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Evaluation of the effects of soil properties on desertification (Case study: Segzi Pediment of Isfahan, Iran)

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Abstract

One of the characters in Iranian Model of Desertification Potential Assessment (IMDPA) is soil. Since soil is very important in the degradation of land, so some indices were determined for this character in order to evaluate desertification potential of arid, semi-arid and dry sub humid areas of Iran. The indices included soil texture, deep gravel percentage, soil depth, and EC. To calibrate the soil character of the IMDPA, above mentioned indices were assessed in Segzi Pediment as arid region. To do this, in first stage, map of the study area was prepared based on slope, land use and geological maps. Scores of indices were recorded in different study units. At last, using the formula, $SI=\sqrt[4]{a.b.c.d}$, final score of soil indicator (SI) was determined in the study area based on IMDPA. In this model, desertification potential classes are low, moderate, high and very high. The map showed that 1.5%, 20% and 78.5% of the study area are considered as medium, high and very high desertification intensity classes, respectively. More over, there wasn't low class based on vegetation character.

Key words: IMDPA; Desertification; Isfahan; Iran; Segzi; Soil properties

1. Introduction

According to the definition given in the Convention to Combat Desertification taken by the United Nations (1994), desertification is any land degradation in arid, semi-arid and dry sub-humid areas, resulting from various factors, including climatic variations and human activities. Arid, semi-arid and dry sub humid areas are defined as lands having a Precipitation / Potential Evapotranspiration ratio (P/ETP) ranging between 0.05 and 0.65.

Land degradation (soil salinity, sodicity, acidity and erosion) is a reduction of current or future capacity of soil to produce (Dregne, 1987; Higgins, 1988). It can be occurred because of erosion, decline in fertility, changes in aeration and moisture content, salinization, or a change in soil flora or fauna (Barrow, 1997).

Success in combating desertification will require an improved understanding of its causes and impacts and especially the linkage between desertification and some change in climate, soil, water, land cover and socio-economic factors.

During the desertification process because of climate change and human impacts, soil characteristics changes during the desertification impacts. Soil salinity and alkalinity degrades soil structure and consequently decrease productivity. Therefore, evaluation of soil changes can be as a suitable indicator to assess desertification intensity. To evaluate the situation of soil

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degradation as an indicator, which is affected by desertification, related indices of soil, should be considered. Therefore, through evaluation of soil, it is possible to determine desertification intensity. These indices have three characteristics which are very important in Iran; simplicity, availability, and finally existing comprehensive basic data. Thus, selected indices must be able to show the changes in productivity and potential of production.

Many studies have been done to introduce land degradation assessment methods i.e. FAO-UNEP, Turkmenistan Model, GLASOD, MEDALUS, LADA, etc.

Ladsia (2000) studied desertification in Barry, Italy, with MEDALUS model. In this research indices such as soil, climate, vegetation, land use, management quality and anthropogenic factors were evaluated.

Doran and Parkin (1994) proposed a minimum data set for characterizing and monitoring soil indicator. Quantitative indicators of soil includes soil attributes and properties such as texture, rooting depth, bulk density, infiltration, water retention characteristics, soil organic matter, electrical conductivity, extractable N, P, and K, microbial biomass, and soil respiration.

Each of the mentioned models has been designed considering an especial region's ecological, biological and socio-economic conditions. Although GLASOD method invented by international experts of soil degradation has more validity than others, but to create a harmony with global system and more reliability to Iran situation, it is necessary to design a national model for Iran. Hence, to have a model with national application and adaptable, it is necessary to design a model adaptable with different environmental condition of Iran with respect to considering different effective indicators in desertification.

Generally, as each country has its own natural and human structure, methods introduced in a country could not be reliable in other countries. In the other words, evaluation of desertification in each country is different from others. This research focuses on soil indicator with Iranian Model of Desertification Potential Assessment (IMDPA).

2. Material and methods

In order to evaluation of soil role in desertification, a part of Segzi pediment in Esfahan province was chosen as study area. The climate of mentioned area, with an area of 345521.1 ha, changes from semi-arid in northern parts to arid in southern parts.

Among different effective indices of soil indicator in desertification, four indices including electrical conductivity (EC), soil depth, and texture and gravel percentage were chosen.

Table 1 shows the indices and their scoring. There are four classes to represent desertification severity based on soil indices effects. Score 0-1.5 is representative of low class of desertification, that is, if any index lies between 0-1.5, therefore its influence on desertification is low. 1.6-2.5, 2.6-3.5, and 3.6-4 are the scores to show moderate, severe and strongly severe classes of soil induced desertification. In this method, it is possible to provide a desertification potential map considering each index score using GIS. The final score of desertification potential caused by soil is calculated using the following geometric mean method:

$$SI=\sqrt[4]{a.b.c.d}$$

Where SI is final score of soil indicator, and a, b, c, d are EC, soil depth, soil texture, and gravel percentage indices scores, respectively.

Before starting the indices scoring, unit work map of the study area was provided using geology, land use and slope maps of the study area. Totally 54 homogenous unit works were recognized in which scoring of four soil indices were performed within the unit works. As it was referred before the integration of information layers of each index to get final desertification map was done using GIS.

