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STUDY OF RATAGA BASIN VALLEY (WESTERN OF IRAQ) CRUSTING AND ERODIBILITY BY WIND AND WATER

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ABSTRACT

A field study was conducted in the area of Ratga Valley, western of Iraq, within longitudes (40º 46' 40" and 39º 36' 37" N) and latitudes (34º 17' 19" and 32º 41' 06" E) to investigate the degradation process of valley lands, depending on the topographic maps, satellite images and digital elevation model, the nature of region was defined as arid and semi-arid land. Results showed the existence seven series of soils within the study area. The Results showed that the values of wind soil Erodibility indicator were ranged between -0.250 and 0.393, (ARCGIS 9.3 software, used), when the soil area of low Erodibility was within the area of 2306 km^2, while the soil mid and high Erodibility indicator was located in the area of 566 and 2748 km^2, respectively. In the other hand, the area of soil that had low crusting was in the area of 3080 km2. The mid and low area categories were approached to 646 and 1894 km^2 for mid and high class, respectively. Also, the areas categories of low, mid and high classes of water Erodibility was located in the area of 154, 1775 and 3691 km^2, respectively.

Keywords: western of Iraq, erosion, soil crust, soil productivity.

INTRODUCTION

Lands deterioration is known as temporary and permanent regression of its productivity ability that happens due to the natural imbalance caused by impropriate or excessive land use by human activities or natural factors. This is a serious problem worldwide threatening dried lands and it is one of the environmental problems that facing desert areas (FAO, 2004). Soil deterioration took many different forms like physical deterioration that refers to wind and water erosion or dust storms, and chemical deterioration, which includes soil salinity in first class, as well as the biological deterioration (Al-Juraisy 2013).

Early; Buringh (1960) reported that 2.4 million hectares of Iraqi soils are exposed to wind erosion which forms about 60% of the total area. Deangelis *et al.,* (1987) mentioned that there are many human and natural causes of the physical deterioration, Soil erosion is one of the most important factors that cause of about 85% of the soil deterioration. Wind erosion at the forefront of erosion processes especially in an arid and semi-arid region where the soil is powdery, dried with fine particles and little vegetation and the wind is high. Wind erosion is one of the worldwide problems that affect the ecological system; wind erosion severity in the past few years is due to extremism climate in those regions.

Water is also causing erosion especially in sloping lands where rainfall is high, where the impact starts form rain splash to the water runoff and ends in the main drainage canals.

MATERIALS AND METHODS

Study zone (Figure1) was determined in 5620 km^2 area using topographic maps and visualizations type DME by which the valley basin was determined. The zone was chosen because of the intention to study the desert lands and the possibility of utilizing it especially within Anbar governorate; as well as the presence of the Algaarh trough; the largest depression in the desert of Anbar; so as to reflect the status of physical degradation of the land within the region and to locate this degradation in areas within the study zone.

Nine areas were chosen within topographic heterogeneity, soils were morphologically characterized according to USDA soil survey staff 2011; and then soil samples were collected from each diagnosed profile, taken to the laboratory then air dried, sieved by 2mm sieve, and prepared for physical and chemical analysis.

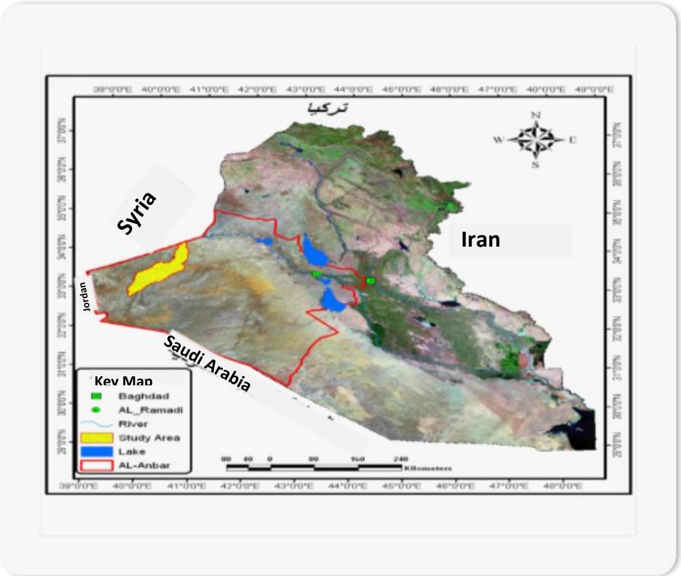

Figure 1: Map shows the study zone location in Anbar governorate.

