Spatial and Temporal Variation of Rainfall in Iraq

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Abstract

Rainfall in Iraq is categorized by unorganized dissemination of both spatial and temporal. The annual, seasonal and monthly mean rainfall contrastsconsider with years. The documented rainfall quantity in the different atmospheric stations varies from location to another conferring to sea surface elevation and the geographical position of meteorological stations. Dissimilarity of rainfall with space and time were studied in Iraq for the period (1980-2010) using 22 meteorological stations. Mean monthly, seasonally and annually values of rainfall were found in dissimilar meteorological stations. Winter months characterize about (42-56) % of total annual rainfall. The annual unpredictability of rainfall in all these stations is high. Isohyet method was used to estimate the mean monthly values of rainfall in Iraq. Simple and Various Regression Equations were found in Mosul, Baghdad and Basrah stations between rainfall and dissimilar meteorological fundamentals.

I. INTRODUCTION

Rainfall investigation is significant in dissimilar domains such as agricultural planning, water resources planning, runoff prediction, climatologically studies,conservationalstudies, stream flow estimation and human life activities. (1, 2, 3) The amount, concentration and areal distribution of rainfall are indispensable factors in many hydrologic studies. (4, 5) Rainfall varies geographically, temporally and seasonally. (6, 7) Provincial and regular variation of rainfall is very important for water resource planning. Temporal of rainfall concentration are extremely important in the rainfall- runoff process in urban area. (8) Rainfall is also highly artificial by meteorological elements and elevation from sea level, so simple and multiple correlations were found between these variables. (9, 10) Iraq is located between latitude (29.5°- 37.22°N) and longitude (38.45°- 48.45°E). Fig (1) show the locations of (22) meteorological stations studied in Iraq. The latitude, longitude and altitude for the different meteorological stations were accessible in table (1). The objective of this research is to study the variation of rainfall with space and time in Iraq and to find simple and multiple relationships between the mean monthly values of rainfall and other meteorological elements.

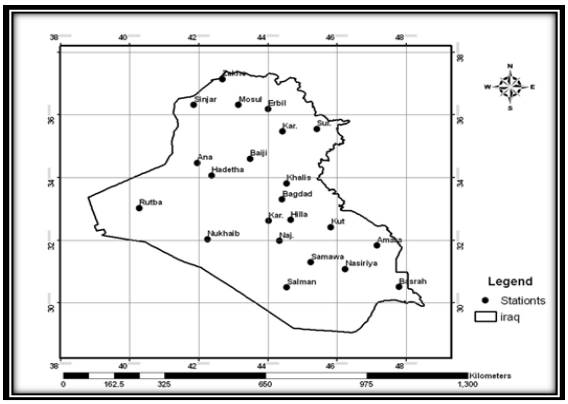

Fig (1): Map of Iraq and Location of Meteorological Stations

II. MATERIAL METHODS

The rainfall year in Iraq is from 1 October to 31 May. Rainfall data for 22 Meteorological stations were collected for the period (1980-2010).

In our research we study:

1- Malicious Monthly, seasonally and annually values of rainfall in all the 22 climatological stations spread in Iraq.

2- Isohyetal method was used to approximation the mean monthly values of rainfall in Iraq using the GIS program.

3- Three places, Mosul in the north of Iraq, Baghdad in the middle of Iraq and Basrah in the south of Iraq were used to find unpretentious and multiple regressions calculationsamong the mean monthly values of rainfall and other meteorological elements (Mean Air Temperature, Relative Humidity, Cloudiness, Atmospheric Pressure, and Evaporation).

