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The influence of the plant coverage on the desertification status in Jarghooye region of Isfahan using IMDPA model

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ABSTRACT

The issue of plant coverage, destroying it and the resulting influence on desertification process has long been taken into consideration by the scholars and researchers of different fields of study specially natural resources and agriculture. In many areas of the world, human being has played the main role, intentionally or unintentionally, in desertification or speeding up the rate of it. It has been accepted that proper and effective plant coverage slows down the rate of desertification to a great extent in an area susceptible for desertification and also it makes the condition conducive for changing the ecosystems into a better form. The current study has been done with the objective of determining the quantitative influence of the plant coverage in Jarghooye area on desertification in this region that is one of the most susceptible areas of the country. In this study, Iranian Model of Desertification Potential Assessment (IMDPA) was applied. This model is one of the valuable models for determining the level of desertification in different areas of Iran. The results of this study shows that the coverage exploitation index with the numeral value of 3.18 is in sever class and has the most influence on the indices studied in the region. Generally the plant coverage index of this area with the numeral value of 1.99 is indicator of the average influence on desertification process in Jarghooye region.

Introduction

Jungles and pastures are among the most precious resources of each country. Some of the advantages of them are: maintenance of the soil and water, prevention from water and wind erosions, stabilization of the moving sands, production of grass without any cost, genetic saving, life platform, production of industrial, food and medical products, refreshing the air, preserving wild life, and stockbreeding.

Human exploitations especially during the recent decades without considering the production capacity of the pastures resulted in a situation in which such resources are not only fruitless but also the resulting destruction of the plant coverage endangered the activities and life in such areas. As a result the governments have to spend budget to recover the plant coverage through scattering seeds and planting trees with appropriate species in order to stabilize the moving sands and prevent the water and wind erosions and accordingly make the situation of the desert areas conducive for life. As a matter of fact more than 1/3 of the land of earth is of dry climate and desertification has been increased during the last decades.

According to the estimation of the United Nation Conference of desertification (UNCOD) the phenomenon of desertification threatens about 17.7% of the population of the world among which from 60 to 100 million of the population are to be affected directly from the decrease in the fertility of the land along with other processes of desertification. Desertification is primarily unexplored and not easily detectable. This phenomenon will be detectable as soon as it causes a change in the fertility of the soil. Desertification is a gradual process in destruction of the land [13].

Factors effective in the process of desertification are classified generally into two groups: natural factors like decrease in the fallings, geographical position of the region, sever heat, and excessive evaporation and also humane factors like the erosion resulted from inappropriate human activities [7], destruction of the plant coverage, overexploitation of the mines, etc. In order to fight with desertification, doing scientific research and evaluations are necessary in different areas of the world. Results probably lead to controlling or decreasing the dangers of this phenomenon [3-16-17].

In most areas of the world especially in dry and semidry regions a number of studies are done to determine the rate of land destruction and destruction locations, and also to make some related maps. In order to do so several methods for determining the severity of desertification have been taken into consideration based on different models of desertification in different areas of the world and regarding the situation of that area. Some of such models are FAO-UNEP [6-7-8-10-11-12], Glasod [2], Medalus [13-15], Icd [1-5], Micd [5], Imdpa [4-13], Etc.

Since the plant coverage plays an important role in Carbon, water, and energy recycling on the land and it exists scarcely and sparsely in the dry areas, destruction of it will have sever effects [9]. The most important is helping the desertification process in susceptible areas.

In order to avoid sparse planting and appropriate planning based on the capabilities of the area with enough knowledge of the natural and artificial obstacles and problems, it is necessary to do scientific studies that includes plant coverage studies and evaluation of the pastures and the status of the exploitations in the area under study. In this study we were after making the

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floristic list of the region, separation of the pastures from farm lands, craggy grounds, inhabitation areas, areas without plant in the pastures, and areas with plant coverage, and also typification of the other species.

