Desertification vulnerability in Varamin Plain, (Central of Iran)

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Abstract:

Desertification is a land degradation problem of major importance in the arid regions of the world.
Desertification is a world-wide phenomenon which causes the earth's ecosystems to deteriorate. It affects about two-thirds of the countries of the world, and one-third of the earth's surface, on which one billion people live, namely, one-fifth of the world population.
The vulnerability of land to Desertification is mainly due to the climate, water sources degradation, the state of the soil and the natural vegetation, and the ways in which these two resources are used and its degradation.
The state of the soil (texture, structure and chemical and biological properties) is a major factor, particularly in the sub-humid zones where the influence of climatic factors is less marked. It plays an essential role in causing vulnerability to Desertification caused by human activities.
In this research we evaluated risk of Desertification of Varamin plain, one of the Great Plains in Iran. This plain has a semi dry climate and have rainfall about 173 mm.
To this aim, three indicators was evaluated by using a geographic Information System (GIS). These indicators are to include soil, Groundwater and Landuse.
Each parameter was weighted in relation to its influence on Desertification process.
And risks of Desertification were computed by geometric mean of the parameters with help of ARCVIEW 3.1 Software.
The results show that the risk of Desertification is high to medium in the south and along of northwestern to southwestern of plain and in the central of plain the Desertification is absent to low.

Introduction

Desertification is a world-wide phenomenon which causes the earth's ecosystems to deteriorate. It affects about two-thirds of the countries of the world, and one-third of the earth's surface, on which one billion people live, namely, one-fifth of the world
Population.

Desertification, as defined is the degradation of the land in arid, semi-arid and sub-humid dry areas caused by climatic changes and human activities. A reduction in the natural potential of the land and depletion in surface and ground water resources accompany it.

The vulnerability of land to desertification is mainly due to Overgrazing and woodcutting, over cultivation practices, and improper water management leading to salinization is the cause of the deterioration of irrigated lands. In addition to vegetation deterioration, erosion, and salinization, desertification effects can be seen in loss of soil fertility, soil compaction, and soil crusting. Urbanization, mining, and recreation are having adverse effects on the land of the same kind as is seen on range, dry farming, and irrigated lands.

As a matter of fact, Desertification is a land degradation problem of major importance in the arid regions of the world. Deterioration in soil and plant cover has adversely affected nearly 50 percent of the land areas as the results of human mismanagement of cultivated and range lands.

Material and Methods

Land degradation involves as complex set of processes of factors, which interact in space and time leading to a decrease in land productivity. Thus, it is necessary to identify the various indicators, which will provide the relevant information to define the desertification prone areas. To this aim, the MEDALUS (Mediterranean Desertification And Land Use: European Commission, 1999) methodology was modified and adopted, and the risk of desertification was evaluated on a regional level by defined the ESA (Environmental Sensitive Area) Index.

ESAs method takes into consideration three broad systems of indicators:

- Ground Water Indicators (Water Table, Cl, Ec, Sar)
- Land use indicator
- Soil quality indicators (Ec , Sar, Organic Mater ,Texture)

Each indicator was weighted in relation to its influences on desertification process.
Each of indicators is assigned a score ranging from 100 (best) to 200 (worst). Value zero is assigned to the areas where the measure is not appropriate and /or those which are not classified (e.g. water bodies, urban areas, etc.). The function representing the variation of the indicators (scores) is liner ranging between the extreme values (100 - 200). The tables 1 to 3 show the classification of each layer.

The integration was done using GIS technology and with help of ArcView 3.1 Software, the various information layers for each index were collected, prepared in a suitable format then overlaid in order to calculate the index as the geometric mean of the parameters related to each singe index according to the following equation:

$$Index\_X = [(Layer\_1) . (Layer\_2) . \ldots . (Layer\_n)]^{1/n}$$

Where n is the number of indicators for each index. And the geometric mean of the three Index gives the ESA index:

$$ESA = (GWI * LUI * SI)^{1/3}$$

Values of three indexes are subdivided into three classes of equal range:

1- high : 100-133
2- medium : 134-166
3- low : 167-200

And ESA index was classified by four main classes of land degradation as high (ESA from 175 to 200), medium (ESA from 150-174), low (ESA from 125-149) and absent (ESA from 100 to 124).

