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CLIMATIC INTERACTION EFFECTS OF RAIN AND WIND ON SOIL EROSION IN ARID AND SEMI-ARID REGIONS

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ABSRACT

To quantify temporal trends of water and wind erosion at Mosul city /northern Iraq, two climatic erosivity index were calculated for the long-term period of 1979-2009. The Rainfall erosivity factor(R) of USLE is calculated from the monthly rainfall amounts of each individual year and reported as (Cp). Temporal aspects of rainfall distribution within a year was defined by the Precipitation Concentration Index (PCI) based on monthly rainfall amounts. Thornthwaits PE index and wind velocity were combined for predicting the potential consequences of the local climatic factor (C) of wind erosion equation (WEQ).

The results showed that although all the annual rainfall records are within the normal moisture regime, but there is a variation in their erosivity effect on soil. The distribution of PCI with the rainfall erosivity (Cp) during the record period follows a regular pattern with somewhat high values (0.684) of coefficient of determination (R^2) .On the other hand, the decreasing trend of the Cp is registered toward the time period of last decade, and registered a low soil erosion risk class. Due to increases in air temperature and decreases in annual rainfall depth , the monthly distribution of wind erosion was between 0.274 and 3.599 *M*g /ha. According to the FAO classification ,climatic erosivity factor C in this region was within high to very high risk class.

From this point, it was concluded that a stronger combined effects of water and wind soil erosion are observed in this region.. It is estimated that more than half of yearly erosivity is located within the risk of water erosion. Therefore, only a small part of the yearly erosive wind energy will be responsible for the soil loss in the region

INTRODUCTION

Erosion is a broadly defined group of a natural geomorphic process involving the movement of soil .This movement is often the result of flowing agents, whether wind or water ,each contributing a significant amount of soil loss each year in Iraq. The ability of soils to resist erosion, based mainly on the physical characteristics of each climate and soil. Generally, climatic erosivity includes the interaction patentability of rain and wind to cause the surface of the soil erodes. With water caused erosion, the process begins with the initial soil particle detachment caused by energy impact of raindrops, while the erosivity power of the wind includes the effect of wind velocity. The erosive of wind in some ways is less forceful than the erosive influence of water. Water, after all, can lift heavier and larger particles than can the winds. (Omafra Staff ,1987).

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In other words , the formula which describe the soil erosion rate in relation to climate erosivity can be put in the following functional relationships;

Erosion Rate = *f* climate (physics of rain and wind)* soil condition -----(1)

The universal soil loss equation (USLE)is the most widely used empirical equation for predicting the average annual soil loss by water erosion (McCoola *et al.* 2004). This equation is given by ;

A = R.K.L.S.C.P ----------------------------------(2)

Where,

A is the average annual soil loss (*M*g ha^{-1} yr^{-1});
R is the rainfall erosivity index;
K is the soil erodibility factor;
L is the slope length factor;
S is the slope gradient factor;
C is the vegetation cover factor, and
P is the conservation protection factor.

Comparable to the USLE, a wind erosion equation (WEQ) was proposed by Woodruff and Siddoway (Skidmore, 1995) to assess soil erosion by wind. This equation predicts the potential average annual soil loss by wind erosion, as shown in model given below ;

E = f (I, K, C, L, V) ------------------------------------ (3)

Where,

E is the potential annual soil loss (*M*g ha^{-1}),;
I is the soil erodibility factor
K is the soil ridge roughness factor
C is the climatic factor (wind energy)
V is the equivalent vegetative cover
L is the unsheltered median travel distance of wind across a field(m);
f is an indication that the equation includes functional relationships that are not straight-line mathematical calculations

The two independent climate variables in the equation 2 and 3 when evaluating the reliability of soil erosion are R-factor in the USLE and C-factor in the WEQ, which signifies the potential erosivity of the rain and wind during a definite period, to erode the definite soil type.

The objective of this study is to analyze climate variability in order to asses the erosive potential of rain and wind and its impacts on soil erosion and conservation measures of cropland soil at Mosul city/ northern Iraq. Because of the high temporal variability of rainfall and wind erosivity, accurate records based on long climatic data covered the period 1979- 2009 are used. This information can be used to predict relative erosion hazards and permits rapid determination of average annual soil loss due to wind and water erosion for different times of the year at the studied region (Aslan and Tokgözlü ,2000).

MATERIALS AND METHODS

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The study was carried out under climatic condition of Mosul city which located at Longitude 43^0 08^- E and Latitude 36^0 20^- N at northern Iraq. Climatologically, Kassim (2006) classified the areas of northern Iraq into three distinguish climatic zones;

1. Low rainfall zone (200–350 mm) covering the largest area of 957007 ha arable land
2. Moderate rainfall zone (350 – 450 mm) covering 537959 ha.
3. High rainfall zone (>450 mm) covering the smallest area of 92492 ha.