Physical characters of the soil:

1. Volumetric distribution of soil separates
   This was evaluated using volumetric pipet method according to Hesse (1976) matrix. Silts separates evaluated in three parts (Roughen, medium and soft silt) according to the time period of each separates to sedimentation while sand separate was divided into five parts (50-100, 100-250, 250-500, 500-1000, 1000-2000 μm) using group of sieves (50, 100, 250, 500, 1000, 2000 μm) respectively for each separate.
2. Chemical and fertility characters of the soil:

- Organic matter (OM): was evaluated using wet digestion as mentioned by Page *et al* (1982).
- Carbonate equivalent estimation: this was estimated by the titration with sodium hydroxide (0.5 molars) according to the method mentioned in Handbook 60.

3- Estimating soil erodibility and crusting ability according to the table 1. Soil erodibility factor and soil crusting factor were estimated for each profile using formula bellow (Fryrear *et al*., 2000).

Table 1: Some physical, chemical and fertility characters of the study zone.

Pedon	Horizon	Depth (cm)	Sand %	Silt %	Clay %	Texture	OM %	$CaCO_3$ gm.kg^{-1}soil	Very Fine Sand %	Bulk Density (gm/cm^3)	Porosity %
P1	A	0- 25	48.235	1.555	50.21	SC	0.936	465	5.21	1.26	51.36
P2	A	0- 20	96.325	0.13	3.545	S	0.234	290	4.785	1.14	57.57
P3	A	0- 22	66.33	1.63	32.04	SCL	0.936	430	4.635	1.12	57.97
P4	A	0- 24	68.34	11.145	20.515	SCL	1.17	440	0.27	1.13	57.64
P5	A	0- 28	65.76	0.8	33.44	SCL	1.17	450	0.19	1.30	50.31
P6	A	0-12	82.05	0.885	17.065	SL	0.936	445	7.88	1.18	55.53
P7	A	0- 14	67.71	1.145	31.145	SCL	1.38	473	6.715	1.50	42.27
P8	A	0- 17	62.6	1.05	36.35	SC	1.12	727	8.545	1.13	56.90
P9	A	0-14	73.05	0.85	26.1	SCL	1.6	334	8.245	1.22	52.81

EF=1/100[29.09+ (0.31*%sand) +0.17*%silt) +(0.33*% sand/clay)-(2.59*%organic matter) -(0.95*%CaCO3)]
Where: EF = is the wind erodibility factor
SCF = 1/ [1+0.0049(%clay) ^{2}]
Where: SCF = Soil crust factor
Water erodibility factor of each profile was estimated according to the formula bellow suggested by (Albyati *et al*, 2003)
EFw= [0.37*(%silt+ very fine sand) + (0.28* %clay) +14.87]/100
Where: EFw = Erodibility factors of water

RESULTS AND DISCUSSION

1- **Soil classification of the study zone.** The classification was according to Al-Agidi (1981) for the desert soils using the general equation (GTB – PCD), and according to the descriptive and analytic obtained results; seven soil series were determined to present the study soil which allocated as showed in figure (2). The seven series areas are shown in the table (2).

Table 2: Areas of soils chains and its percentages of study zone.

No:	Series	Pedons	Area km^2	%
1	142SCW	P1, P5	311.8	5.55
2	112SCW	P2	815.4	14.51
3	143VCW	P3	392.8	6.99
4	143SCW	P4	808.7	14.39
5	122SCW	P6	660	11.74
6	142CCW	P7, P8	2125.8	37.83
7	121CCW	P9	505.5	8.99
Total	7	9	5620	100%

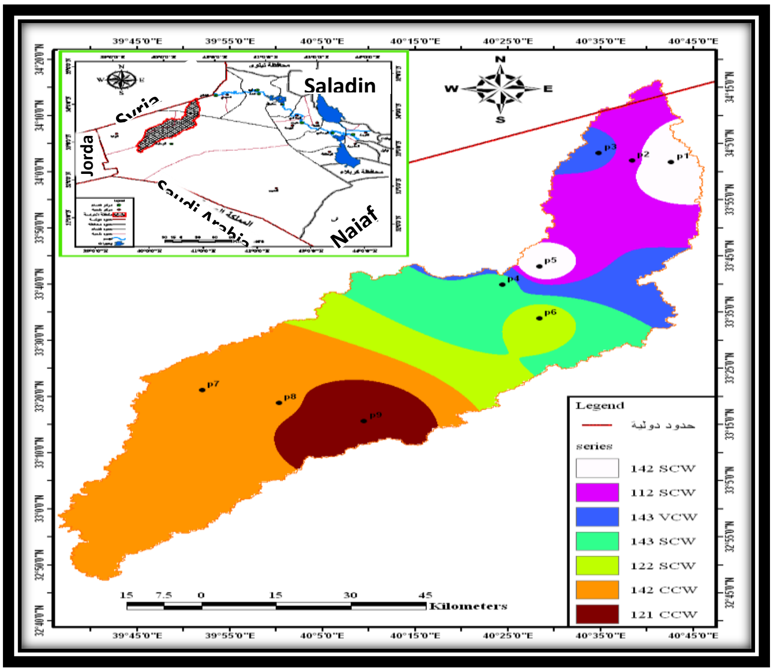

Figure 2: Map of the distribution of studied soils chains (source. Research work according to Al-Agidi, 1981 classification)

