International Journal of Geographical Information System Applications and Remote Sensing
"المجلة الدولية لتطبيقات نظام المعلومات الجغرافي والاستشعار عن بعد"

Vol. 4, No. 1, June, 2013
ISSN 2077-771X; Copyright © ICSRS Publication, 2013
www.i-csrs.org

The relation among climatic factor that affects the desertification in Iraq by using general linear model

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Abstract.

Desertification is regarded as one of the most problems in Iraq. There are two factors lead to desertification (human activity and climatic factors). Climatic factors were chosen to study their effect on desertification.

There are many climatic factors can cause as the most important factors which lead to desertification. Four climatic factors (Temperature, rainfall, evaporation and relatively humidity) were used to study their effect on desertification phenomena. Climatic data were taken from the Iraqi metrological department. Different climatic stations (Mosul, Kirkuk, Ramadi, Khanaqin, Baghdad, Kerbela, Najaf, Nasyria and Basrah) distributed around the country were taken. Statistical Package for the Social Sciences (SPSS) was used to estimating these data. The general linear model (GLM) is a flexible statistical model that incorporates normally distributed dependent variables and categorical or continuous independent variables was used.

In this research statistical study was done and different coefficients were calculated to compare among the climatic factors and to seen their effects on desertification phenomena in Iraq. These factors are the mean (Y), standard error (SE), standard deviation (SD) and least square difference (LSD) for the duration data from 1990 to 2011. Then the relation among climatic factors was calculated by studying the correlation coefficient among them.

Keyword: Remote Sensing, soil degradation and NDVI.

1 Introduction

Desertification which is the most important problem that threatened the people in Iraq and in the entire world. It is land degradation in arid, semi-arid and dry sub-humid areas. These phenomena started spreading worldwide at high speed since the second half of the last century [1]. It becomes a serious problem in Iraq, peoples are directly affected by desertification in Iraq and one billion people in over 100 countries are at risk. Fighting desertification is essential to ensuring the long-term productivity of inhabited drylands [1].

The desertification phenomena pass generally by four stages; these are:-

1. Deterioration of vegetation cover and erosion.
2. Drought stage (local climatic change).
3. Erosion stage.
4. Desertification stage (Sahara), in which the last phase of it is the emergence of bedrocks.

2-Study area

According to FAO (1984), Iraq, with a total area of 438 320 square kilometers of area in the Middle East including 924 km² of inland waters, the definite latitude of Iraq signifies its position in Northern Hemisphere and its moderate distance from the equator. The country of Iraq is bounded by Persian Gulf, Iran and Kuwait. It is estimated that 26% of the total area of the country estimated to be used for agriculture is 8 million ha, which is almost 93% of the cultivable area. Iraq lies between latitudes 29° and 38° N, and longitudes 39° and 49° E (a small area lies west of 39°) [2].

Topographically Iraq is shaped like a basin, consisting of the Great literally, the land between two rivers. This plain is surrounded by mountains in the north and the east, which can reach altitudes of 3 550 m above sea level, and by desert areas in the south and west, which account for over 40% of the land area.

For administrative purposes, the country is divided into 18 governorates, of which three are gathered in an autonomous region [2].

The local climate is mostly semi arid, with mild to cool winters and dry, hot, cloudless summers. The northern mountainous regions have cold winters with occasional heavy snows, sometimes causing extensive flooding.

The terrain is featured with by and large wide plain lands, high marshlands beside Iranian boundary towards south with great inundated regions. There are mountain and crag ranges all along the boundary line with the countries of Iran and Turkey [2].

3-Methods

There are missing values in the climatic values, first the data rearranged and the missing values estimated by using SPSS program. As a general rule, SPSS procedures that perform computations handle missing data by omitting the missing values. Second statistical study was done by calculating the mean ($\bar{Y}$), the standard deviation (SD), the standard error (SE) and the least square difference (LSD).

