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A Research on Technogenic Desertification Indices (Case Study: Yazd)

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Abstract

There have been different indices identified for desertification. Among these is technogenic desertification index which seems much more efficient. In this study, some of technogenic desertification indices were studied and evaluated. First land use maps of the region were taken from IRS-PAN satellite image and aerial photos analysis. After evaluating the area of different uses, lands that had productions (like agricultural and horticultural lands) were taken apart. The ration of production per surface unit was also calculated. The region roads map was also derived from satellite image. Finally per capita production, road and mine density and per capita green space indices were used. The per capita production index 9.1, population pressure with 59, road and mine density with 3.6 km/km^2 and green space with 18.2 m^2 for each person were the other indices calculated. According to the proposed table on these indices, per capita production and per capita green space in the region show very high level of desertification but road and mine density identifies lower level.

Keywords: Land use map; Desertification indices; Technogenic desertification; Per capita production; Road and mine density; Green space

1. Introduction

Studies on quantifying the desertification are in a high level of importance. You should consider that in most of studies, the quantibility of factors, increases their value and lowers the possibility of errors and risk of personal ideas. You can also compare different time and region in your studies.

Nowadays, desertification is known as a fact that treats different regions of the world. To proof this, series of studies were done to show the desertification ratio and the condition of degradation in different parts of the world. Researchers believe that you can study desertification only if its indices are given. But it has not been possible to evaluate these indices, to use them in international, regional, national or local stage and they are not widely accepted (Akbari, 2004).

Studies that were performed in Iran showed that the most important factors of desertification in Iran are: destroiment of a forest and range land, over using from ground water resources, mining, road making, municipal expansion, etc.

Ekhtesasi and Ahmadi (2005) and Tazeh (2004), proposed the indices: ratio between potential population and real population, road-mine density in km/km2, green space (parks, house gardens) per individual in the region, etc., to analyze current state of desertification.

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Shahidi Hamedani (1998) counts the following factors for desertification in Dashteh Nahavand: Extreme pasture changing to ranches, insufficient management, extra exploitation of mine matters, over use of new technologies in agriculture, population growth, etc.

Babaev (1999) has reported that almost the whole area of Iran (more the 80 percent) is desertifying and factors that cause this are: extreme pasture usage and wind erosion.

The region area is about 2100 hectares and it's placed between 54 degrees and 15 minutes to 54 degrees 25 minutes in east and 31 degrees 44 minutes to 31 degrees 56 minutes in north and a surrounds the city of Yazd. The average fall in this region, according to lost 20 years statics, is 64 millimeters and the average temperature has been 11.2 to 20.7 degrees Celsius according to records. We can count the followings as the natural restricting factors: high temperature, low rainfalls, high level of dehydration, dry deserts, shortage of water, frosting, etc.

2. Materials and Methods

One of the tools that are needed is land use map. Because of different land uses and its effect on desertification process, we used 1:4000 aerial photographs taken in 1982 and PAN pictures from IRS satellite taken in 2002.

Researches showed that statistics and numbers are not exact and the changes process has not been well registered, In order to get exact results, we used the area of agricultural lands to calculate the percentage of production in these lands,

After analysis and comparing aerial and satellite photographs and images, the land use maps were published as below: municipal lands, agricultural lands, horticultural and etc. According to the percentage of agricultural lands and ratio of output per meter, the ratio of production in agricultural and horticultural lands was calculated.

In this calculation, a wide area of agricultural lands was used to grow grass, so we took the percentage of livestock in the area in our calculation too.

For studying the road–mine density index, we used road with different rates, we rated main roads with 3 and the others with 2 or 1 and finally took the average of them in our calculations. Finally, in measuring the green space including parks, house gardens and gardens, we calculated the average green space per individual.

3. Result and Discussion

After researches and using different analyzing factors and also comparing satellite images, land use map for the region was prepared as presented in Figure 1 and Table 1.

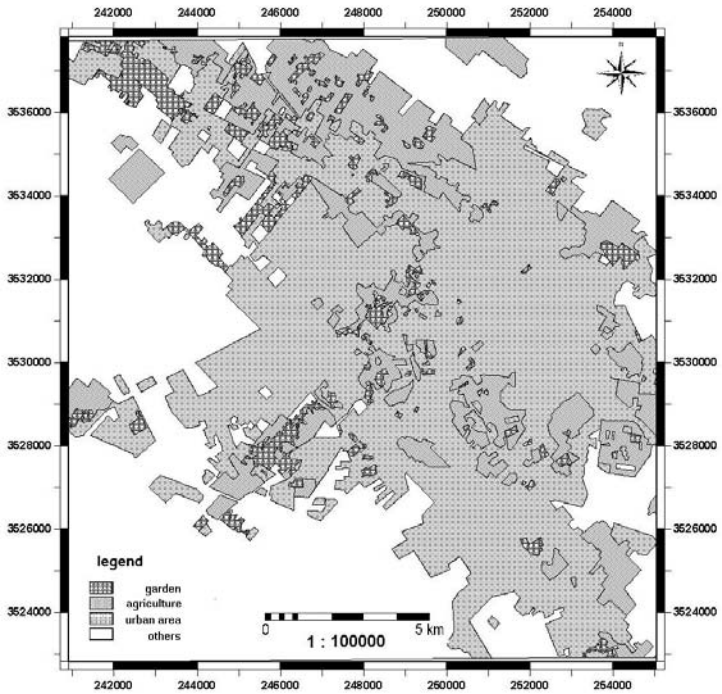

Fig. 1. Land use map of the study area

Table 1. The area of different land uses in the region

Land use	Agriculture	Horticulture	Urban	Others
Area (ha)	3075	695	6739	10550

The other map analyzed is the roads map of the area that was divided from high contrast satellite photographs.