Soil Wind Erodibility Factor: This was considered of important indicator to evaluate soil deterioration case especially in the arid and semi-arid regions. Table (3) presenting that the lowest value of this indicator was for the series 142CCW and the pedon P_8 which reached -0.250 while the highest value of this indicator was within the series 112SCW for the pedon P_2 and reached 0.393. The reason behind the increased percentage of clay and calcium carbonate in the site P_8 is because this series is originally a limestone compared to pedon P_2 within series originally of sand. Hassan, (2012) revealed that the soil erodibility is increasing by removing calcium carbonate of it. The reason for the negative sign of the obtained value is due to the increased percentage of calcium carbonate and exceeding the limit in the formula. Using ARC-GIS 9.3, results were divided into three categories and the area of each category was estimated (Fig. 3), low erodibility soil area was 2306 km^2 while it was 566 km^2 of the intermediate and 2748 km^2 for the soil of high erodibility (Table 4).

2- **Soil crust factor:** This indicator was evaluated, and results are presented in table 3 and ranged (0.075 - 0.942). The highest value was at the pedon P_2 within the series 112SCW while the lowest was 142-SCW for pedon P_1, such variation between these values could be due to calcium carbonate, clay and the rough separates of the soil in addition slop and physiographic location impact on soil crusting. Results then divided into three categories (Figure 4), and areas were 3080 km^2 for the low crusting area, 646 km^{2,} and 1894 km^2 consequently for both categories intermediate and high (Table 4).

Table 3: soil crust factor and erodibility by wind and water.

Pedons	Soil Erodibility Factor	Soil crust factor	Erodibility Factors of water
P1	-0.039	0.075	0.314
P2	0.393	0.942	0.160
P3	0.054	0.166	0.274
P4	0.060	0.327	0.278
P5	0.021	0.154	0.295
P6	0.096	0.412	0.235
P7	-0.004	0.174	0.297
P8	-0.250	0.134	0.308
P9	0.136	0.231	0.269

Table 4: Areas of the study zone affected by crusting, and water and wind erosion.

Type	Water erodibility	%	Soil crusting ability	%	Wind erodibility	%
Week ability	154	54.80	3080	41.03	2306	2.74
Mid ability	1775	11.50	646	10.07	566	31.58
High ability	3691	33.70	1894	48.90	2748	65.68
Total km^2	5620	%100	5620	%100	5620	%100

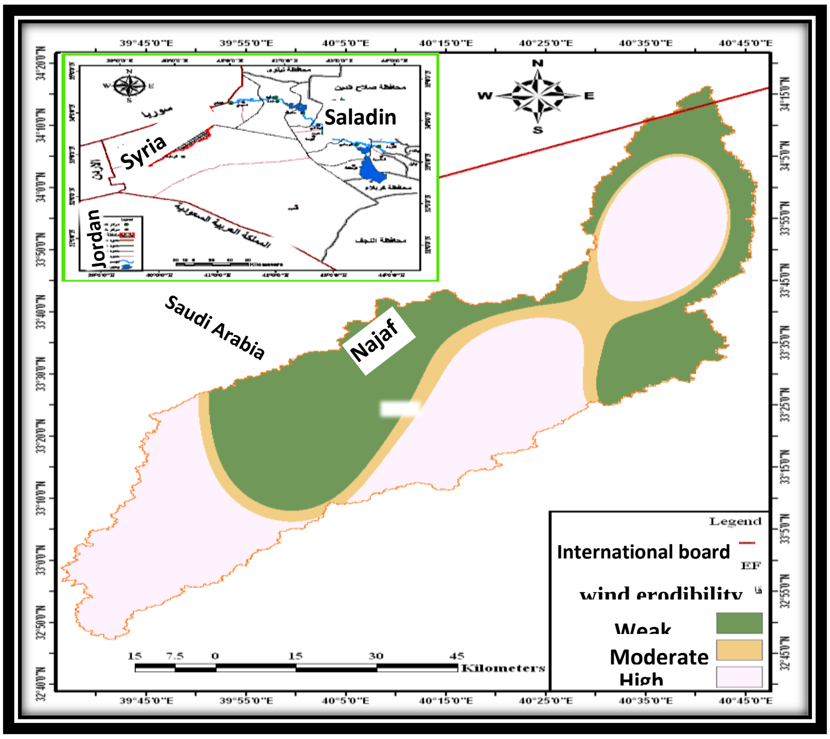

Figure 3: **Map of wind erodibility of the Soil, (source: researcher work done according to results in table 3 and using ARCGIS 9.3).**