Standard deviation shows how much variation from the average mean. A low (SD) shows that the data points tend to be very close to the mean, whereas high (SD) shows the data are spread out in excess of a large range of values. The square root of the variance is called the Standard Deviation. The variance is calculated from the squares of the observations. Standard Deviation can be calculated as in the following equations [3]:-

$$SD = \sqrt{\frac{\sum(Y_i - \bar{Y})^2}{n-1}} \quad \text{---------- (1)}$$

The standard error is a process of estimation the standard deviation of the sampling distribution associated with the estimation method every statistic has a standard error associated with it. A measure of the accuracy of the statistic can be derived that the standard error of 0 represents that the statistic has no random error and the bigger represents less accurate of the statistics [4]. (SE) can be calculated by the following equation:-

$$SE = SD/\ squ\ (N) \text{ ---------- } (2)$$

Where:-
SE= the standard deviation of the mean.
N = Number of observations of the Sample.

Then the least square difference (LSD) was calculated by taken the difference by any two means and the results were compared to shown the effect of each climatic factor on desertification problem and to show if there is a relation among these factors or not.

4-Results and discussions

There are some coefficients were calculating here and comparison between them was occurred by using SPSS program. From the following results the effect of each factor (rainfall, temperature, relative humidity and evaporation) was shown and the relation between these factors was estimated too.

In the following tables the statistical coefficients (mean, SE, and SD) were calculated for each of the Iraqi stations which chosen to achieve this research.

Table (1):- Shows the statistical results for Mosul station

Variable	N	Mean	SE	SD
Temp.	261	20.745977	0.5958938	9.62695885
Hum.	254	51.0905512	1.2805716	20.4089531
Evap.	236	167.4415254	8.0656690	123.9071583
Rain	264	27.4254091	2.3056876	37.4629897

Table (2):- Shows the statistical results for Kirkuk station

Variable	N	Mean	SE	SD
Temp.	252	23.6650936	0.68241825	10.8203977
Hum.	248	46.3225806	1.2015197	18.9215505
Evap.	247	210.7817814	9.0013681	141.4676042
Rain	261	26.8709310	2.3245344	37.5540021

Table (3):- Shows the statistical results for Ramadi station

Variable	N	Mean	SE	SD
Temp.	244	23.30702105	0.6248645	9.86173
Hum.	228	52.6188596	1.1295096	17.0552211
Evap.	243	234.9563786	9.0024530	140.3343540
Rain	253	17.2411423	7.9702133	126.7740034

Table (4):- Shows the statistical results for Khanaqen station

Variable	N	Mean	SE	SD
Temp.	252	24.5367392	0.7129858	11.3171093
Hum.	243	48.1304527	1.2738105	19.8567405
Evap.	251	270.5195219	11.0017977	174.3012550
Rain	260	21.7758577	1.9360850	31.2184331
Max.	251	24.5960159	0.6326011	10.0222864

Table (5):- Shows the statistical results for Baghdad station

Variable	N	Mean	SE	SD
Temp.	252	23.98234125	0.64990865	10.31697985
Hum.	228	44.0394737	1.1001044	16.6112117
Evap.	239	269.3979079	10.4725430	161.9015853
Rain	252	8.9794881	0.9250498	14.6847098
Max.	252	23.9823413	0.5907608	9.3780374

Table (6):-Shows the statistical results for Kerbala station

Variable	N	Mean	SE	SD
Temp.	236	24.5961253	0.614589	9.4432755
Hum.	247	46.4838057	1.1068598	17.3956675
Evap.	255	234.3203922	8.7970662	140.4778823
Rain	259	14.7024363	7.7428066	124.6086800
Max.	235	24.5425532	0.6141453	9.4146695

Table (7):- Shows the statistical results for Najaf station

Variable	N	Mean	SE	SD
Temp.	256	25.64613175	0.66146265	10.5935878
Hum.	257	41.8910506	1.0298540	16.5098159
Evap.	235	303.1808511	11.7011711	179.3755567
Rain	256	7.1211836	0.7602284	12.1636550

Table (8):- Shows the statistical results for Nasyria station

Variable	N	Mean	SE	SD
temp	251	26.148008	0.606694	9.6118402
Hum.	238	39.2941176	1.1273472	17.3918663
Evap.	174	278.7807471	12.9790145	171.2049593
Rain	253	26.3992806	11.1808443	177.8422153

Table (9):- Shows the statistical results for Basra station

Variable	N	Mean	SE	SD
Temp.	242	28.29545455	0.7067191	10.99396945
Hum.	240	40.3416667	1.1106966	17.2068371
Evap.	194	265.2257732	11.6786460	162.6647159
Rain	250	11.5929000	1.2403621	19.6118466
Max.	242	28.2954545	0.6077907	9.4550037

