# Investigation of Wind Erosion in Khousf Plain of Iran by IRIFR.E.A Model

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## Introduction

Wind erosion not only results in destruction of soil structure, but also affects land production potential ( Lopez, 1998). Thus wind erosion is considered to be a principal mechanism of land degradation ( Hennessy and Kies, 1986 and Okin et al., 2001) and is one of the most serious environmental and agricultural problems in many arid and semiarid agricultural regions of the world ( Gomes et al., 2003). Although it is not a new phenomenon, wind erosion is currently recognized as a major source of environmental degradation. Areas of wind erosion have increased, and current knowledge of its environmental and economic impacts suggests that appropriate measures need to be taken for soil protection ( Pimentel et al., 1995 and Saxton, 1995). Research on wind erosion has increased in recent years ( Gomes et al., 2003). Farmland soils are vulnerable to erosion by wind in arid and semiarid regions because such soils are relatively coarse-grained and generally lack crop coverage in the windy season ( Su and Zhao, 2003 and Li et al., 2004). Over the last 40 years in Iran, about 14000000 ha of Natural land have been damaged by wind erosion each year. Wind erosion models are used for a variety of purposes including estimating the on-site and off-site consequences of wind erosion, as well as for designing erosion control measures. Because of their widespread use, it is imperative to validate the performance of erosion prediction models. Iran research Institute Forest and Rang (Ekhtesasi M.R. H. Ahmadi 1994) IRIFR model improved for determining rate of wind erosion in arid and semi-arid region of Iran.

## Materials and methods

### Study area

The study area is located in the Lout Plain sand land (32° 25' N, 58° 42' E,) in the Northern part of Lout Plain, which belongs to the continental arid climate in the temperate zone. Mean annual precipitation is 155 mm, mean annual potential evaporation is 1375 mm, and the mean annual temperature is 15.9°C. The average annual wind speed is 3.4 m s- 1 and mean wind speed in the wind erosion season (summer) is 4.3 m s- 1. The thickness of the soil layer in the farmlands is about 30–45 cm and the soil consists mainly of coarse sand and silt; the C Horizon is sand aggraded during the Quaternary period. Crop monoculture dominates the cultivated land. In this system, the crop is planted at the end of April and harvested at the end of September, leaving the soil bare for about 7 months, from October through April of the following year. Wind erosion is very pronounced during the spring season. From the thawing of the frozen surface in mid-March until the sowing of crops at the end of April, the loose soil surface is dry and bare, and thus extremely susceptible to wind erosion.

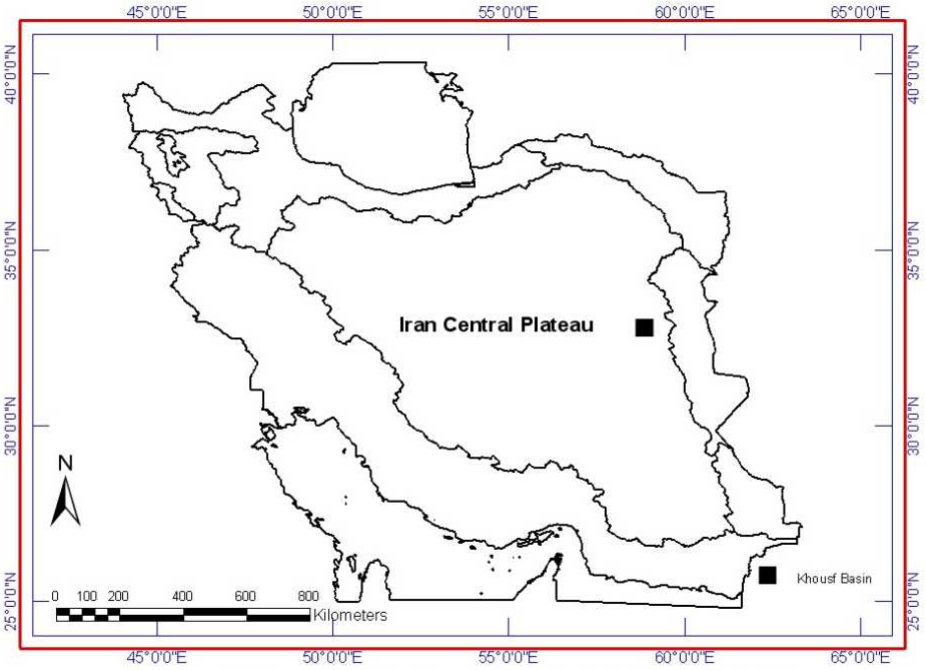


Figure 1 : Geographical location of Khousf basin in Iran central plateau

**Empirical method for estimating aeolian sediments (IRIFR or Black Box)**

In this procedure, geomorphologic studies are conducted to define unit, type and faces of each working unit. Then, the following nine factors were considered to estimate level of erosion and sediment yield (Ekhtesasi – Ahmadi Method 1994)

**The studied factors**

**A) Lithology**

To study rock susceptibility to erosion, rocks of arid regions in Iran were considered in four categories and a score range of 0 – 10 were assigned to this factor.