Table 1.Groundwater layers, classification and relative scores

Layer	Classes	Scores
Color (CL) (mg/lit)	< 250	100
	250-500	125
	500-1500	150
	1500-3000	175
	> 3000	200
Electrical conductivity (EC) (µmho/cm)	< 250	100
	250-750	125
	750-2250	150
	2250-5000	175
	>5000	200
Water table (cm)	> 315	100
	285-315	150
	< 285	200
SAR	< 10	100
	10-18	133
	18-26	166
	> 26	200

Table 3.Soil layers and relative Scores

Layer	Classes	Scores
Soil EC (mmho/cm)	< 4	100
	4-8	120
	8-16	140
	16-32	160
	32-64	180
	> 64	200
Soil SAR	< 8	100
	8-13	125
	13-30	150
	30-70	175
	>70	200
Soil Texture	Course	100
	Medium	125
	Medium - fine	150
	Fine	175
	Very fine	200
Soil Organic Matter	> 3	100
	2-3	125
	1-2	150
	0.5-1	175
	< 0.5	200

Table 2. Land use and relative Scores

Land use classes	Score
Agricultural lands	100
Range lands	133
Range lands (poor and degrade)	166
Barrennless	200

Results and Discussion

The results have been showed in 1 to 3 figures, and fig 4 shows the ESA map.