Table 1. Suggested indices to assess soil degradation in Iran

	Index	Potential of land degradation			
		0-1.5 (low)	1.6-2.5 (medium)	2.6-3.5 (high)	3.6-4 (very high)
1	Ec(dsm^{-1})	<5	5-8	9-16	>16
2	Soil depth (cm)	>80	50-80	20-50	<20
3	Soil texture	Fine loam	Fine loam	Coarse loam	Sandy, sandy loam
4	Gravel (%)	<15	15-35	35-75	>75

3. Results and discussion

The map of current desertification status caused by soil, prepared according to final score of soil indicator (Fig 1).

Table 2 shows the surface areas of each desertification classes caused by soil. Table 2 indicates that 5182.8 ha, 69104.2 ha and 271234.1 ha of the study area are considered as moderate, High and very high desertification intensity classes, respectively. There was not low class based on soil indicator.

The final map of desertification revealed that 1.5%, 20% and 78.5% of the study area are considered as moderate, high and very high desertification intensity class, respectively.

Table 2. Extent of different desertification classes in Segzi pediment

Desertification intensity	Area	
	hectare	percentage
Moderate	5182.8	1.5
High	69104.2	20
Very high	271234.1	78.5

In addition to soil, IMDPMA includes eight different indicators including; climate, geology, water resources, vegetation, agriculture, wind and water erosion, socio-economic, and techno genic indices and any changes in the mentioned indicators, affect soil characteristics.

Low precipitation, severe wind erosion in southern parts and water erosion in northern parts of the study area, overgrazing, poor vegetation and over use of ground water for agriculture, are the factors that have unfavorable influences on structure and salinity properties of the soil. This leads to soil degradation and therefore it is not surprising a major part of the study area is in class four (very high) of desertification.

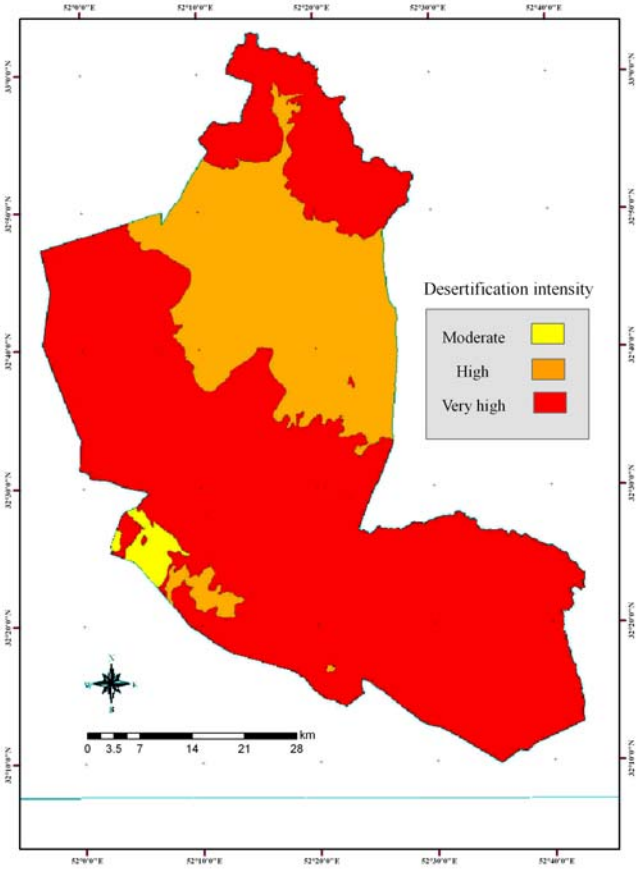

Fig 1. Map of current desertification status caused by soil degradation

References

Barrow C.J., 1991. Land degradation: development and breakdown of terrestrial environments. Cambridge University Press, New York.

Doran J.W. & T.B. Parkin, 1994. Defining and assessing soil quality. In: Defining Soil Quality for Sustainable Environment, J.W. Doran C. Coleman, D.F. Bezdicek and B.A. Stewart (Eds).). Soil Sci. Soc Am. Special Publication No. 35, Madison, Wisconsin, USA, ppp. 3-21.

Dregne H.E., 1987. Soil erosion: cause and effect. Land use Policy, 4:412-418.

FAO/UNEP, 1983. Methodology for the compilation of desertification hazard map of Africa, Scale 1:500000, Rome.

FAO/UNEP, 2001. Land degradation assessment in Dry land (LADA), UNEP. Pp: 67.

Higgins G.M., 1988. Soil degradation and its control in Africa. Paper to first all African Soil Science Conference, Kampala, Uganda, December, 5-10.

Ladsia G., 2002. Characterization of areas sensitive to desertification in southern Italy. Proc of the 2nd Int. Conf. on New Trend in water and environmental engineering for safety and life, 24-28 Jun, Italy.

LDA's conference, 2002. Land degradation assessment in dry lands-LADA project, Report of email conference, Oct-Nov 2002
(http:/www.fao.org/landandwater/agll/lada/emailconf.stm)

UNEP, 1997. World atlas of desertification. New York & London. John Wiley & Sons, Inc. and Arnold (Second edition), 182 p.