ESTIMATE AND COMPARISON OF WIND AND WATER EROSION POTENTIAL BY IRIFR AND PSIAC MODELS

ESTIMATION ET COMPARAISON DU POTENTIEL DE L'EROSION EOLIENNE ET HYDRIQUE PAR LES MODELES IRIFR ET PSIAC

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ABSTRACT

Erosion and sediment is one of the major problems in the watersheds in Iran. Bad Effects of wind and water erosion in the short term is not well discernible, but the long term damages are irreversible. In this paper we used IRIFR and PSIAC empirical methods in order to estimate sediment created due to water and wind erosion in Milesefide-Jahan Abad region. This study is in two parts: The first is preliminary studies and preparing work unit map and the second is grading and comparing of nine factors by IRIFR and PSIAC models. The watershed area 561.54km^2 and studies show that the annual soil loss is 17047 ton/km^2/yr, produced partly due to wind erosion (16291 ton/km^2/yr) and partly by water erosion (756 ton/km^2/yr).

Key words: *Water erosion, Wind erosion, IRIFR and PSIAC models, Jahan Abad region, Iran.*

RESUME

L'érosion et les sédiments est l'un des problèmes majeurs des bassins versants en Iran. Les mauvais effets à court terme de l'érosion éolienne et hydrique ne sont pas visibles, mais les dommages à long terme sont irréversibles. Dans ce rapport, on a utilisé les méthodes empiriques d'IRIFR et de PSIAC pour évaluer les sédiments créés à cause de l'érosion éolienne et hydrique dans la région Milesefide-Jahan Abad. Cette étude est divisée en deux parties: (i) préparation des études préliminaires et de la carte d'unité de travail, et (ii) classement et comparaison des neuf facteurs par les modèles IRIFR et PSIAC. L'étude de la superficie du bassin version (561,54km^2) montre que la perte annuelle du sol est de 17047 tonne/km^2/an dont 16 291 tonne/km^2/an est due à l'érosion éolienne et 756 tonne/km^2/an due à l'érosion hydrique.

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Mots clés : *Erosion hydrique, érosion éolienne, modèles IRIFR PSIAC, région de Jahan Abad, Iran.*

1. INTRODUCTION

Soil erosion is one of the natural processes that would cause many constrains to the environmental and regional planners. Many attempts have been made to use different models to estimate the volume of soils eroded every year. For example USLE, PSIAC, MPSIAC and EPM are the most widely used models in water erosion estimation and IRIFR is model of wind erosion estimation. Soil erosion in different parts of Iran has been studied by several researchers. Heydarian1996 and Tajbakhsh et. al, (2003) used PASIC and Modified PSIAC (MPSIAC) to estimate erosion yield and producing erosion intensity map. The specific objective of this study is assessment and mapping of wind and water erosion by IRIFR and PSIAC models in Milesefide-Jahan Abad region, Yazd, Iran.

Study area:

Milesefide-Jahan Abad basin with area about 561.54km^2 is situated between 53 ° 30' to 54°10' E and 31°15' to 32°50' N. This basin contains the five sub basins which Talkhestan sub basin (12.78Km^2) is smallest and Jahan Abad sub basins (470.92km^2) is the largest one. The mean annual temperature and precipitation is about 18.84°C and 106.6 mm respectively.