Materials and Methods

Study Area

The area under study is a part of Gavkhooni Lagoon located in Jarghooye which is considered as one of the fragile and critical areas of the Isfahan Province. This region is in an area of 82329.46 Hectare and geographical coordinates of 52°11' and 52°43' east longitude and 32°09' and 32°27' north latitude. It is located in south east of Isfahan and its circumference is 143 Kilometers.

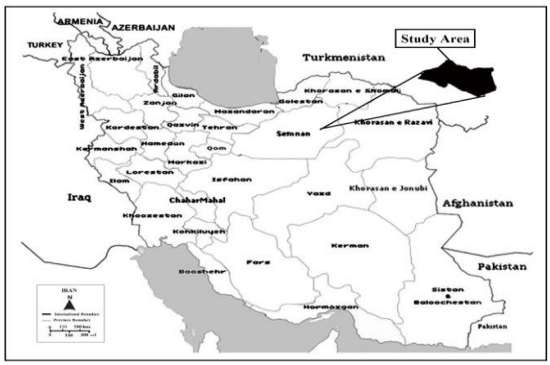

Fig1. Location of the study area in Hormozgan province and Iran

Methodology

In order to study the plant coverage firstly the map of the area under study was prepared with the scale of 1:50000. Then we went to the mentioned area with enough facilities including GPS and after getting acquaintance with the region started to make separation of the pastures from farm land, craggy grounds, inhabitation areas, areas without plant in the pastures. Then in the areas detected as pasture we started to typify and determine the major species and also other species with less percentage of presence in comparison to the major types.

Using GPS and walking around the pastures, we determined the borders of each type and then transferred the information to the map. In this study, to determine the influence of the plant coverage on desertification, the Iranian model of IMDPA has been used. This model that was prepared by a number of the scholars and researchers in cooperation with international researchers and organizations specifically for the situation of Iran has 9 criteria after all reforms and each criterion includes several indices and finally the numerical value of each criterion is determined through numeral average of the indices of each criterion. Then according to the related table it is determined that the criteria under study is in which range in terms of the influence on desertification [4].

In this study we investigated the plant coverage criteria and considered three indices of coverage status, coverage exploitation, and recovery of the coverage. After investigating each index the numerical value is extracted from the following formula:

Plant coverage= (coverage status × coverage exploitation × recovery of the coverage) $^{1/3}$ (1)

For grading the indices and the criteria of coverage the unit map of the region was prepared and grading the sub-indexes and the related indexes was done on this map. The unit map of the region shows that 38.6% of the region is covered with pastures, 8.21% farm lands, and 53.19% with lands without coverage. Table 1 illustrates the classes and the values of the indices for plant coverage for evaluating the desertification in this region.

Results

After visiting the deserts and investigating the air photos, 11 plant types have been recognized in Jarghooye region each of which included major and minor types. A vast area of this region was without any discernible plant coverage that is shown in yellow in the typification map of the region. Table 1 illustrates the available species in these 11 types briefly. Figure 1 is the plant typification map of the region prepared with GIS software.

Table1. Vegetation type of the study area

Type	Dominant species	Along species	Area
(A) 1	Salsola sp_1	Alhagi camelorum	803.12
(B) 2	Seidlitzia rosmarinus	Artemisia sieberi	5550.38
(C) 3	Seidlitzia rosmarinus	Phragmetis australis	6224.83
(D) 4	Salsola sp_2	Artemisia sieberi	4737.46
(E) 5	Anabasis aphylla	Stipagrostis plumose	3443.44
(G) 6	Artemisia sieberi	Noea mucronata	7059.58
(H) 7	Artemisia sieberi	Sphandiaria calcarea	1080.34
(I) 8	Alhagi camelorum	Phragmetis australis	398.37
(K) 9	Alhagi camelorum	Phragmetis australis	115.40
(L)10	Phragmetis australis	Lawnea spinosa	1046.86
(M)11	Halocnemus strobilaceum	Salsola sp	1113.89

