The Comparison of ICD and MICD Models for Assessment of Desertification in a Desertified Pilot Region, Iran

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Resume

There are different models for mapping and evaluation of desertification condition, such as global FAO_UNEP model. There are also several models for evaluation of desertification in Iran. In this study, tow following methods was used: 1- ICD method, (Iranian Classification of Desertification), 2- MICD method, (Modified Iranian Classification of Desertification).
In this research, at first, these models were considered and indices and factors were improved. Then, working unit map in this region was made by geomorphologic method and land use of each working unit was determined. This map has 14 working unit. At last, evaluation of desertification condition was determined in this region by ICD and MICD methods. The results methods were:
- In ICD method, from an intensity of desertification point of view, Fakhrabad-Mehriz region is in low and medium classes. In this region the low class is about 82351 hectare (91.59%) and the medium class is about 7565 hectare (8.41%) of total area. In MICD method, this region has four classes of calm, low, medium and high. The calm class is about 33327 hectare (37.06%), low class is about 8346 hectare (9.28%), medium class is about 37245 hectare (41.42%) and high class is about 10998 hectare (12.23%). According the results of this investigation and by comparing them with the condition which have been observed in the Fakhrabad-Mehriz region, the MICD is better method for evaluation of desertification condition in this region.
Keyword: Iran, Desertification, ICD, MICD, Desertification assessment

Introduction

The study area is about 89916ha and located on 25 km southeast of Yazd city. It located on 31º 25´ 55´´, 31º 42´ 46´´ latitudes and 54º 03´ 02´´, 54º 33´ 15´´ longitudes. Fakhrabad-Mehriz basin is a part of great Yazd-Ardakan plain. Iranian Classification of Desertification (ICD) and Modified Iranian Classification of Desertification (MICD) were selected to evaluate current condition of desertification (with emphasis on wind erosion processes) in the studied area.
The objectives of current study are as follows:
1- Investigation of efficacy, advantages and weaknesses of ICD and MICD methods
2- Preparation of the current condition of desertification map with empasis on wind erosion in Fakhrabad-Mehriz basin
3- Determination of major and secondary factors of desertification in each region
4- Introduction of the benchmarks and indicators of desertification in the study area.

Materials and methods

Steps of desertification assessment based on ICD method:

1- Determination the types of deserts: Several base maps of landuse and vegetation cover of the region were considered to determine natural desert landscapes and then, work unit map consists of geology, topography and geomorphology maps was prepared (Table 1).

Table 1: Classifications and symbols of natural landscapes in ICD method

Row	(Land escapes)			Symbol
1	Lands covered with vegetation	Natural vegetation	Forest	**P/F**
			Range land	**P/R**
		Forest plantations	Forest	**ap/f**
			Range land	**ap/R**
2	(Bare lands)		mountain	**m B**
			Salty	**s B**
			clay	**c B**
			Hamada	**b**
			bad land	**b B**
			Active sand dune	**s.d B**
3	(Agricaltural land)		Irrigation	**I A**
			Dry-farming lands	**Ni A**
			habitat & building	**A/b**

The criteria used for assessment of desertification condition include environmental and anthropogenic factors as well as desertification indicators. Within this frame work, several factors and sub-factors were considered and modified as follows:

A: Climate: This factor includes two sub-factors including climate and length of drought period. In ICD method, the length of drought period is assessed by qualitative factors while in the modified model, the factor is scored using number of dry years within a drought period.

B: Geomorphology: In the modified ICD method, geomorphology was replaced by topography consisting of slope factor. Because of the reverse effect of slope on water and wind erosion and since changes of vegetation cover have similar effect on both water & wind erosion, the slope factor was classified and scored based on its effects on soil and vegetation cover establishment to evaluate its role in desertification.

C: Geology: Rock susceptibility and resistance to erosion was considered in the modified ICD method. To reduce errors in scoring, standard tables introduced by the Iranian Geological Survey were used for evaluation of rock resistance.

D: Soil and water resources: In the ICD method, this factor has two sub-factors including quantitative and qualitative limitations. These sub-factors have been scored qualitatively. In the modified ICD approach, soil parameters are evaluated quantitatively. Because of the important role of soil on vegetation cover and desertification, some other parameters of soil were considered in the modified method. So, six sub-factors for soil and two sub-factors for hydrology were introduced. In order to reduce errors, scoring was done quantitatively.

Anthropogenic factors contributing in desertification

A- Management: Degradation of vegetation cover is considered as an important factor in ICD model which includes sub-factors such as shrub and trees removal, livestock grazing, reforestation and inappropriate agricultural techniques. In the modified ICD, management factor consists of degradation of vegetation cover and land resources to score each factor separately.