Using the above maps, the following factors were produced as technogenic desertification indices: Population pressure per capita production in calories, road-mine density and green space per individual (Figure 2).

Per capita production of the annual production in the study area is 3486103kcal/year and every person needs about 547.8 k cal/year, and about 380127 people live in the area. According to this information, per capita production is 9.1k calories.

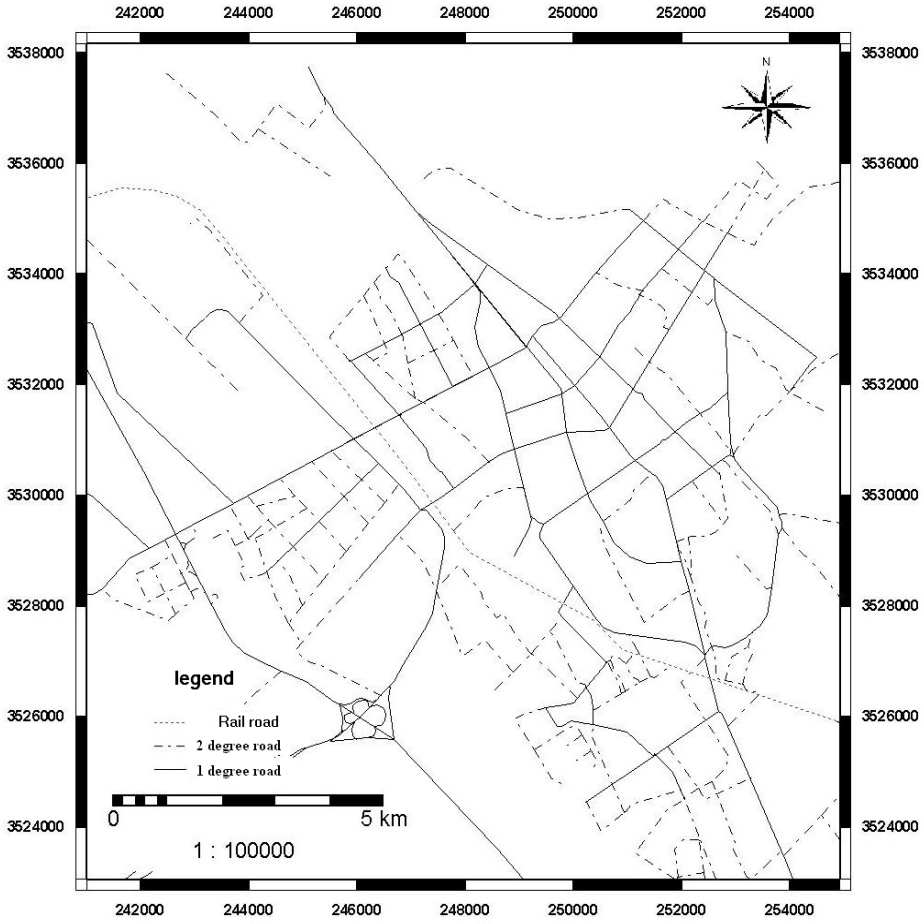

Fig 2. The roads map of the area.

Table 2 was also used to define the indices domain in the area.

Table 2. The current technogenic desertification indices

Index type	The current desertification status			
	Low 0-25	Maximum 15-50	High 50-75	Ultra high 75-100
Population Capacity ratio	Below0.5	0.5-1	1-1.5	Above 1.5
Road-mine Density km/km2	Below 10	10-20	20-40	Above 40
Green space per individual	More than 100 m2	100-50	50-20	Below20
Per capita production kcal/ year	More than 400	400-200	200-50	Below 50

By studying the proposed tables and maps, the given numbers were analyzed and validated. The acceptance ratio of potential population to the current population: to finalize this ratio, we used the ratio between the current population and the population that could live in the area, 'the current population can be found in statistics, bat to estimate the potential population we can calculate the production in the area and from that we can find the produced energy per individual, By dividing this to the annual need of energy per individual, we can find the value of this parameter. Current population in the area is 360127 and numbers of individuals that can live there were calculated by dividing the whole energy the needed energy for one individual.

As everyone needs 1500 calories in average for one day, we need 547.8 kcal in one year, According to the above population; per capital production is 9.1 kcal. Researches showed that the annual production is 3486103 kcal and can be enough for 6367 individual, considering the current population; the region is in an ultra-high level of desertification (Beyrodian, 2001).

Road-mine density: to find the value of this parameter, we can use roads map of the area; so, we divide the length of road, in km to the area of the region in km? the resulted number is calculated considering the importance of the roads and is 3.8 km^2 and does not play an important role, 'green space per individual: this factor is calculated by dividing the area of parks and other green spaced to number of individual living the area.

4. Conclusion

After gathering and analyzing the information, we begin rating the technogenic desertification indices. Per capita production: considering the annual production of the region and the population of 380127 individual in the city, the per capita production gets 9.1 that is an ultra-high level.

Road-mine density: By using corresponding coefficient, the value of this index is 3.8 km/km^2that is in a low level.

Green space per individual: considering that the green space area in the region is about 695 hectares and the area of the whole region is 2056 hectares and the foresaid, population, this index value is 18.2 m per individual which is in ultra-high level.

The population pressure: the produced calorie in the region is 348313 and is sufficient only for 6367 individuals. By dividing this amount to the current population of the region, the number 59 will be achieved that is in an ultra-high level.

The above indices show that current expansion of municipal space and destruction of agricultural lands, mining and road construction indices have high level of importance in technogenic desertification because each of them affect the decrease of biomass in dry regions and then accelerate the desertification.

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