According to this classification, the studied area is located within the 1st and 2nd zones and described as semiarid continental Mediterranean with an average annual precipitation around 350 mm.

As the origin of rainfall erosivity is linked to climate dynamics, there is a need to apply climate analysis methodologies to conduct the study. Data of mean monthly and annual rainfall, mean wind speed and air temperature for successive hydrological 30-years (from October1979 to September 2009) are analyzed. Three climatological indices were determined to describe the rainfall erosivity (R-factor) and wind erosivity (C-factor) of the USLE and WEQ respectively as follow :

1-The erosivity effect of rainfall (R) in the USLE was calculated using the annual and monthly rainfall depth based on the Fournier index which described by Oduro-Afriye (1996) as the climatic index (Aslan 2003) and reported as Cp;

$$Cp = P^2_{MAX} / P \qquad \text{-------------------------------(4)}$$

where ;

Cp is the Fournier Index (mm),
P is the annual precipitation (mm). and
P_{MAX} is the rainfall amount in the wettest month

This index is well correlated with the capacity of precipitation to provoque water erosion and evaluate the rain erosivity on a monthly or yearly basis. For this, it is also called “Climatic aggressively index”. Table 1 shows classes of rainfall erosion risk based on the Rainfall Erosivity Index Cp .

Table 1. Conceptual scale for assessing the Cp index (Oduro-Afriye ,1996)

Class No	Fournier Index Cp	Soil Loss (t/ha/yr)	Erosion Risk Class
1	<20	<5	Very Low
2	21-40	5-12	Low
3	41-60	12-50	Moderate
4	61-80	50-100	Severe
5	81-100	100-200	Very Severe
6	>100	>200	Extremely Severe

Further calculations for surfaces of the precipitation concentration index (PCI) similar to the calculations made for the Fournier index (Cp) surfaces conclusively. The PCI was a valuable index in determining the potential of the rains for causing

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erosion on a scale that ranges from less than 10 for evenly distributed rainfall to 100 for extreme monthly rainfall erosivity distribution (Table 2). PCI is determined as follow;

$$PCI = 100 \sum Pi^2 / Pa^2 \quad \text{-------------------------------(5)}$$

Where;

Pi : is the mean rainfall of the i-the month (mm) and
Pa : is annual precipitation, (mm)

Table 2. Conceptual scale to evaluate the PCI index (UNESCO 2006)

PCI	Concept
0.8 – 10	Uniform
10 – 15	Moderately seasonal
15 – 20	Seasonal
20 – 50	Highly seasonal
50 – 100	Irregular

2- The wind erosivity climatic factor, C, of the WEQ was derived from the relationship stating that rate of soil flow varies directly as the cube of the wind velocity and inversely as the square of the effective surface soil moisture (Aslan, 1997). The climatic factor (C) of wind erosion was determined after analyzing the metrological data especially wind speed , rainfall depth and air temperature for a 30-year periods at the studied area. The annual climatic factor (C_a) of wind erosion is expressed as,

$$C_a = 34.483\ V_a^{3} / (P\text{-}E)_a^{2} \quad \text{--------------------------------(6)}$$

Where;

C_a = The annual wind erosion climatic factor
34.483 = Constant expressing the climatic factor as a percentage of the average annual value of $V^3/(P\text{-}E)^2$, for Garden City, Kansas.
V_a = Mean annual wind velocity (mph) for the studied location.
$(P\text{-}E)_a$ = The annual Precipitation-Effectiveness index of Thornthwaite. and is calculated by:

$$P\text{-}E = \sum^{n \square 12} 115\ [P/T-10]^{10/9} \quad \text{--------------------------------(7)}$$

Where;

P = Mean monthly precipitation in inch and
T = Average monthly air temperature in F°.and
n = Months =12
To compute monthly climatic factors C_m , the equation (6)was modified to:

$$C^{-}_m = 34.483\ V_m^{3} / (P\text{-}E)_a^{2} \quad \text{----------------------------(8)}$$

Where;

C^{-}_m is the monthly wind erosion climatic factor,
V_m is the average monthly wind velocity and

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$(P\text{-}E)_a$ is the annual Precipitation-Effectiveness index of Thornthwaite

The monthly climatic factor was calculated as follows. First, climatic factor for each month was calculated with the monthly mean air temperature ,wind speed, and precipitation. Second ,the summation of the monthly distribution rate of C value was calculated. Finally, the monthly C value was calculated with the annual C value and the monthly distribution percentage (Paltineanu1 *et al*. 2007) as in the following;

$$C_m \% = 100\ C_m\ /\ C_a \qquad \text{-------------------------------(9)}$$

Where;

