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# Assessment of The role of geological structure on Desertification in Sistan Plain

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**ABSTRACT**

Natural environmental conditions of Iran and its geographical location that falls in the arid belt in one hand, and overuse of non renewable resources in the other hand, cause series of problems and conditions that brings the country into a rapid deterioration. the two main factors of degrdation are natural factors and human factors. Of major natural factors, three factors are notable: climatic, geomorphologic and morphologic. In this study to evaluate the desertification condition regarding to local conditions of the study area, two processes of water and wind erosion were selected and assessment of desertification condition was conducted Based on these processes, wheightening indicators and MEDALUS model. The results showed that Qs and NQts all responsible for much of sentiment delivery and erosion and as a result, desertification severity of these two geological units considered as severe and very severe.



## Introduction

Today desertification is a challenging problem in the majority of countries, especially in the developing world so that it includes not only the semi-arid but also subhumid areas. According to the much definitions, desertification refer to all the processes that arise from both natural and anthropogenic causes and defined as: decrees in land productivity potential due to effects of one or more combind processes like water and wind erosion, destruction of plant cover, destruction of water resources, water logging, salinistation, sodificion, etc. that endorsed by human activities and the natural factors (Chaman Pira, 2003).

Based on updated statistics, more than 20.2 million hectares of global croplands and rangelands is converting to desserts annually. Arid and semi-arid areas in Iran call where 80% of land surface and more than one-third of its surface is exposed to the desertification. In addition development plans and rapid growth in population cause a high pressure on such fragile environment, increase the rate of desertification and promote the nregetive natural factors such as climactic, morphologic and geologic.

Ladisa et al (2002) considered six indexes for assessing desertification in Bari region, Italy. The six indexes include soil, climate, vegetation, landuse, management, and the human pressure indices. Finally, trough geometric mean the desertification map was obtained (Yuassogoalu, 1995).

Jiardao et al (2002) used MEDALUS model to evaluate desertification in Sisil region of Italian. After modification and rebuilding the model, four indices were selected that includes soil, climate, vegetation cover and land management. the results indicated that for more than 50% of the land surface, desertification is a high to moderate (Yuassogoalu, 1995).

Wang et al (2005) assess the discrepancies of seven indices in a 50 year period results indicated that both human factors and environmental factors have an important role in desertification.(Nikeghbal, 2005).

Ghasemi (2006) evaluated the desertification condition in the Zabol area using MEDALUS model.

Azadnia (2006) includes MEDALUS model to measure the role of soil and water in desertification of Einkhosh reason at Dehloran (Azadnia 2006).

## Material and methods

### Location of the study area

The area that was studied in these research is 69.281 square kilometers laying between 61° 28’ 31” to 61° 44’ 0” E and 31° 12’ 0” to 31° 28’ 0” N. this area contains deposition section of Hamun Sistan lake the sediments back to late third era or miosen to present age. Because of the recent drought, the level of water fall dramatically and find sediments of lake bed has came into view. In Sistan plain because of dominant geologic conditions that is a peaceful and downward trace, there is no evidence of past geologic units and sediments (except quatrnary) and for this reason no statement regarding the foldings, stratigraphy, discontinueties, degarshib Can be declared.

Sistan plain with its eastern parts in Afghanistan forms the Hirmand delta. In the last geologic phases as movement of Alpine phase was started, the delta filled with sentiments and alluvials of Hirmand and other rivers and formed the present morphology. The depositions of Sistan depression orderly from older to newer include SIVALIC formations, mainly of Pliosen, alluvial sands and clays of pliestocen. ( Miri 2005).

After reviewing MEDALUS, ICD, MICD, FAO-UNEP and quantitative models and also remote sensing methods, we selected MEDALUS to evaluate and mapping the current

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desertification condition with a special emphasis on water and wind erosion indexes. The main reason for selecting MEDALUS was its higher accuracy, less error and use of the geometric mean instead of arithmetic mean.

The methodology that we used in this research include 1) gathering basic maps, geologic, topographic and morphology data (TM images of year 2002 and filed surveys). All the required maps obtained using satellite imagery and ILWIS academic 3.1, ArcGIS 9, Arcview 3.2 softwares. In the first step for field surveyings, boundary shifts and local synchronization (adaptation) have been done. 2) determine the best indicators of desertification: after sufficient evaluation and checking, suitable indicators and indexes were selected based on local conditions.

Indexes that considered for the water and wind erosion indexes are as follow:

Indexes for water erosion indicator: type and density of water erosion, drainage network, dominant land use, percent of vegetation cover during the growing season. (synthesis report of desertification indicators and indexes, 1999).

Indexes for water erosion indicators: emerge of wind erosion facies, determination of erosion intensity, dead vegetation cover or plant cover percentage, dusty days. ( sinthesys report of desertification indicators, 1999).

Regarding different levels of erosion in the study units, above mentioned indicators of classification can not present effectively the state of desertification condition.

Considering the role of erosion in desertification, it is clear that classes of desertification intensity are mainly based upon the geologic structures and in turn on soil erosion intensity. The more the soil erosion, the more the intense desertification.

Taking into account above mentioned issues, final map according to propose table 1 was obtained. ( map 1).

Then the assessed and evaluated the desertification classes along with the role of geology structures in this classes and finally the erosion rate of area was estimated.

**Results**

Geologic units of the study area are owned to late neogene and quaternery. According to Feiznia classification, the units are as found in table 2 and Qs unit is very sensitive to wind and water erosion.