Benchmarks affecting desertification

A- Soil erosion and degradation: ICD model includes four sub-factors such as water erosion, wind erosion, salinity increase and erosion intensity. To avoid repeated scoring of erosion

intensity, this sub-factor was ignored in the modified ICD model and some other sub-factors were added to it.

B- Combating desertification feasibility: This factor includes needed measures and implemented activities. In the modified ICD model, the former sub-factor was not changed but much consideration was focused on the negative impacts of combating desertification activities. Three points should be considered in this process:

1- If there are no features of each factors in the tables of modified ICD method, the score of a given factor will be considered "Zero" .

2- High range of scoring (0-2, 2-4, 4-7, 7-10) in ICD method was a major source of error then it was replaced by a new range of scores (0-1, 1.1-2, 2.1-3, 3.1-4) in the modified ICD model.

3- In ICD method, for the areas in which the role of anthropogenic factor on natural vegetation cover is limit, scores are not allocated and the obtained scores of the environmental factors are multiplied by two. This logic is not coincided with the reality. So, in the modified ICD, zero was given to such areas in which human has no effect on desertification. In ICD, in order to assess desertification, each factor and benchmark was given a score and finally environmental and anthropogenic factors were summed to obtain a final score for each working unit. Then, according to the standard tables which categorize different classes of desertification in each working unit, desertification status was identified. In each working unit, the major and sub-factors which obtain the highest score, are introduced as the most effective factors and sub-factors on desertification in each working unit.

Results

Preparation method of desertification map

All working units having similar intensities of desertification are categorized under homogenous groups. The class of desertification intensity, natural landscape, type of desertification (anthropogenic "A" or environmental "E") and sub-factors are as follows:

The stages of desertification evaluation on the basis of the modified ICD method (MICD) for Iran (with emphasis on wind erosion)

MICD method is capable to evaluate both current (current potential) and natural condition of desertification (natural potential) in a certain region. In this research, current condition of desertification in Fakhrabad-Mehriz basin was evaluated based on wind erosion processes and the final map of desertification was prepared.

According to this method, landuse classes were determined as:

1. Forest and rangeland,
2. Agricultural lands and
3. Areas with no land use.

Then, scores of each index within the working units were selected to determine current condition as well as class of desertification. Because of difference in scales of indicators, it was not possible to use a unique classification. In this case, indicators were rescaled. Soil texture indicator was added while vegetation cover density and surface gravels (>2mm) for forest and rangelands were classified in a similar level. Total score of each working unit was obtained based on the summation of scores related to each indicator which classifies and determines desertification intensity for each working unit (Table 2).

Table 2: Classes of desertification intensity

Desertification intensity	Score	Symbol
Slow	0-5.6	I

Low	5.6-11.2	II
Medium	11.2-16.8	III
High	16.8-22.4	IV
Very high	22.4-28	V

The working unit map of the region was prepared using geomorphology method which includes 14 units.

Discussion and conclusion

Based on the results of current study, ICD has the following advantages:

1- It is in accordance with Iran conditions

2- It easily determines the type of factors including anthropogenic and environmental ones contributing in desertification for future planning

The method has also limitations as follows:

1- Qualitative - based scoring of some indicators decreases the accuracy of the model

2- High range of scores of different classes causes differences in opinions among experts

3- A variety of factors and their interactions decrease effectiveness of the model

4- Some factors of ICD model are scored repetitively

5- The natural factors in areas having no vegetation cover are scored twice.

This study attempted to solve the mentioned limitations. Based on the results, the study area was classified in low and medium categories. About 82351 ha (91.59%) of the area has low class of desertification while 7565 ha (8.41%) is in medium class.

MICD has the following advantages:

1- Selection of indicators for desertification is based on type of land use.

2- In the modified method, desertification intensity is assessed separately with emphasis on processes. Only, the factors are evaluated which are effective. To avoid interactions of different factors, other ones are not assessed.

3- The number of indicators used for different landuses are not the same. To resolve this problem, all indicators were balanced.

Based on the results of MICD method (with emphasis on wind erosion processes), the study area covers following conditions:

1- Slow; 33327 ha (37.06%)

2- Low; 8346 ha (9.28%)

3- Medium; 37245 ha (41.42%)

4- High; 10998 ha (12.23%)

The comparison of the results showed considerable differences between two methods. ICD method categorized the area in two classes while MICD showed four classes. The reason is due to interaction among different factors in ICD method which underestimates desertification intensity. In water erosion model, it is possible to compare the predicted values with the recorded data but in assessment of desertification, the results of the model must be compared with the current condition of the area. Therefore, the results showed that MICD model is more appropriate for evaluation of desertification in this region.

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