C_m is the wind erosion climatic factor of the i-the month

C_a is the annual wind erosion climatic factor

Because the data set are widely different mean, statistical analysis for the standard deviation (usually represented by S) is more better to use for measuring the variability of rainfall and wind erosivity in the studied area. Standard deviation, was computed and defined as follows:

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2} \qquad \text{---------------------------------(10)}$$

Where;

X_i = The value of annual rainfall depth (Pi) and

$\overline{X}$ = Mean annual rainfall depth for 1979-2009

RESULTS AND DISCUSSION

Based on recorded data analysis during 1979 until 2009 (as shown in Table 3) the annual rainfall depth (Pi) shows a wide variation in their pattern from seasonal to decadal scales, but no significant periodicity appears to be present. Over the studied periods ,the highest rainfall of 703.1mm was recorded in the year 1992-1993 and the lowest rainfall of 97.2mm was reported in 2007-2008. Mean annual rainfall for entire period was 361.26mm with a coefficient of variation (CV) of 31.4% and standard deviation(SD)of 133.41. To evaluate the degree of Intra-annual rainfall variability across the study area, the precipitation concentration index PCI was used.

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Table 3. Annual rainfall in relation to moisture regime and erosion risk classes

Year No.	Hydrological Year	Pi (mm)	Moisture Regime*	PCI	Concept	Cp (mm)	Erosion Risk classes
1	1979-1980	501.0	Abnormal Year	21.3	Hi. Seasonal	54.34	Moderate
2	1980-1981	431.9	Normal Year	18.5	Seasonal	29.04	Low
3	1981-1982	389.5	Normal Year	16.7	Seasonal	18.94	Very low
4	1982-1983	327.6	Normal Year	16.0	Seasonal	24.89	Low
5	1983-1984	267.3	Normal Year	23.1	Hi. Seasonal	41.48	Moderate
6	1984-1985	465.2	Normal Year	20.3	Hi. Seasonal	65.38	Sever
7	1985-1986	309.2	Normal Year	22.2	Hi. Seasonal	47.82	Moderate
8	1986-1987	354.5	Normal Year	21.9	Hi. Seasonal	44.92	Moderate
9	1987-1988	666.0	Abnormal Year	18.8	Seasonal	59.04	Moderate
10	1988-1989	280.5	Normal Year	27.0	Hi. Seasonal	34.16	Low
11	1989-1990	365.1	Normal Year	22.2	Hi. Seasonal	48.81	Moderate
12	1990-1991	335.3	Normal Year	41.3	Hi. Seasonal	126.07	Extr. Sever
13	1991-1992	465.2	Normal Year	18.6	Seasonal	37.90	Low
14	1992-1993	703.1	Abnormal Year	17.7	Seasonal	41.78	Moderate
15	1993-1994	441.1	Normal Year	15.6	Seasonal	19.94	Very low
16	1994-1995	418.5	Normal Year	16.0	Seasonal	26.19	Low
17	1995-1996	419.6	Normal Year	25.6	Hi. Seasonal	66.38	Sever
18	1996-1997	342.3	Normal Year	24.1	Hi. Seasonal	51.59	Moderate
19	1997-1998	351.7	Normal Year	16.1	Seasonal	19.02	Very low
20	1998-1999	127.6	Drought Year	26.5	Hi. Seasonal	18.20	Very low
21	1999-2000	176.7	Drought Year	.18.4	Seasonal	15.65	Very low
22	2000-2001	342.9	Normal Year	16.9	Seasonal	20.43	Very low
23	2001-2002	339.9	Normal Year	24.0	Hi. Seasonal	46.87	Moderate
24	2002-2003	187.2	Drought Year	39.1	Hi. Seasonal	58.00	Moderate
25	2003-2004	399.9	Normal Year	18.3	Seasonal	18.92	Very low
26	2004-2005	357.0	Normal Year	21.0	Hi. Seasonal	24.75	Low
27	2005-2006	460.2	Normal Year	23.5	Hi. Seasonal	44.55	Moderate
28	2006-2007	300.0	Normal Year	14.3	M. Seasonal	18.20	Very low
29	2007-2008	97.2	Drought Year	30.2	Hi. Seasonal	15.80	Very low
30	2008-2009	214.6	Drought Year	.21.8	Hi. Seasonal	24.56	Low
Average (P_{iavg})		361.26	Normal Year	22.0	Hi.Seasonal	38.78	Moderate
St. Deviation (SD)		133.41				22.93	

*(1) Normal Year: year receiving rainfall between Piavg ± SD
(2) Drought Year: year receiving rainfall less than or equal to Piavg - SD.
(3) Abnormal Year: year receiving rainfall greater than or equal to Piavg + SD