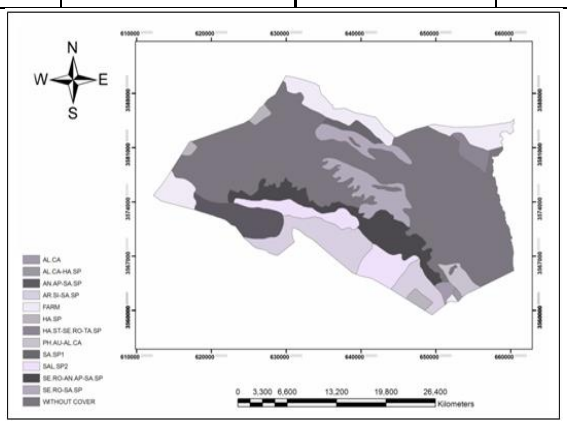

Fig2. The vegetation type map of the study area

In order to determine the level of desertification of the region using the plant coverage criteria, firstly regarding the information in table 1 and field surveys, the indices considered in the unit map of the region have been graded. Figures 3, 4, and 5 are prepared maps for coverage index, coverage exploitation index, and recovery of the coverage index respectively. Then the numerical value of the criteria for plant coverage index was determined by using the mentioned formula and the map of the plant coverage criteria was prepared for the region. Figure 6 illustrates the map of the plant coverage criteria.

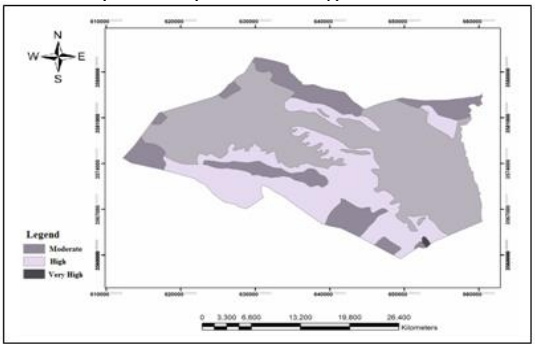

Fig3. The Map of coverage index

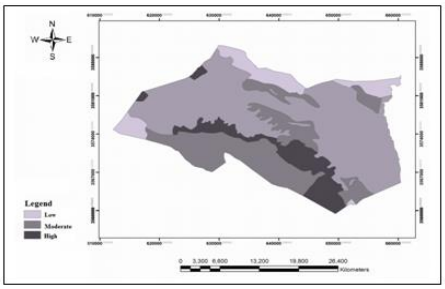

Fig4. The map of coverage exploitation index

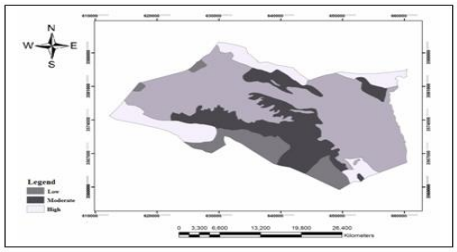

Fig5. The map of coverage recovery index

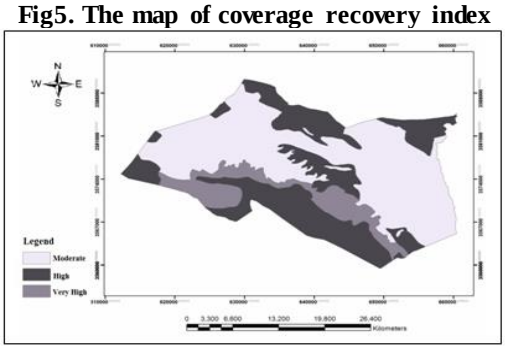

Fig 6. The maps of plant coverage criteria

Investigation of the maps illustrates that coverage exploitation index with numeral average value of 3.14 and with sever class has had the most significant influence on desertification in this area and the both of the indices for coverage recovering and plant coverage status with numerical values of 1.41 and 1.4 respectively are classified in low influence on desertification of the area.