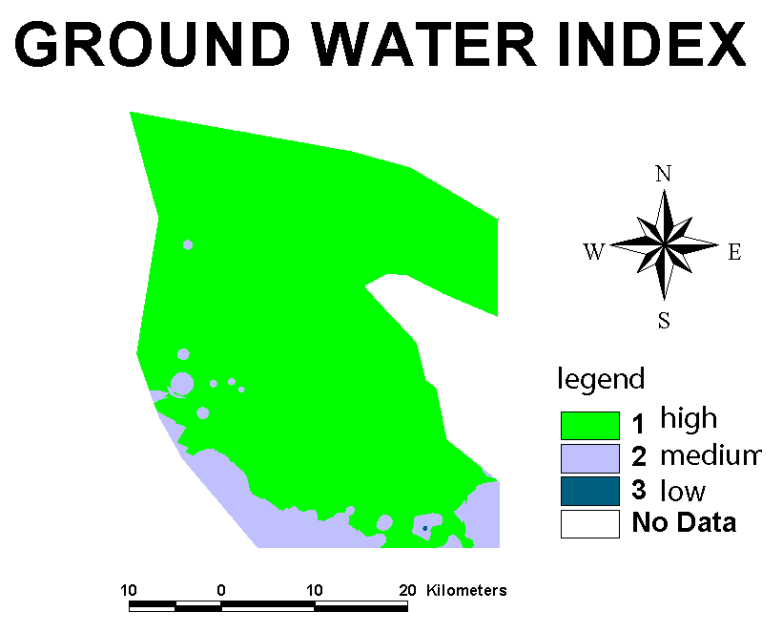

Figure 1. Map of Ground Water Index

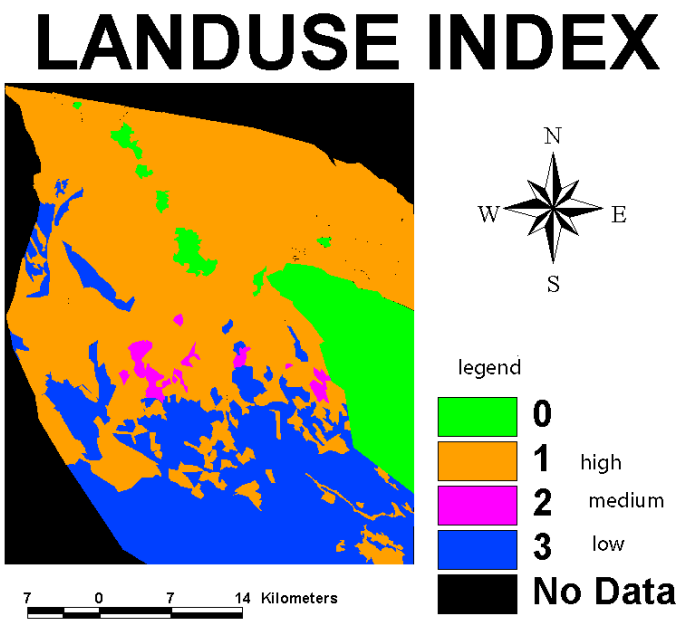

Figure 2. Map of Land Use Index

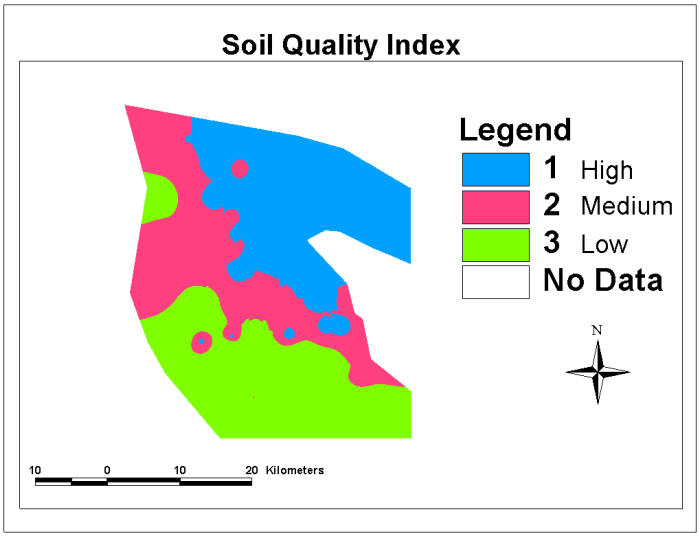

Figure 3.Map of Soil Quality Index

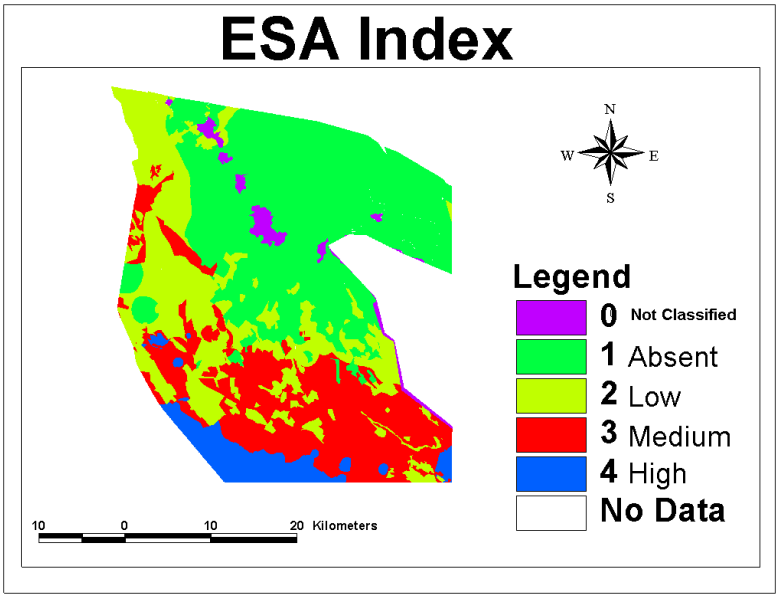

Figure 4. Map of ESA Index

The map of ESA index shows that in the central part of plain and along the northeastern it, there isn't any risk of desertification. But in the south western and in the limited area in southeastern the risk of desertification is high. And the others part of plain the risk of desertification is low to high.

The results shows that from the total area of plain about 58 134 ha is in the Absent class, 33 578 ha is in the low class, 31 665 ha is in the medium class and about 7 812 ha is in the high class and about 2859 ha is not classified, because these places are city, Village or water body.

With attention to the above results, although in 1 class the risk of desertification is low but the management in these lands are very necessary and important because these lands are generally of rangeland and also agricultural (the fallow is the most) and may be in affect of mismanagement, change to medium class. And in the south of plain that are medium to high classes, generally have drainage problems and also salinization; therefore we should be restrain of desertification speed with the soil improvement and others planning in these lands.

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