The PCI index is very helpful tool in measuring of the frequency and intensity of rainfall erosivity at continental scale from observations in semi- arid agricultural soil (Asllan, 1997; Sun *et al*., 2000) The more concentrated is precipitation, the more difficult is water management and soil erosion prevention. The PCI value was ranged from 15.6 to 40.1 (Table 3), which means that most recorder years denote seasonality to Hi seasonality of the rainfall distribution over the year with substantial monthly variability in rainfall amounts (De Lu´ıs *et al*., 2000). In more detailed ,the last two series years 2007-2008 and 2008-2009 are a period of low PCI associated with drought moisture regime. This result mean that although all the annual rainfall records are within the normal moisture regime, but there is a variation in their erosivity effect on soil. The distribution of PCI with the rainfall

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erosivity index (Cp) during the record period at investigated area follows a regular pattern displaying high values in the central region to the left and right side of the curve (Fig 1).

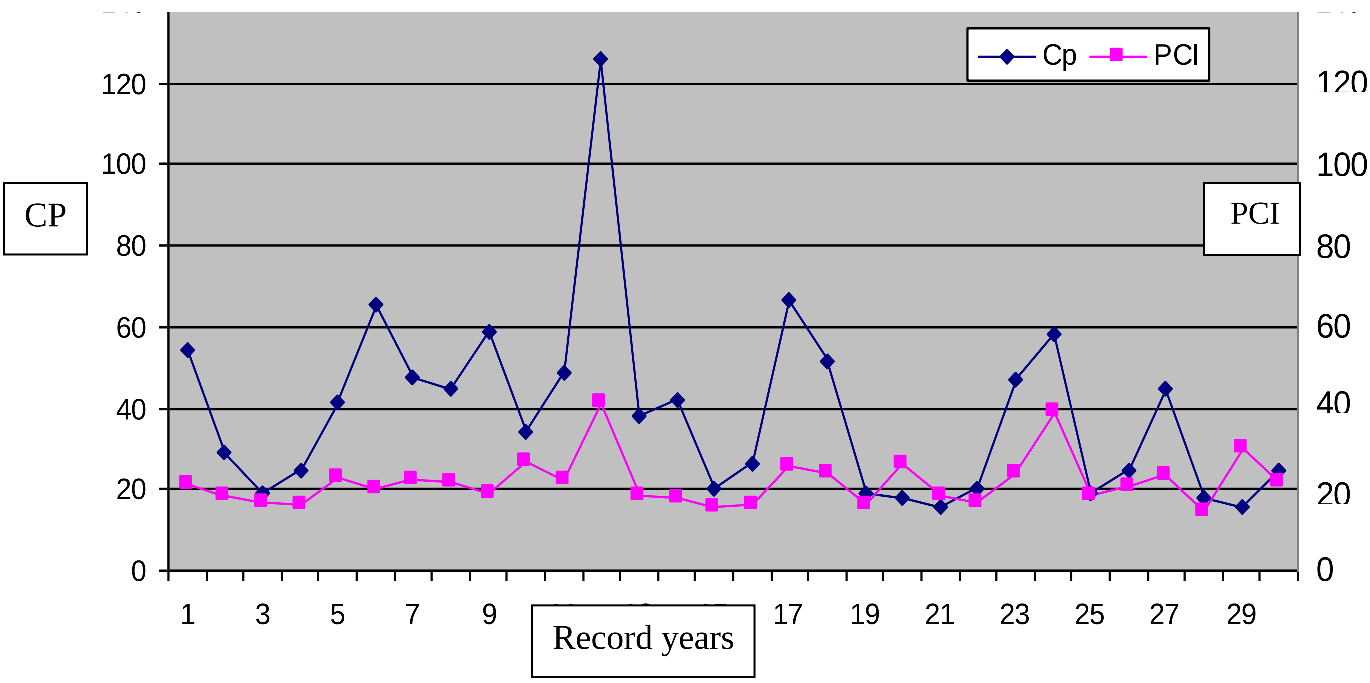

Fig 1. The yearly relationship between Cp and PCI

The effect of precipitation concentration index PCI on the rainfall erosivity index Cp, was determined by regression the data to time series. Independent variable of precipitation concentration index PCI was regressed as a function of dependent variable of rainfall erosivity index Cp. The best fitting regression model (as shown in Fig 2) has been observed to be linear and modeled by ;

$$Cp = -0.7566\ PCI + 50.515 \qquad \text{---------------------------------(11)}$$

The positive relationships with somewhat high values (0.684) of coefficient of determination (R^2) indicated that the rain erosivity index Cp had a strong linearity with precipitation concentration index PCI during a given record years. According to the conceptual scale of Oduro-Afriye (1996) as reported in Aslan (1997) and presented in Table 1, the spatial distribution of Cp during the studied periods indicating that most of the water erosion in this area falls within the moderate class 36.6 % of soil erosion risk in comparison to 30 % very low 23.3 % low , 6.6 % severe and 3.3 % extremely sever. This result coincides the averaged Cp value determined for overall over Mosul city for the same period which show a moderate erosion risk . The maximal value of the rain erosivity index Cp during the analyzed period was 126.7 in the season of 1990-1991, and minimal 15.65 in the season of 1999-2000.