**B) Geomorphology (Land form and topography)**

Based on the condition of arid region basins, two major units of detachment and sedimentation were studied in three classes and scored as 0 – 10. The most import part of this method is preparing geomorphology map to determine type and faces which leads to more detailed working units based on slope and faces.

**C) Velocity and duration of wind**

Wind is one of the most important factors responsible for erosion and degradation of arid regions. There fore wind velocity and duration was classified into three groups and scored 0 – 20.

**D) Soil and surface cover factor**

Soil texture and cover play major role in resistance against wind *** and four classes were selected with a score range of -5 to 15.

**E) Vegetation covers**

Vegetation cover is the must important factor protecting the land from wind ***. Based on density of vegetation cover four groups were classified and scored – 5 to 20.

**G) Soil moisture**

This factor affects on erosion especially on aeolian deposition and has four groups with a scoring category of 0 – 10.

**H) Evaluation current condition of wind erosion.**

Study of detachment, transportation and deposition regions may help evaluation of wined erosion activities in a region. Then, area and condition of facies in detachment area, distance of transportation region as well as area of erg (sedimentation region) were evaluated in four groups and scored 0 – 10.

**I) Land use and management**

Type of land utilization is an important factor for control of wind erosion. Four groups were selected during this study and were scored 5-15.

**Identification of qualitative and quantitative condition end estimation of wind erosion yield.**

The effective factors on wind erosion include: Lithology, land from, condition and velocity of wind, soil texture and surface condition, density of vegetation cover, effects of soil surface and soil moisture. After evaluation of the effective factors on erosion, the area was classified into five classes and scores of each class was assigned. The class 1 has the lowest score of 25 that shows very low condition of erosion while class 5 with the highest score of 100 has very high class of erosion. Based on the effectives factors on wind erosion scoring for empirical estimating aeolian sediments were considered.

Table1. Determining class of erosion and estimation of sediment yield to wind erosion based on the empirical method IRIFR

| Class of erosion | Quality of erosion | Obtained total score | Sediment yield (Ton/Km$^2$/year) |
|---|---|---|---|
| I | Very Low | <25 | <250 |
| II | Low | 25-50 | 250-500 |
| III | Medium | 50-75 | 500-1500 |
| IV | High | 75-100 | 1500-6000 |
| V | Very high | >100 | >6000 |

Table2. Determining class of erosion based on IRIFR empirical method

| Facies | Obtained score | Quality of erosion | Class of erosion |
|---|---|---|---|
| I | 7 | Very Low | I |
| II | 16 | Very Low | I |
| III | 19 | Very Low | I |
| IV | 16 | Very Low | I |
| V | 7 | Very Low | I |
| VI | 16 | Very Low | I |
| VII | 8 | Very Low | I |
| VIII | 17 | Very Low | I |
| IX | 8 | Very Low | I |
| X | 17 | Very Low | I |
| XI | 62 | Medium | III |
| XII | 77 | High | IV |
| XIII | 82 | High | IV |
| XIV | 56 | Medium | III |
| XV | 91 | High | IV |
| XVI | 57 | Medium | III |
| XVII | 67 | Medium | III |
| XVIII | 105 | Very High | V |
| XIX | 110 | Very High | V |

| | | | |
|---|---|---|---|
| XX | 80 | High | IV |
| XXI | 104 | Very High | V |

**Determining quality and estimation of sediment yield.**

After allocating scores of each facies or working unit of geomorphologic units, the total score of nine factors was determined. Then quality of erosion and annual sediment yield (Ton/$Km^2$/yr) was obtained using Table 1 and shown in Table 2.

$S = 0.41 \exp (0.05 \times N)$

That:

S: Sediment yield (Ton/$Km^2$/yr)

N: Obtained score of IRIFER method

**Results**

As shown in Table 2, Quality of erosion on based IRIFER method in three facies, Bare and desert land with limited vegetation, cover Ploughed or destroyed croplands and floodway is Very high and class of erosion in these facies is V.

**Conclusion**

The research results showed that Empirical method for estimating aeolian sediments (IRIFER E.A.) in study area was a good model for estimating wind erosion and determining of sensitive facies to wind erosion.

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