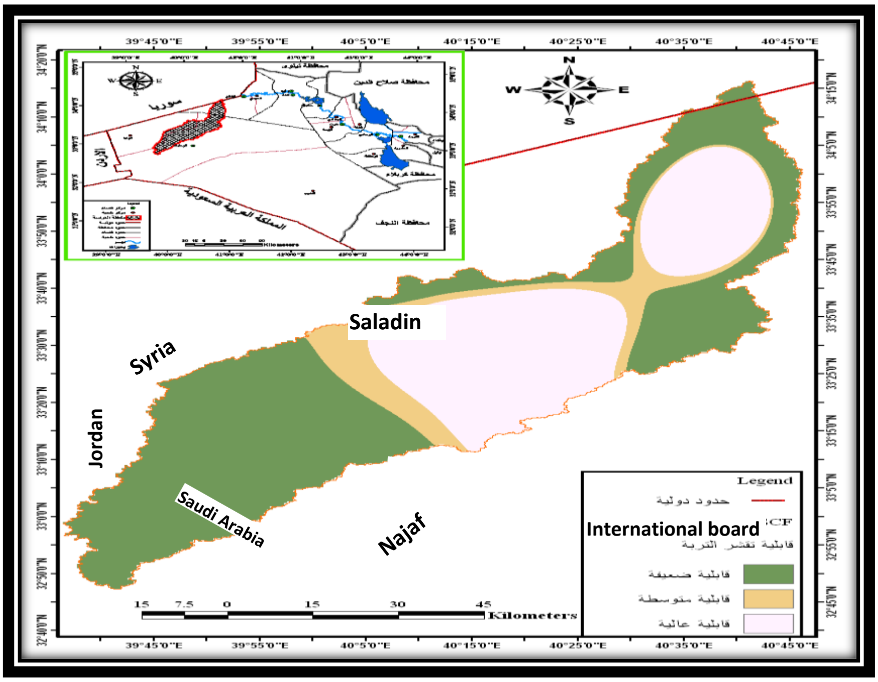

Figure 4: **Map of soil ability to crust. (Source: the researcher works according to table 3 results and using ARCGIS 9.3)**

3- Soil water erodibility

This factor was considered one of the most important factors to understand water erosion and its impact on soil. Results as presented in Table 4 shows values ranged between 0.160 to 0.314, where the highest value was for pedon P1 within the series 142SCW while the lowest was for pedon P_2 within the series 112SCW and the reason is thought to be due to surface profile content of clay and calcium carbonate in addition to the slope impact. Results revealed that soil erodibility increasing in areas with a high slope which increasing the impact of rainstorms and the movement of the rough. The Results divided the erodibility into three categories (Figure 5) and their areas were 154, 1775, and 3691 km2 for the low, intermediate and the high consequently (Table 4). It can be concluded that most of study area have high ability to wind and water erosion while most of studied areas have weak crust, therefore suitable management systems should be followed when agricultural practices occurred.

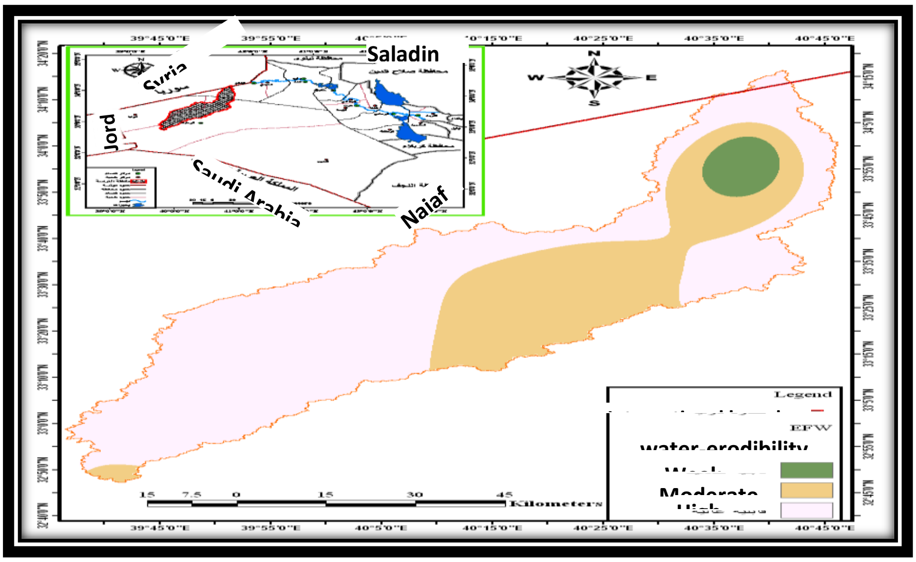

Figure 5: Map of soil water-erodibility, (Sours: researcher work according to the results presented in table 3 and by using ARCGIS 9.3)

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