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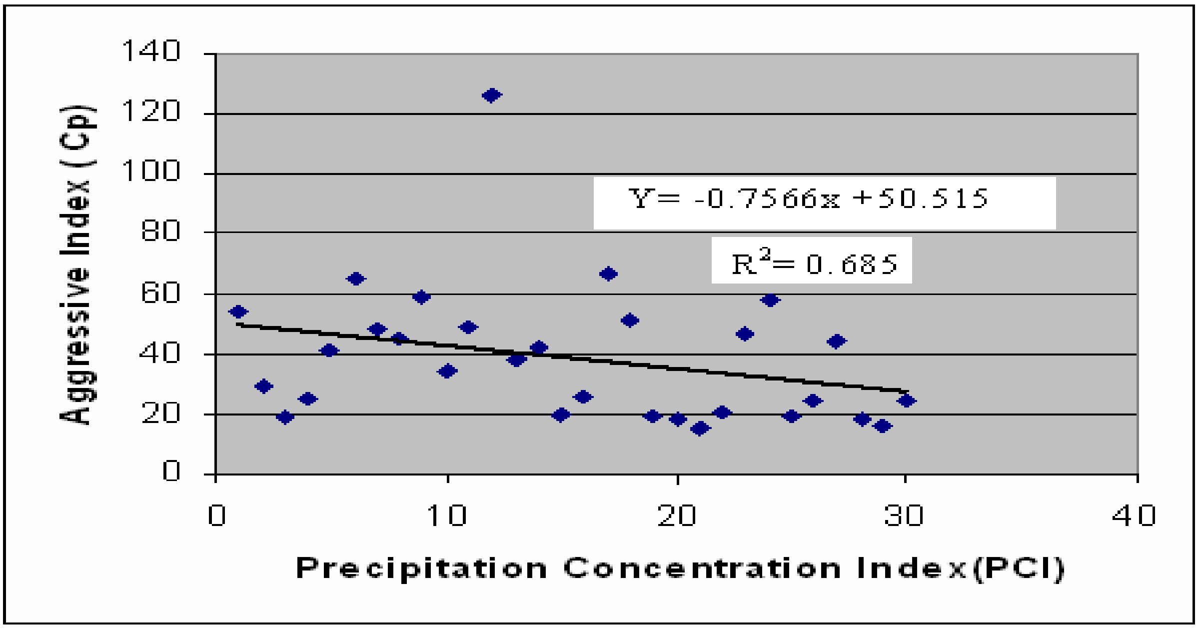

Fig 2. Best-fit lines between Cp and PCI

To examine this relationship in more detail, the statistical moving average method was used. Moving average method can be applied to time-data set to remove the effect of seasonal variation and extract the data trend of Cp values during the successive year series. In this method, series moving average is formed by computing the average rain erosivity over the five specified periods on the basis of decadal scale (10-yr interval) as given in Table (4) and were compared to the baseline of (1979-2009) seasons.

Table 4 . Moving average of rainfall erosivity index Cp in relation to Intra-annual rainfall during five decadal periods (1979-2009).

Hydrological Years	Intra- Annual Pi (mm)	Moisture Regime	Cp	Erosion Risk Classes
1979-1989	399.27	Normal Year	50.62	Moderate
1984-1994	438.52	Normal Year	52.58	Moderate
1989-1999	396.95	Normal Year	44.54	Moderate
1994-2004	300.71	Normal Year	34.12	Low
1999-2009	287.56	Normal Year	28.77	Low
Base line 1979-2009	361.26	Normal Year	38.78	Moderate

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The average Cp of the same periods was varied and show a decreasing trend in their erosion risk class toward the time period of last decade (1999-2009) and registered a low soil erosion risk class. The relative differences in Cp values of the five record periods remained reasonably stable in 1st and 2nd decadal periods , then decreased toward 3rd ,4th and 5th decadal periods respectively. The decadal Cp averages for the last decade (1999-2009) studied, reported values 28.77 less than the Cp (38.78) of the base line period (1979-2009). The reduction in Cp values during the study period must be reflected in decrease of mean annual rainfall through the same period. On the other hand, the increasing trend of CP is registered only in the time of second decade period (1984-1994) and show average Cp (52.58) exceeded the series annual mean but still within moderate erosion risk class. Figure 3 is the Cp for the five periods identified from Table 4. This figure show striking changes in the intensity and spatial patterns of rain erosion activity Cp.