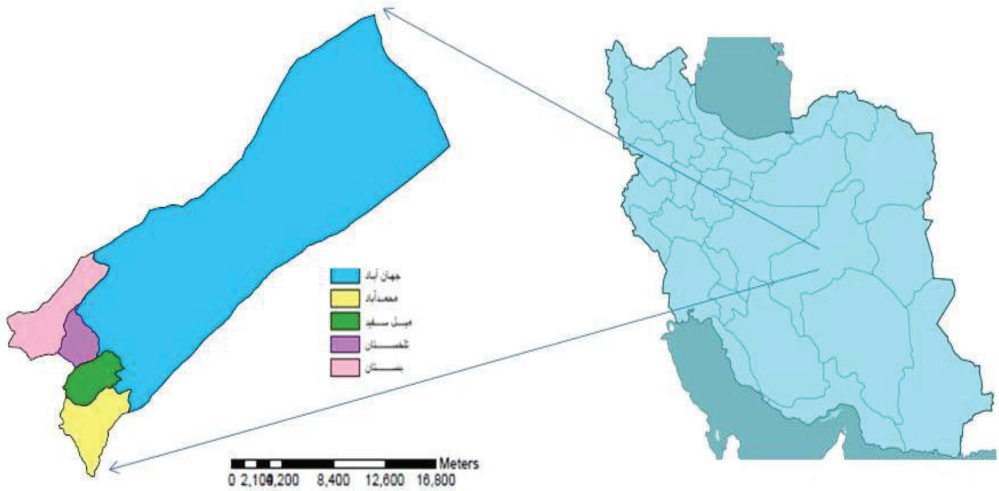

Fig. 1. Study area

2. MATERIALS AND METHODS

In this study, for estimating water and wind erosion potential, Geomorphology facies were determined by satellite images(ETM$^+$) and field survey(Table1). Then In order to identify number of samples in each facie, the systematic- random method was used and finally 31 points was selected. After that, the factors which used in the PSIAC model, was investigated independently and a rating assigned to each of them. Finally using PSIAC model, sediment yield was calculated and using Table 1, the quality classes were determined (Table 2).

Table 1: Characteristics of the study area

Features	Area(%)	Area (km^2)	Type	Unit
slip, collowial, creep, rock Exhibition	19/32	108/5		Mountain
Agricultural lands, Coarse Reg	5/49	30/87	glacis pediment	Plain
Intermediate Reg	54/05	303/56	appendage pediment	
parabolic ‘clay land ‘Kalut Sand sheet	19/16	107/63	covered pediment	
Agricultural and Garden lands	0/0019	0/01	Agricultural lands	Agricultural lands

Table 2: Determination of erosion class and sedimentation rate

sedimentation		Calculated rating	Category	Erosion class
Ton/km^2	m^3/km^2			
<200	<95	<25	Very low	I
200-500	95-250	25-50	low	II
500-1500	250-450	50-75	moderate	III
1500-2500	450-1450	75-100	high	IV
>2500	>1450	>100	Very high	V

In the next step IRIFR model was applied for calculating wind erosion sedimentation potential. The factors which used in this model, was investigated independently. Finally using following formula and table, sedimentation yield erosion quantity and quality classes was acquired.

$$Q_s = 41e^{0.05\,R}$$

Q_S : total sediment yield in $m^3/km^2/yr$.

R = sum of the effective factors

Table 3: Sedimentation potential

Calculated rating	sedimentation Ton/km^2	Category	Erosion class
<25	<250	Very low	I
25-50	250-500	low	II
50-75	500-1500	moderate	III
75-100	1600-600	high	I V
>100	>6000	Very high	V

3. RESULTS

The Table 4 shows the results of water erosion evaluation using PSIAC model

Table 4: Quantitative evaluation of the 9 effective factors in water erosion in PSIAC model

Sedimentation Categories

Sedimentation Categories	Sedimentation class	Calculated score	Rating factors									Facies
			channel erosion / sediment transport	upland erosion	land type	ground cover	topography	climate	climate	Soil	Surface Geology	
low	II	41	6	3	7-	5	14	5	4	4	7	rock Exhibition
low	II	44	4	4	0	6	15	6	4	3	2	glacis pediment
Very low	I	25	2	2	1	4	3	3	2	3	5	appendage pediment
low	II	41	5	8	3-	2	5	2	6	2	7	Agricultural lands
Very low	II	17	0	2	7	3-	1	0	1	8	1	Parabolic lands
Very low	II	23	0	7	9-	9	0	0	0	9	7	Sand sheet

Table 5: Quantitative evaluation of the 9 effective factors in water erosion in IRIFR model

Sedimentation Categories	Sedimentation class	Calculated score	Rating factors									facies
			management and land use	type and distribution of wind deposits	Soil moisture	soil surface erosion effects	abundance of vegetation	surface cover and soil	speed and wind conditions	topography	Lithology	
low	II	30	0	0	8	7	7	2-	4	3	3	glacis pediment
moderate	III	53	2	2	6	7	12	1	16	5	2	epandaje pediment
Very high	V	104	13	8	9	18	11	12	17	8	8	Clay land

high	IV	100	13	9	7	15	15	13	12	8	8	Sand sheet
high	IV	73	7	7	8	8	11	8	12	6	6	Agricultural lands

Results obtained from sedimentation rate in water and wind erosion using PSIAC and IRIFR models is presented in table 6.

Table 6: sedimentation rate in water and wind erosion using PSIAC and IRIFR models

sedimentation rate IRIFR (ton/km^2/yr)	sedimentation PSIAC (ton/km^2/yr)	Facies
435/21	164/84	rock Exhibition
183/75	183/25	glacis pediment
580/32	93/7	Epandaje pediment
7432/16	70/65	Parabolice and clay lands
6084/94	87/31	Sand sheet
1577/46	159/12	Agricultural lands

The final map shows different levels of water and wind erosions in this area (Figs. 2 to 5).

