Early Warning System for Desertification in I. R. of Iran

(An Application of GIS and Remote Sensing)

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Abstract:

Desertification is one of the main global environmental phenomena. It has resulted in deterioration environment and poor economy, and imposed threat to the surviving environment of the overall mankind. Therefore, creating of methods for monitoring and estimate of risk desertification are necessary. Early warning system is one of important ways for monitoring and forecasting of desertification. Remote Sensing and GIS technology are as suitable tools and methods for early warning system. In this aim, we have evaluated of applications of remote sensing and GIS in monitoring and estimating desertification process (case study in Fars Province of Iran). In this research, we have considered erosion and vegetation cover parameters as main factors affecting in desertification process. The result shows that remote sensing and GIS technology could be useful in evaluation of desertification as one method for desertification early warning. Also, Results suggested that erosion and plant cover are affecting in develop the desertification process in study area.

Keywords: *Early Warning System, Desertification, Remote Sensing, GIS*

Introduction:

Early warning systems are technological instruments for detecting and forecasting impending hazard events and for issuing alerts but for fulfilling the risk reduction function, they need to be complemented by information on the actual-risks posed by the hazards and likely mitigation strategies. Subsequently, this information needs to be communicated to the vulnerable groups for it to become a holistic exercise. As such, the early warning mechanisms comprise of warning, risk information, preparedness and efficient communication. Early warning systems facilitate national disaster management agencies in decision-making. In addition, early warning is among the most cost effective measures for improving human security against natural disasters. It is self evident that early warning has to be an integral part of managing the risk from natural extreme events. Establishing of a disaster early warning system require the development of both local and national risk information capabilities and use of relevant technological applications for rapid and improved warnings. Satellites through their continue coverage of the globe; provide essential information that can lead to rapid and effective detection and interpretation of many hazards.

Desertification is from main natural hazards. Desertification is *"land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities"*.

I. R. of Iran is one of countries that are affected by desertification with serious adverse impact. Desert lands cover about 78 million ha of Iran's terrestrial lands. Therefore, it is important for protecting natural resources and combating desertification.

Geographic Information System (GIS) and Remote Sensing (RS) are techniques that use in early warning systems.

Geographic Information Systems and Remote Sensing have immense scope for wide range of applications in natural resources and environmental management. These technologies provide many tools to deal with the complex relationships between different biophysical and social processes.

In this paper, we were considered plant cover and erosion (wind and water) as most important factors that affecting on desertification process in the study area (natural factors of desertification), and assessment of desertification process by using of GIS and RS technologies.

Materials and Methods:

To aim of assessment of desertification process we have been followed below steps:

1) An area of 43000 ha has been selected in Larestan plain located in Fars Province of Iran as case study (52° 37' - 52° 59' E and 27° 56' - 28° 08' N) (Fig. 1). The highest mean monthly rainfall is 81.6mm. The mean annual rainfall in a wet year is 300mm and 50mm in a dry year. The hottest month is July and the coldest is January, with a mean monthly maximum and minimum temperature of 46°C and 4°C respectively, where affected by erosion.
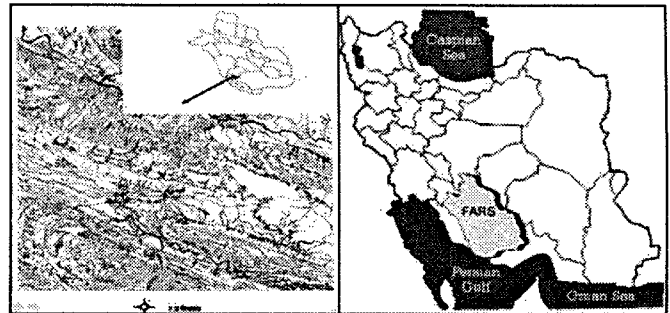

Fig. 1: The position of study area

2) Then, using topographic maps (1: 25000), aerial photographs (1: 55000), especially Landsat satellite images (ETM$^+$ with color composite of 4-3-2 for evaluation of plant cover and 5-4-3 for evaluation of geology and soil) were identified slope regions, geology map and geomorphology facies (Fig. 2).

3) We have been considered geomorphology facies as study unit that identified 27 facies in study area, contain two main unit that called of mountain unit and glacis unit. Then, Information on plant cover and erosion were collected according of study area.