III. RESULT AND DISCUSSIONS

A. *Study of Mean Monthly, Seasonally and Annually Rainfall in all Stations.*

a) The northern stations (Sulaimaniya, Zakho, Erbil, Kirkuk, Mosuland Sinjar) show high values of mean monthly rainfall in associating with the middle and southern stations in Iraq. The topography, atmospheric hopelessness and the nature of air masses blowing from the neighboring areas play an important role in the variation of monthly value of rainfall in these locations.

b) May and October gives the lowest values of rainfall in all positions in associating with the other rainy months.

c) November and April gave value of rainfall larger than May and October but less than the other rainy months.

d) December, January, February and March gave the maximum values of rainfall in matching with the other rainy months in all stations.

e) Sulaimaniya station shows always the maximum value of rainfall, while Nukhaib station shows the lowest value. Winter month receives about (42-56) % of the annual rainfall and thus it characterizes the wettest season of the year. The vernal season accepts a valuable amount rainfall and contributes (27-32) % of the total annual rainfall. The autumn season subsidize (15-27) % of the total annual rainfall. Summer season receive less than 0.5% of the total annual rainfall and for the most of the times can be mistreated. The mean annual value of rainfall varies from location to another conferring to sea surface elevation of meteorological stations. The maximum mean annual value of rainfall was acquired in Sulaimaniya station (717) mm and lowest mean annual value was in Nukhaib station (87) mm.

B. *Study of Mean Areal Rainfall in IRAQ*

The main hydro meteorological problem associated to the areal variation of rainfall is the assessment of rainfall over a given period of time. Isohyetal process was used to estimate the mean areal rainfall over Iraq. Fig (2) and Fig (3) showed the dissemination of mean monthly values of rainfall in (mm) during winter and spring months. Two main areas can be acknowledged; the first one north of (35°) latitude and the second one are in the south of (35°) latitude. Fig (4) showed the circulation of mean monthly values of rainfall during October and November. Three main areas can be identified; the first one in the further most of north and north east of Iraq, the second area extent to (35°), the third area is in the south of (35°). The mean areal rainfall over Iraq during the raining months are (10.5, 24.7, 33.8, 32.6, 32, 30.3, 22.3, and 7.8) mm in October, November, December, January, February, March, April and may correspondingly.