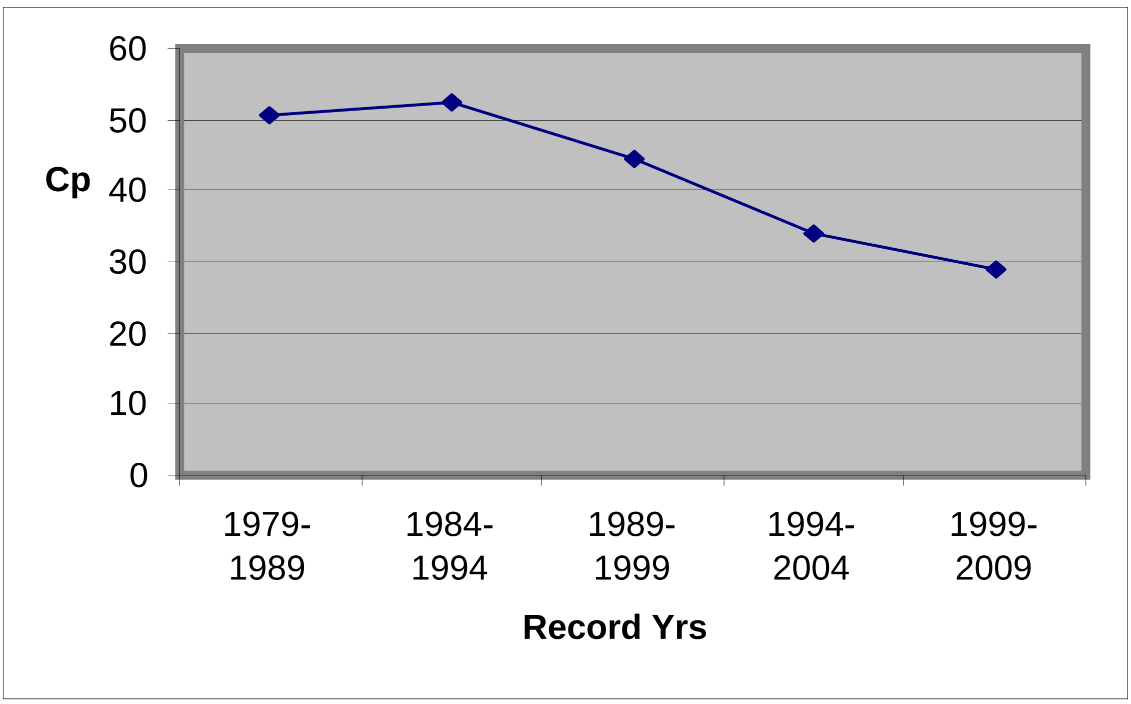

Fig 3. Moving average of rainfall erosivity index Cp

To compare different months and seasons with one another with reference to their erosive climatic conditions, the term Rainfall Erosivity Density (RED) was used. The RED method was developed to maximize the precipitation data that could be used to compute and provide a consistent set of erosivity values for conservation and erosion control planning (.Deyanira *et al*. 2005). This density, is the ratio of the monthly erosivity to monthly precipitation.

The results presented in Table (5) indicate that the Cp is highest in December (6.71) January (7.62), and February (7.73), whereas the June, July, August and September shows the lowest Cp value which its PCI=0. The highest values of RED are observed from December to February in winter , with RED value ranging from

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10.54 to 12.61 indicating that most of the precipitation in this region falls in only a few months and the highest erosion density can be expected during these months.

Table 5 . Monthly and seasonal rainfall erosivity index (Cp) in relation to erosivity density (RED)at studied region.

Rainy Months	Season	Pi (mm)	Cp	(RED) %
Dec.	Winter	63.7	6.71	10.54
Jan.		63.8	7.62	11.95
Feb.		61.3	7.73	12.61
Semi-total		188.80	22.06	11.70
Mar.	Spring	60.4	5.95	9.85
Apr.		39.6	3.89	9.82
May		16.5	1.62	9.82
Semi-total		116.50	11.46	9.83
June	Summer	000	000	000
July		000	000	000
Aug		000	000	000
Semi-total		000	000	000
Sep	Autumn	000	000	000
Oct		15.90	1.49	9.37
Nov.		40.06	3.77	9.41
Semi-total		55.96	5.26	9.39
Total		361.26	38.78	10.73

For the computation of seasonal (cumulated) precipitation, four seasons are defined following the hydrological year: autumn(September, October and November), winter(December, January, and February), spring (March, April and May) and summer(June, July and August). Due to greatest cumulated precipitation (188.80mm) in December , January , and February, the winter is the most erosive season (Cp=22.0) in this region. By analyzing the distribution of the all annual rainfall depth records, it is concluded that the greatest number of rainstorms and heavy rain were within its season.