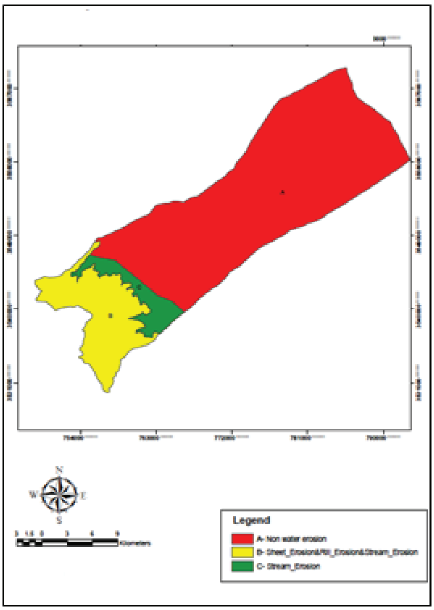

Fig. 2. The map of water erosion types

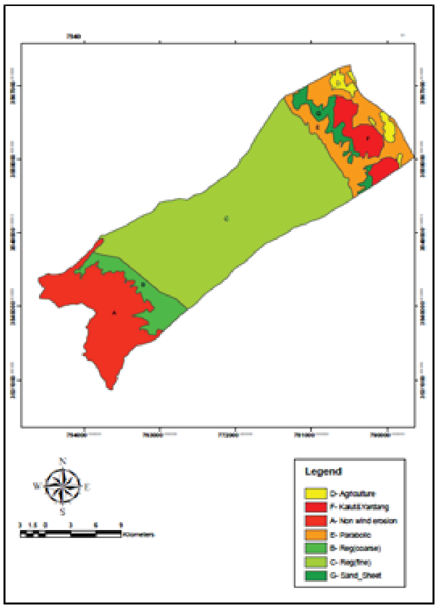

Fig. 3. The map of wind erosion types

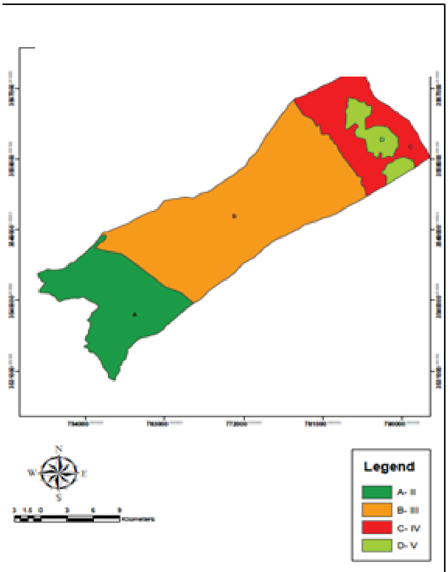

Fig. 4. The map of sedimentation classes whit IFIFR

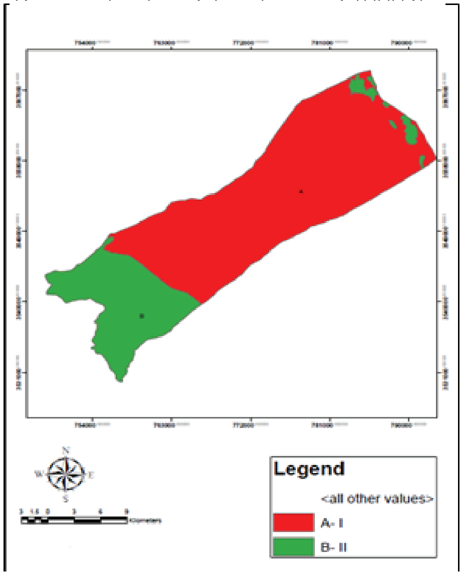

Fig. 5. The map of sedimentation classes whit PSIAC

4. RESULTS AND DISCUSSION

As it is clear from the Figures, in this area the wind erosion process very active. Thus, much of the sediment from the basin is produced by wind erosion and much less is due to water erosion. Also estimating erosion rate in facies Indicating that Intermediate Reg face on appendage pediment (258.66km^2) and agricultural lands face in the covered pediment (0.01km^2), have the most and the least space, in wind erosion. Also Clay and parabolic lands have the most sediment and glacis pediment have the least sediment in wind erosion, while the most and the least sediment that is produced by water erosion is in glacis pediment and clay and parabolic lands, respectively. Generally the most important causes of erosion in the region is geology, Climatic factors and Human interference in that area.

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