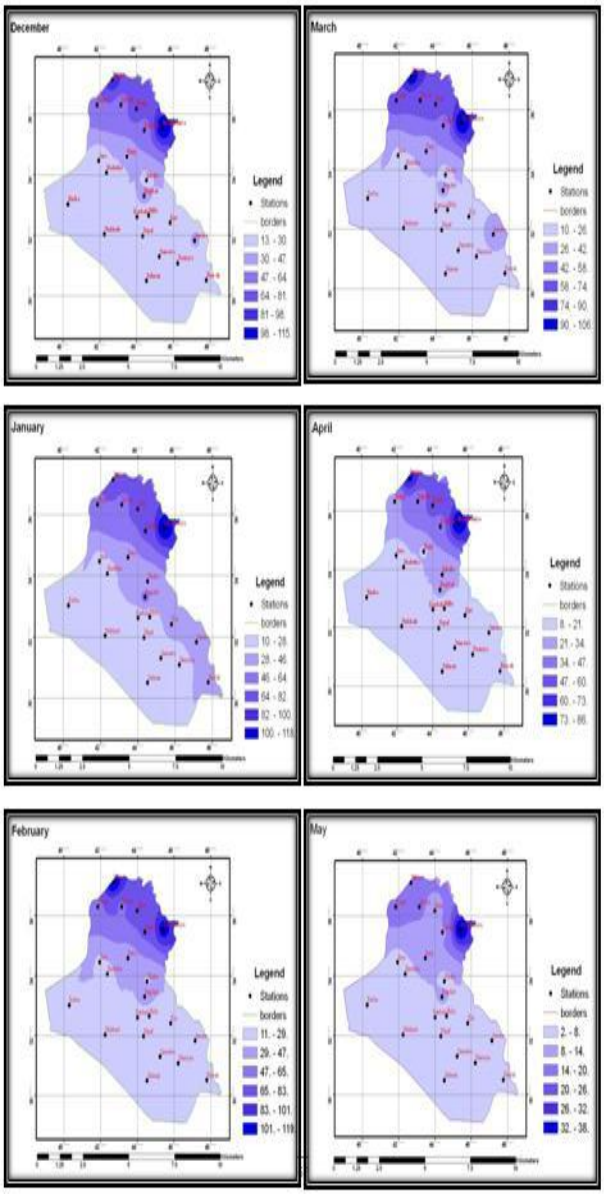

Fig (2) and (3) Isohyetal Map of Iraq During Winter Season and Spring Season

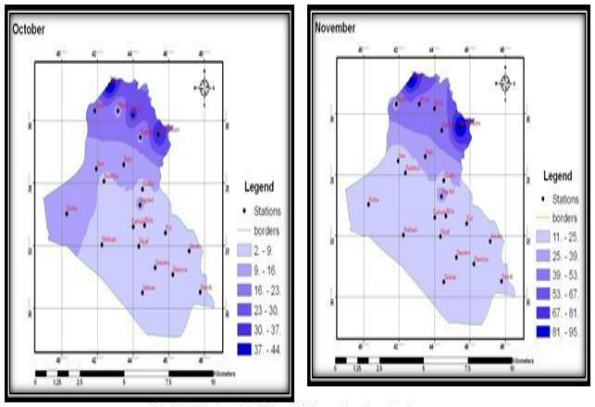

Fig (4): Isohyetal Map of Iraq during Autumn season

C. Correlations Between Rainfall and Different Meteorological Elements in Three Locations in IRAQ

Mosul, Baghad and Basrah were chosen to study the associationsamong mean monthly values of rainfall and mean monthly values of dissimilar meteorological elements, Fig (5) show these correlations. A highly positive correspondence were obtained between mean monthly values of rainfall and mean monthly values of (Relative Humidity, Cloudiness, atmospheric pressure) in these stations. The values of association coefficients (R) between (Rainfall & RH) are (0.94, 0.90, 0.94), and between (Rainfall & Cloudiness) are (0.87, 0.83, 0.80) and between (Rainfall & atm. Pressure) are (0.76, 0.86, 0.88) in Mosul, Baghdad and Basrah correspondingly. A highly negative association was obtained between mean monthly values of rainfall and mean monthly values of (Air Temperature, Evaporation). The values of correlation coefficient of (R) between (Rainfall & Temp.) are (-0.95, -0.94, -0.95), and between (Rainfall & Evap.) are (-0.87, -0.84, -0.88) in Mosul, Baghdad and Basrah correspondingly. Multiple correlations were obtained between the mean monthly values of rainfall and the mean monthly values of the meteorological elements (Temperature, Relative Humidity, Atmospheric pressure, Cloudiness, Evaporation). Table (4) shows these multiple associations and their correlation coefficients. These correlations are very important for hydrological and climatologically studies.