Soil erosion rates may be expected to change in response to changes in climate for a variety of seasons by two ways. The first is the change in the erosive power of rainfall which would tend to lead to higher soil moisture levels (water erosion). A second dominant pathway is a higher air temperatures which may translate to

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higher evaporation rates and increase annual wind erosion (Saha, 2003; Paltineanu1 *et al*. 2007).

Table (6) summarizes information about the given climatic parameters used to calculate the monthly and annual climatic C- factor of wind erosion. The monthly Thornthwaite (PE) index was calculated using monthly rainfall depth with monthly air temperature based on long term observations from 1979 to 2009 record years. These data showed that the maximum PE index values are observed in January (5.32) and December (4.95). The minimum ones are in June, July, August and September which is equal to zero.

Table 6 . Variables of the computed climatic factor C of wind erosion

Months	Average Rainfall Pi (inch)*	Average Temperature (F°)	Thornthwaite index (PE)	Average Wind Speed (mph)	Monthly Climatic Factor "C" V_m/PE_a	Climatic Factor " C " %
Jan.	2.51	50.0	5.32	1.95	0.429	2.49
Feb.	2.41	54.5	4.52	2.11	0.544	3.15
Mar.	2.38	60.8	3.85	2.48	0.881	5.13
Apr	1.56	71.6	1.94	2.62	1.042	6.05
May	0.65	80.4	0.63	2.90	1.413	8.19
June	000	89.6	000	3.71	2.960	17.17
July	000	93.2	000	3.96	3.599	20.89
Aug	000	94.1	000	3.82	3.231	18.74
Sep	000	87.8	000	3.32	2.121	12.30
Oct	0.63	77.0	0.66	1.91	0.403	2.342
Nov	1.74	64.4	2.52	1.80	0.338	1.960
Dec	2.51	52.7	4.95	1.68	0.274	1.593
Annual∑	14.39		24.39		17.235	100.000
Estimated annual $C = \sum^{n=12} [\ 34.483\ V_m^3\ / (P\text{-}E)_a^{\ 2}\ ] = 17.235$						

Inch=25.4mm

By the analysis of all wind episodes it is concluded that there are no rainstorms (Pi=0) occur in four months (June, July, August and September). In this case as the precipitation approaches zero, the PE index approaches zero and the climatic C-factor in equation (1) approaches infinity. For this reason the annual

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Thornthwait (PE_a) index was used because monthly PE_m index did not give meaningful monthly climatic C-factor.

The monthly climatic C-factor reflect the effect of wind erosivity better than the annual factors do. Therefore, use of the monthly factors climatic C-factor is highly recommended in all applications of the wind erosion equation.(. Leon, 1983).

Due to increases in air temperature and decreases in annual rainfall depth , the monthly distribution of values of C-factor shows fluctuation in their behavior .The highest values of the climatic C-factor (3.599 *M*g /ha) is observed in July whereas lower climatic C-factor values (0.274-1.413 *M*g /ha) are recorded between October to May period. According to the FAO classification (FAO-PNUMA, 1980), climatic erosivity factor C in this region was high to very high. From this point on ward, it was assumed that the climatic conditions for this period prevailed for the entire year rains occur in the period of rainy month , which is also in agreement with the high values of rainfall erosivity factor of the region. Soil moisture levels can be very low at the surface of excessively drained soils or during periods of drought, thus releasing the particles for transport by wind.

In summary, this study showed that a stronger combined effects of water and wind soil erosion are observed in this region. Soil erosion by water as compared to wind erosion (Fig 4), is a major land degradation issue and had a significant changes in soil erodibility and cause a high probability of soil loss. It is estimated that more than half of yearly erosivity is located within the risk of water erosion. Therefore, only a small part of the yearly erosive wind energy will be responsible for the soil loss in the region. .

