erosion	2-3-2				
	10	Agricultural land with surface erosion	3-3-2				
	11	Waterway erosion	4-3-2				
	12	Residential	5-3-2				

4. Results

As studied, ICD method was chosen for scoring and assigning values, and assessing desertification. ICD method was carried out in an area covering 456 km^2. The results were obtained and analyzed based on the procedures followed, geomorphologic facies were determined first. Each facies was evaluated separately and the results were compared with the faces existing in the basin. Final results are listed in Table 2. Then using base studies, basin visits and desertification parameters in the basin were investigated. The work unit (7) with the quantity value a 52 has the highest destruction class. The work units (3) and (11) each with the quantity a 29 has the lowest destruction class (Table 1). In general, the intensity of desertification was assigned and classified as high, average and low (Figure 6). Through The analysis of parameters and processes, the desertification intensity in the basin had an average weight.

Assessment of factors, process and desertification intensity in zone basis on the average weight

Desertification factors

The data indicates that the average weight of human parameter (scored, 21. 25) and the average weight of environment factors (scored, 9.65) had the high class and average class in land erosion (Tables 3 and 4).

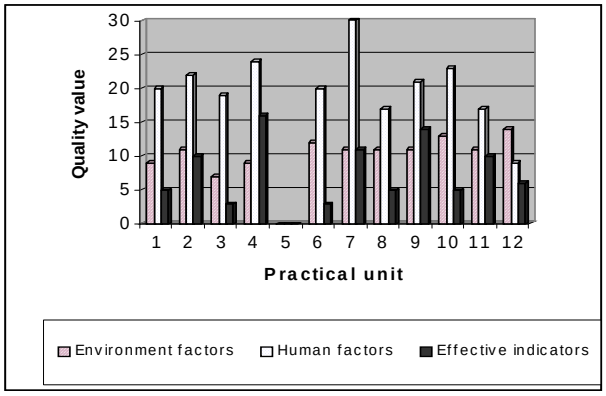


Fig. 6. Effective factors and indicators on land degradation

Table 3. The estimation of desertification intensity based on the total scores of both human and environmental factors

Extreme	High	Average	Low (normal)	Desertification
21.1-30	12.1-21	6.1-12	0-6	Scores
IV	III	II	I	Symbol

Also, regarding the average weight the effective factors on the land soil resources degradation (scored 8.35) have the highest degree of desertification.

Table 4. Estimation of desertification intensity based on the total scores of the desertification

extreme	high	Average	Low (normal)	Desertification
14.1-20	8.1-14	4.1-8	0-4	Scores
IV	III	II	I	symbol

As it is seen, we can infer that in Kouhdasht catchments, only the human parameters play the major role in the watershed. The environment factors have the minor role in desertification.

4.1. Desertification processes

As we can see from the obtained investigations, we can claim that among the influencing factors of desertification in the basin, the processes of water supply destruction, soil erosion, land destruction, vegetations destruction and the quantities conditions of water and soil resources has a significant role on the decortications phenomenon, respectively. These are indicated by the following symbols. W.d (Pu) >S. e (WA) >L.d (ch) >p.d (cu-gr)> a (at)

4.2. Desertification intensity

The quantity value of average weight of desertification in the whole area was determined based on the manipulating process (SD=39.2). Matching this with the table of desertification intensity, the class of desertification interests for the whole arena was estimated. Frequency distribution in class intensity and the present condition of desertification (land erosion).

4.3. Frequency distribution of class intensity and the present status of desertification

Frequency distribution of class intensity and the present condition of desertification determined based on the manipulation process in the basin and ICD method indicate that now in the whole area land erosion occurs with different degree so as to no area in the basin was classified as low or normal . Frequency distribution of the class intensity of desertification is summarized in Figure 6.

4.4. Map preparation of present condition desertification

After desertification evaluation using ICD method and data analysis, and matching results obtained with the geomorphologic facies map of studies area, we took actions to prepare the map of the desertification status. Along with maps, the summarized materials associated with desertification severity offered. The kind of desert environment and factors influencing desertification were suggested as a fraction beside the map (Figure 7).