Discussion and Conclusion

The environmental limitations are the most significant factor in lack of plant coverage in the area under study. Lack of fallings and its proper distribution, long dry period, excessive heat and high evaporation, saltiness and alkalinity of the soil, highness of the salty water aquifers with high EC in some areas resulted in limitation in the plant coverage formation and expansion. The lower parts near the farm lands are without plant coverage and higher parts and foothills with more conducive status of the soil are richer in density and variety of the plant coverage. Among other factors, the increase in the population and unemployment especially in southern areas of the region under study are mentionable.

Regarding the prepared maps for different indices of plant coverage (figures 2, 3, and 4) it is concluded that the index of the plant coverage status in the farm land type is classified in average class, type E (Anabasis aphylla and Salsola) in the sever class and type K (Alhagi camelorum and Haloxylon) in very sever class. The index for exploitation of the coverage in the farm lands type is classified in low class, type D (Salsola) in average class, type G (Artemisia sieberi and Salsola) and type H (Haloxylon) in sever class. The index for coverage recovery in type G (Artemisia sieberi and Salsola) is classified in low class, in type C (Seidlitzia rosmarinus, salsola, and Artemisia sieberi) and type D (Salsola) in average class, and farm lands type in sever class.

According to figure 5 that illustrates the plant coverage of the region it is concluded that in this criterion type E (Artemisia sieberi and Salsola) is classified in average class and type G in sever class. Other areas are without discernable plant coverage. Based on the map for plant coverage criteria it is concluded that in Jarghooye region 43790.965 hectare is without coverage, 13829.544 hectare is in average influence on desertification class, and 24708.934 hectare is in sever class. In table 2 the area of each class for each index is illustrated.

Table2. The area of each class for each index

Index	Numeral average value	Class	Area (ha)
coverage	1.4	Without cover	43790.96
		moderate	13385.74
		sever	25037.34
		Very sever	115.39
coverage exploitation	3.14	Without cover	43790.96
		low	7567.93
		sever	9533.56
recovery of the coverage	1.41	Without cover	43790.96
		low	8139.92
		moderate	18745.07
		sever	11653.48

Some of the plant capacities of the region are the plants Haloxylon, Seidlitzia rosmarinus, Nitraria schoberi, and Artemisia sieberi by plantation of which and watering for a couple of years, facilitation of the increase in the plant coverage will be possible. It is worth mentioning that the plants Seidlitzia rosmarinus and Artemisia sieberi are natives of this region and Haloxylon and Nitraria schoberi has been planted before successfully. Some of the limitations in the plant coverage are scarce canopy cover, coverage, and density of the plant species. Even in most areas of the region under study land is without coverage. It should be mentioned that the strong erosive winds and excessive saltiness of the soil in this region are other factors that limit the formation and expansion of the plant coverage. The species suggested for recovering the pastures are illustrated in table 3.

Other point to be mentioned is that the plant Aeluropus is one of the plants that is native and adaptable to the region under study, but because of the inappropriate distribution of the fallings, seed scattering for this plant is not justifiable. Aeluropus exists in vast area beside Gavkhooni Lagoon that formation of this plant is possible in case of restricting the area. It should be mentioned that in some areas of the province, Atriplex is used instead of Nitraria schoberi, Artiplex is also native of this region and can be used fruitfully in recovering the pastures of the region.

Table3. The species suggested for recovering the pastures

Spices Name	Family	Location
Nitraria schoberi	Zygophyllaceae	Plains with high level of underground water
Haloxylon spp.	Chenopodiaceae	Plains with sparse vegetation cover
Amygdalus scoparia	Rosaceae	As an experimental model on the top of soil barriers
Artemisia sieberi	Compositae	Seeding in the furrows

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