4) Ultimately, have been combined plant cover map and erosion map, and prepared of desertification map for study area (Fig. 3).
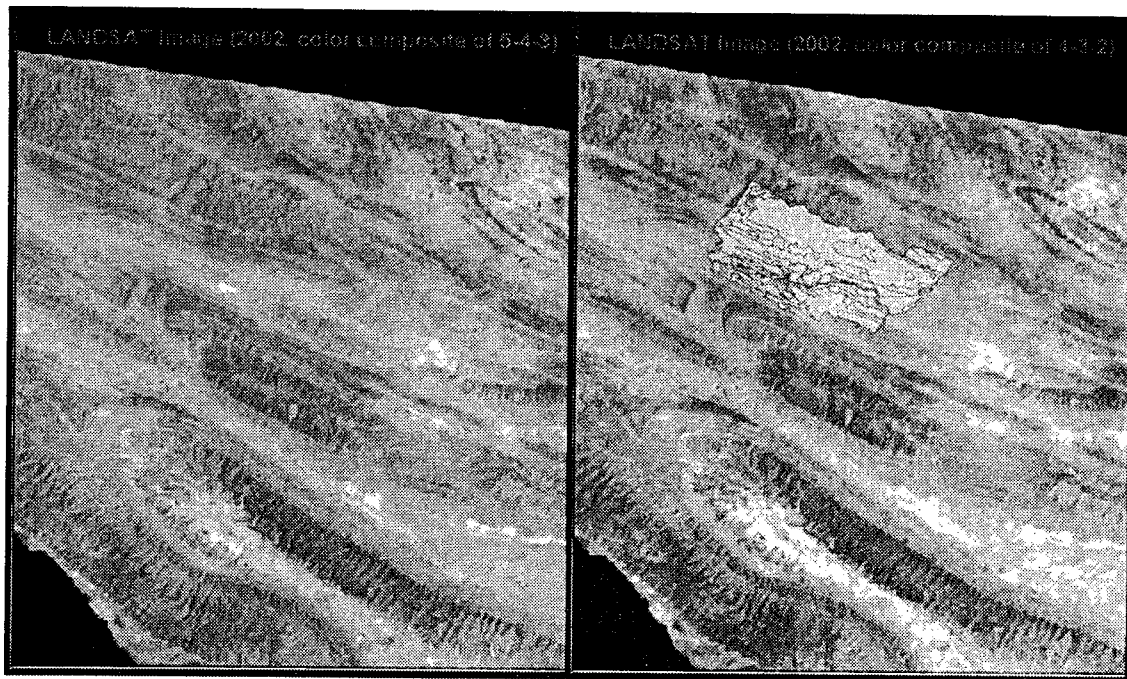
Fig. 2: Image of LANDSAT (ETM$^+$, 2002) for
investigation of plant cover and geology.

Results and conclusions:

The results showed that the desertification severity studied area was 5.5% as low severe, 87.5% as moderate severe and 7% was high severe. Plant cover in area was poor and consequently erosion was high. These results showed that plant cover and erosion were the most important parameters leading to desertification in the studied area.

Results indicated that Remote Sensing and GIS can be useful in assessment of desertification as tools of early warning system. Although, desertification map shows severe of desertification process in the study area, it should be noted that the final prepared map was based on the available data. We considered only natural factors that affecting on desertification process in the studied area contains plant cover and erosion. Therefore for evaluation of total desertification hazard should be calculated natural factors and demographic parameters.

Consequently, it shows an overall picture of the study area, but there is scope for minor improvements whenever more recent data is available. Considering the above results, although in D_1 class the risk of desertification is low but the management in these lands is very necessary and important. Therefore we should be restraining of desertification speed with the correct management and combating desertification policies.

Remote sensing is a cost- and time-efficient way to determine the spatial characteristics of desert-derived mineral aerosols, desert soils and vegetation, and land use and land degradation in arid regions. The use of remote sensing to understand land use and land degradation is a common goal in modern research. Nonetheless, special complications are presented when using remote sensing to look at soils and vegetation in deserts.

The integration of GIS and RS can be useful in researches of natural resources management. They can be used to observe, map, assess and monitor features and

phenomena on the earth's surface. In addition these technologies are as part of tools for early warning system.
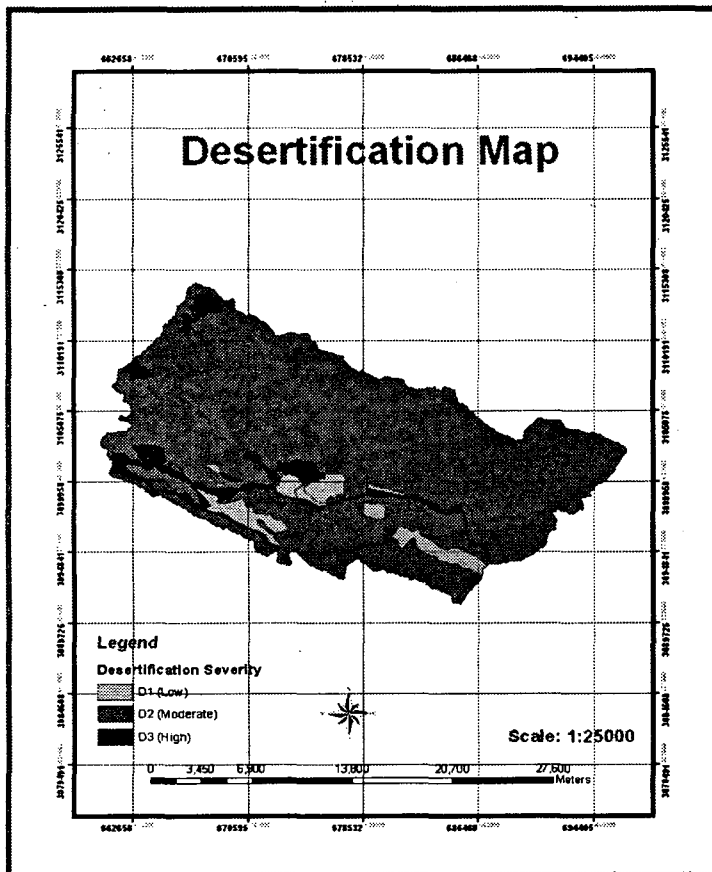

Fig. 3: Desertification Severity Map

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