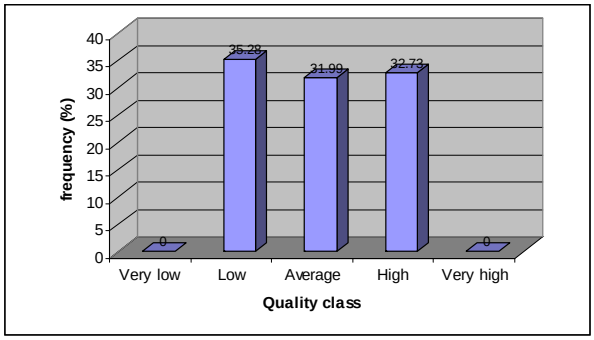


Fig. 7. Frequency distribution of class intensity and the present condition of desertification

5. Discussion and Conclusion

The appropriate criterion and process matched to the condition of the basin on hand and consideration of different aspect of desertification existing with this method help us to make the exact estimation of desertification severity and the factors affective on land erosion. Taking the geomorphologic Factors into account in these methods we were able to estimate the desertification severity easily in upper part of knick line which is the boarder between the plateau and the mountain. The human agent was more manipulation than the environment agent in all facies, except mass stone faces. This was also the major influencing factor on desertification in the basin. Among the human agent, the most important process of desertification in the basin was the destruction of water supply caused by pumping and reducing the water bed. Then the destruction of land and vegetation comes as a result of civil residential replacement and cutting the traces and heavy grazing.

The special topography, geology and climatic conditions of the basin caused water and soil erosion to be of the factors on desertification. The quantity average weight of desertification confirmed the priority of human factor over environment one. As the quantity value of human agent (scored 21.25) has sever class (IV) and the quantity value of environment agent scored 8.65 has the average class (II). Also, considering average weight, quantity value of desertification 8.35 was determined as high class. So the desertification severity for the whole basin was determined as average class based on the total score (Ds=39.2).

Throughout the whole area the desertification phenomenon has occurred with different degrees. No area was classified as low class or normal. Of the 45600 hectares of land under study, 35.2% has low class (II), 31.99% has average class (III and 32.75 has high class IV. Although the area under study has three classes (IV, II, II) it is found with a little attention to the table and graphs obtained from the analysis of desertification processes. That some of the unit works were progressing to ward higher classes. This will intend to warn the increase of desertification severity in future (Figure 8, Table 5).

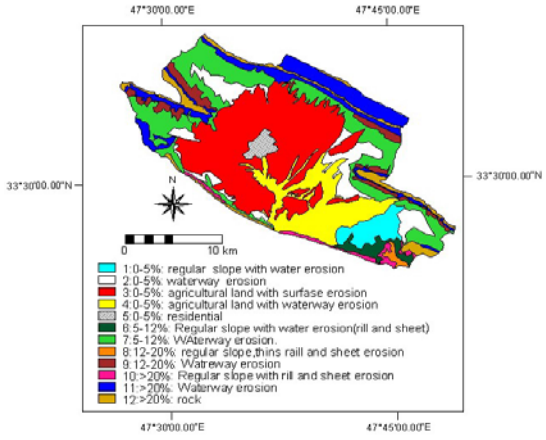
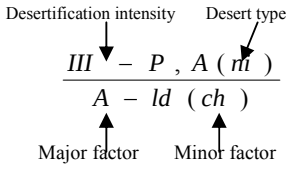


Fig. 8. The present status of desertification map in Kouhdasht

Table. 5. The present status of desertification map in Kouhdasht

Desertification present condition on the map	Area (km2)	Slope (%)	Faces code
III – P , A (ni) / A – ld (ch)	18.83	0-5	1
III – A / A – wd (pu)	58.12	0-5	2
II – A (i) / A – wd (pu)	135.82	0-5	3
IV – A / A.E – wd (pu), se (wa)	55.44	0-5	4
Ab	6.53	0-5	5
III – P / A.E – pd (cu , gr), ld (ch)	6.35	5-12	6
IV – P , A (n) / A – pd , wd (pu), ld (ch)	70.69	5-12	7
III – P / A – pd (cu)	1.97	12-20	8
IV – PR , A (n) / A – A + I	23.07	12-20	9
III – PR / A – pd (cu)	5.84	>20	10
III – P / A – pd (cu)	54.76	>20	11
II – B (m) / E – Q (qt)	18.54	>20	12



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