Table (10):- The correlation analysis shows the simple statistics

Var.	N	Mean	SD	Sum.	Min.	Max.
Temp.	2246	24.5207	10.5266	55092	7.2	82.0000
Hum.	2183	45.5705	18.4843	99480	6.8000	143.1000
Evap.	2074	246.8279	159.8729	511921	18.1000	729.9000
Rain	2308	18.0886	86.6756	41748	0	2011

Table (11):-Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	Max.	Min.	Hum.	Evap.	Rain
Temp.	1.843905 0.00005 2245	0.843905 0.00005 2240.5	-0.73738 0.0001 2167.5	0.756905 0.0001 2013.5	-0.181925 0.0001 2234
Hum.	-0.79103 0.0001 2169	-0.68373 0.0001 2166	1.00000 0.0 2183	1.00000 0.0 1974	0.25646 0.0001 2167
Evap.	0.80672 0.0001 2015	0.70709 0.0001 2012	-0.80596 0.0001 1974	1.00000 0.0 2074	-0.20614 0.0001 2058
Rain	-0.19807 0.0001 2232	-0.16578 0.0001 2225	0.25646 0.0001 2167	-0.20614 0.0001 2058	1.00000 0.0 2308

Table (12):- Shows the least square difference (LSD) for each of the parameters used in this study.

Parameters	LSD
Mean Temp. with year	1.022*
Year with RH	2.378
Year with Evap.	17.881
Year with Rain	7.23
Station with Temp.	0.641
Station with RH	1.462
Station Evap.	11.093
Station with rain	14.61
Month with Temp	0.740
Month with Evap.	12.72
Month with Rain	16.87
Moth with RH	1.687

Table 13. Correlation coefficient between parameter in this study

Parameters	Max. Temp.	Min.Temp.	Humidity %	Evaporation	Rain full
Max. Temp.	.	0.68 **	- 0.79 **	0.80 **	- 0.20 **
Min. Temp.	-	.	- 0.68 **	0.71 **	- 0.16 **
Humidity %	-	-	.	- 0.80 **	0.25 **
Evaporation	-	-	-	.	- 0.20 **
Rain full	-	-	-	-	.
** (P<0.01)					

There is a variation in each of the climatic factors (temperature, rainfall, relatively humidity and evaporation) along the period of study (1990 – 2011).

Temperatures warm quickly once rainfall begins to taper off and skies clear of the last storm clouds. Because of the arid atmosphere, the diurnal temperature spread between daily highs and lows spread as rainfall slows and then stops. Summer is hot and dry throughout Iraq and the desert is the hottest part of the country. Diurnal temperature spreads are the widest of the year in summer because the air is so dry it cannot retain heat after sunset.

5. Conclusion

There is a relation between the three factors which used to perform this study (months, years and stations). The different in (mean, standard deviation, standard error and least square difference) values among the month and the different in mean values among the year and their relation with the stations. From these relations the most station which has the high temperatures according the period of study is Basra station. Basra station is the hottest station according to these results.

Roughly 90 percent of the annual rainfall occurs in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, are dry.

Mean minimum temperatures in the winter range from near freezing (just before dawn) in the northern and northeastern foothills and the western desert to 2o-3° C and 4o-5° C in the alluvial plains of southern Iraq. They rise to a mean maximum of about 15.5° C in the western desert and the northeast, and 16.6° C in the south. In the summer mean minimum temperatures range from about 22.2° C to about 29° C and rise to maximums between roughly 37.7o and 43.3° C. They are more likely, however, to go over 46° C in the summer months, and several stations have records of over 48° C.

The combination of rain shortage and extreme heat makes much of Iraq a desert. Because of very high rates of evaporation, soil and plants rapidly lose the little moisture obtained from the rain, and vegetation could not survive without

extensive irrigation. Some areas, however, although arid do have natural vegetation in contrast to the desert. For example, in the Zagros Mountains in northeastern Iraq there is permanent vegetation, such as oak trees, and date palms are found in the south.

There is a relation between the three factors which used to perform this study (months, years and stations). The different in (mean and standard deviation) values among the month and the different in mean values among the year and their relation with the stations. From these relations the most desertification station can be determined as Basra station with a mean of temperature (28.29) ^{0}C and standard deviation (9.45). Basra station is the hottest station according to these results.

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