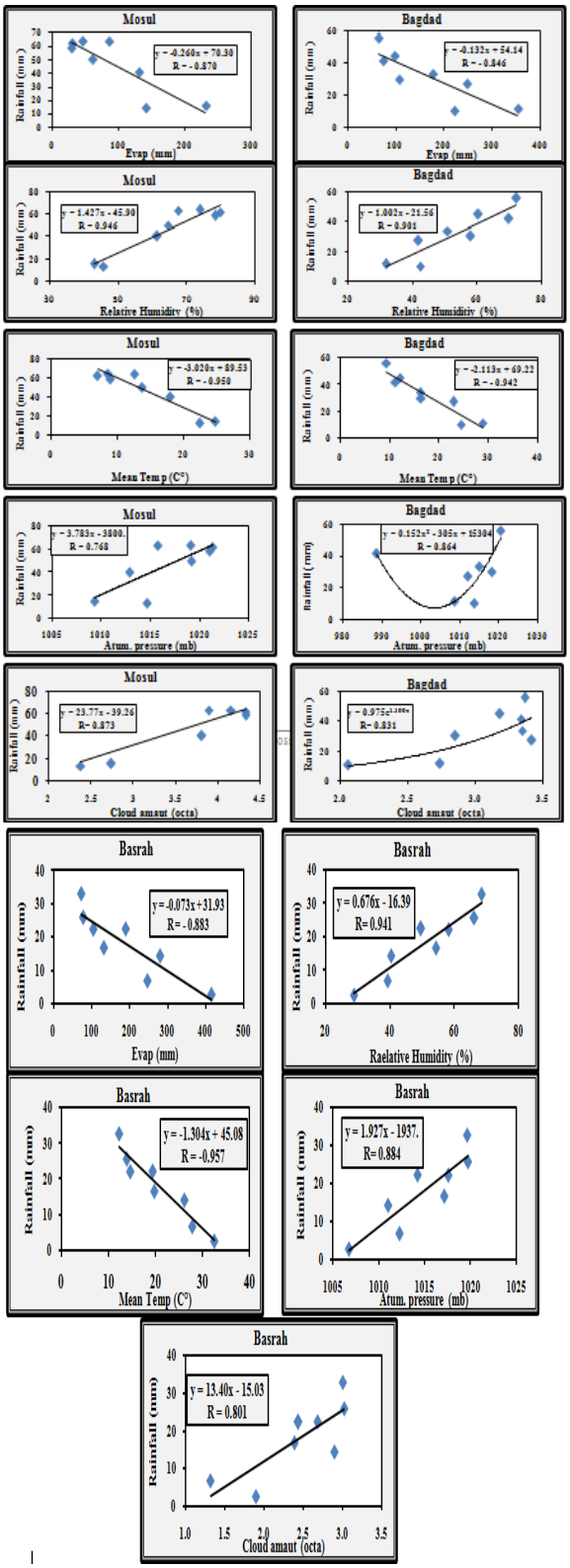

Fig (5): Correlations of the Mean Monthly Values of Rainfall and Different Meteorological Elements in Mosul, Baghdad, and Basrah Stations

Stations	Equations	R
Mosul	**Rainfall = -0.242*Evap+1.413*RH-4.487*Tmean -8.061*Pressur-20.9*Cloud +8312.6**	**0.996**
Bagdad	**Rainfall = 0.106*Evap + 0.867*RH – 1.528*Tmean +0.296*Pressure +9.033*Cloud – 332.357**	**0.993**
Basrah	**Rainfall = -2.20*Evap + 1.894*RH + 0.554* Tmean – 8.717*Pressure + 1.70*Cloud + 8794.1**	**0.999**

Table (4): Multiple Correlations Between Rainfall and All The Other Meteorological Elements in Mosul, Bagdad and Basrah Stations.

IV. CONCLUSION

1- Mean monthly values of rainfall all over Iraq that is premeditated by contour lines method are (33.8, 32.6, 32, 30.2, 22.6, 7.8, 10.5, 24.7) mm throughout December, January, February, March, April, May, October, November months respectively.

2- The dissemination maps of mean monthly values of rainfall in Iraq during ending and spring months showed two main areas, first one northern of 35° latitude, second one is in south of it. During Oct and Nov three areas had been categorized, the first one is in additional most of north and north east of Iraq, the second one extend to (35°) latitude and the third one in south of (35°) latitude.

3- Simple regression equations were found among mean monthly values of rainfall and mean monthly values of dissimilarmeteorological fundamentals (Mean Air Temperature, Relative Humidity, Cloudiness, Atmospheric Pressure, and Evaporation) in station of Mosul, Baghdad and Basrah station. These correspondences gave high correlation constant between these variables.

4- Several regression equations were found among mean monthly values of rainfall and mean monthly values of changed meteorological elements which gave high correlation coefficient (0.996, 0.993, and 0.999) in Mosul, Baghdad, Basrah respectively.

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