Amount of sedimentation due to water erosion is 2.06 ton/km2/year which is a low erosion class according to PSIAC model. This amount of erosion is of Qal unit that lyed around the Niatak river and according to IRIFR model, mean annual sedimentation is 6202.57 in which NQTs, Qs and Qls1 have major contribution.

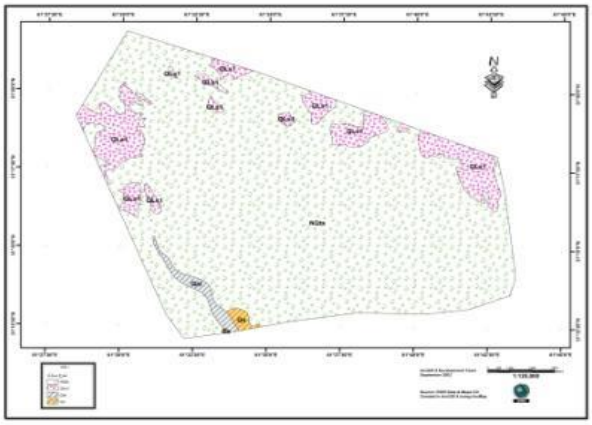

**Figure one. geology units of the study area**

Figure two. current desertification condition with emphasis on water and wind erosion

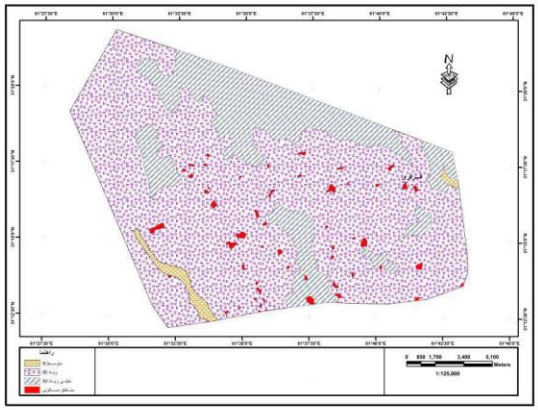

Figure two. current desertification condition with emphasis on water and wind erosion indicators using a modified MEDALUS model in Ghorghori region, city of Zabol.

**Table one**

**Table(1):classes of desertification intensity proposed in $ESA_S$**

| Desertification severity cllass | Current desertificatin condition | Valu domain | NO |
|---|---|---|---|
| I | Low to non-sensible | 1 to 1.65 | 1 |
| II | moderate | 1.66 to 2.1 | 2 |
| III | high | 2.11 to 2.6 | 3 |
| IV | Very high | 2.61 to 4 | 4 |

| Geologic score according to IRIFR | Resistance coeficient according to PSIAC | Area of geologic unit (km2) | Geologic properties | Geologic unit |
|---|---|---|---|---|
| 5 | 7.5 | 248.14 | Fine grain old sediments | NQts |
| 4 | 10 | 3.16 | River bed sediments without cement | Qal |
| 7 | 8 | 29..18 | Fine sediments of lake bed | $Qls_1$ |
| 10 | 9.5 | 1.2 | Sand dunes and sand seas | Qs |

Type II : this type has area of 4 square kilometers include northern parts of Niatak river and belongs to Qlsl unit. Soils of this type falls in the Entisol order. Northern parts is classified as Typic Torrifluvents suborder while southern parts belongs to Typic Haplosids. This type has moderates desertification severety according to the final map.

TypeIII: This type occupy 214.68 km2 of the study area and includes Kavir the clay flats and lyed in the majority pars of the study area especially central regions. That's considered as a hyper arid region and contains Qlsl, NQts, Qs units at the eastern and central parts and Qs , Qlsl and Qal at western parts. General reliefs is not considerable. Moisture regime is Aridic and thermal regime is Hyperthermic. Central and eastern parts of the type have hydrologic group of B while in western parts, hydrologic group of D is evident. Soils of this type belongs to Entisol order which in the western parts are Typic Torrifluents and in central and eastern parts are Typic Torrifluent and Typic Haplosids suborders.

Type II: this site has an area equal to 63.01 square kilometers and located in northern part of the study area. It encompasses Apandage pediments and covered pediments and it's climactic is hyperarid. From the geologic point of view this type includes NQts and Qlsl units at north and Qls1 units and south. General conditions of soil also indicate that reliefs is little and not consoiderable. Moisture regime is aridic and thermal regime is hyperthermic and hydrologic group is C. the soils of this type are of Entisol order. Suborders are Typic Torrifluents at north and Typic Haploolids at south. Regarding final map, this typy has high desertification severity.

**Discussion and conclusion**

Among the geologic units of the study area, NQts with 248.14 square kilometers area has the greatest surface, but in terms of sedimentation the units of NQts and QS have the most erosion and as a result the desertification severity class for these two units is a high and very high.

QS geologic unit is very sensitive to wind and water erosion and because of recent drought, wind erosion has a great contribution in sediment production while water erosion is not noticeable.

Qal unit produce the least wind blown sentiments and falls in the moderate class of desertification severity. The amount of annual sediments delivery that arise from water diversion is 2.06 ton/km2/year that according to PSIAC model, it would be considered low erosion class. But according to IRIFR model, average special sedimentation is 6202.57 ton/km2/year that indicates severe wind erosion in the region. After plenty analysis, it observed that properties of geologic units have remarkable effects on desertification severity of the region.

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