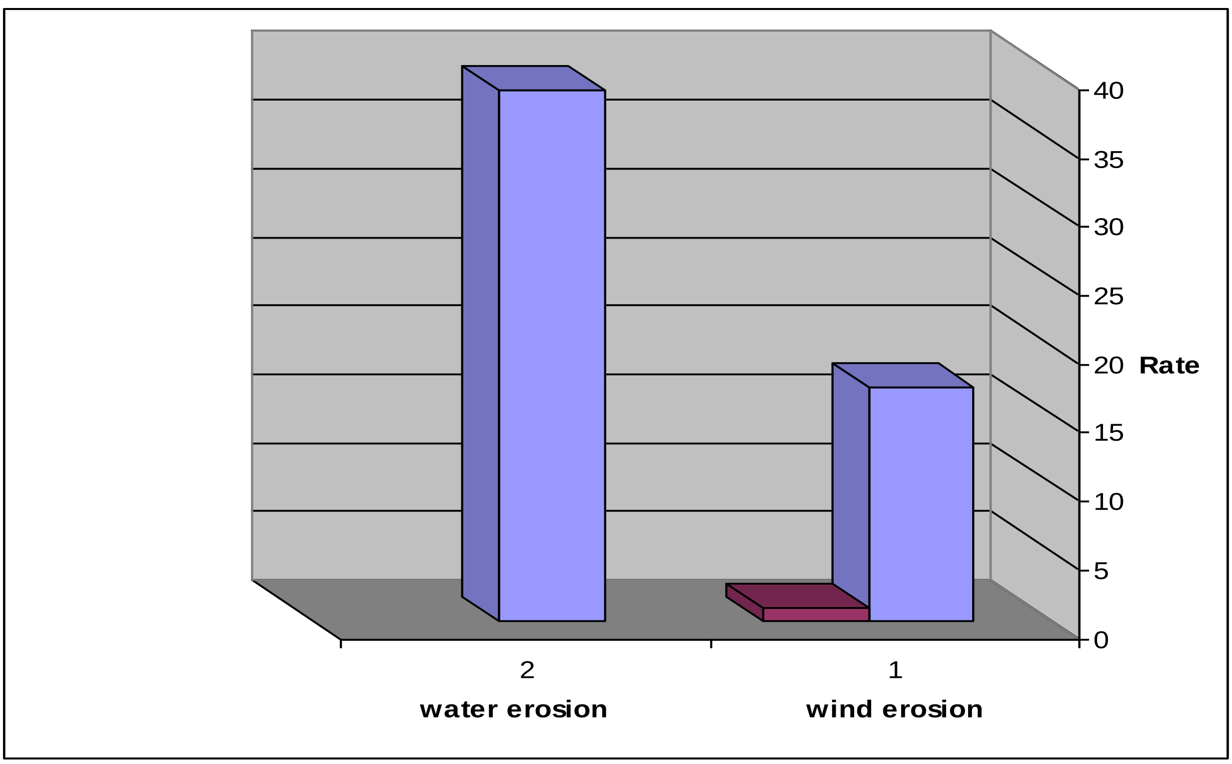

Fig. 4 . Annual rate of water and wind erosion at studied location.

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تأثير التداخل المناخي للأمطار والرياح في تعرية ترب المناطق الجافة وشبه الجافة

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المستخلص

قدر عامل قابلية المطر R و عامل قابلية الريح C على تعرية الترب تحت الظروف المناخية لمدينة الموصل / شمال العراق بالاعتماد على تحليل البيانات المناخية للفترة بين عامي ١٩٧٩ و ٢٠٠٩. حيث احتسب عامل قابلية المطر على التعرية من كميات الأمطار الشهرية والسنوية وكما حددها دليل تركيز الأمطار على أساس كمية الأمطار الشهرية .كما تم الجمع بين مؤشر ثابت ثورنثويت ومعدل سرعة الرياح لتقييم النتائج المحتملة من التعرية بفعل الرياح

أظهرت النتائج أنه على الرغم من إن المعدل السنوي للأمطار الساقطة كانت متجانسة تقريبا إلا أن هناك تباين في قابليتها على تعرية التربة. حيث إن العلاقة فيما بينهما خلال فترة الدراسة يتبع نظام النمط المنتظم إلى حد ما وبعلاقة خطية لها معامل التحديد (R^2) يساوي (٠,٦٨٤) ٠ و بسبب الزيادة في درجة حرارة الهواء وانخفاض في عمق الأمطار السنوي فقد كان التوزيع الشهري للتعرية الريحية بين 0.274 - 3.599 ميكاغرام /هكتار ٠وطبقا لتصنيف منظمة الأغذية والزراعة ، فان التعرية في هذه المنطقة تقع ضمن صنف التعرية الشديدة إلى الشديدة جدا. وان التعرية المائية لهذه المنطقة تتركز سنويا خلال الفترة من شهر كانون الاول إلى شهر نيسان. والتي هي نفس الفترة التي لها معدلات أمطار عالية في المنطقة. وماعدا ذلك فان مستويات رطوبة التربة تكون منخفضة جدا على سطح التربة خلال الأشهر الأخرى نتيجة للاستنفاذ المفرط للرطوبة مودية إلى حدوث فترات جفاف تساعد على سيادة التعرية الريحية ونقل حبيبات التربة بوساطة الرياح٠

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