A Study of Change in Rainfall Pattern in Dhatarwadi Reservoir Catchment, Amreli, Gujarat

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Abstract--- The impact of climate change on water resources have received much attention globally especially in last 30 years. Rainfall, the main driver of the hydrological cycle, has been varying in part of the world in various ways. Rainfall is the main source of water. But rainfall is scares and erratic in Gujarat especially in Saurashtra region. So, its preservation and conservation has become the most important aspect in relation to the water resources development planning. Its magnitude, variation and distribution plays important role in hydrological response of the area. The analysis of rainfall records for long period provides information about rainfall pattern and variability. And also rainfall studies are utmost utility for understanding nature and behavior of climate change. In this study, trends in rainfall, maximum rainfall intensity and rainy day for 1961-2011 were examined for Dhatarwadi reservoir catchment, Amreli and also decade wise monthly rainfall variation were examined. Linear regression technique were used to determine climatic trends and conclusions are derived.

Keywords: Climate change, Linear regression, Rainfall Pattern, Rainfall variation, Trend

I. INTRODUCTION

Water is a vital natural resource which forms the basis of all life. Rainfall is the meteorological phenomenon that has the greatest impact on human activities and the most important environmental factor limiting the development of semi-arid regions. And also rainfall is scares and erratic in Gujarat especially in Saurashtra region. So, its preservation and conservation has become the most important aspect in relation to the water resources development planning. Its magnitude, variation and distribution plays important role in hydrological response of the area.

The impact of climate change on water resources has received much attention globally. In case of India, the climate change expected to adversely affect its natural resources, forestry, agriculture, and change in precipitation, temperature, monsoon timing and extreme events (M. H. Fulekar, R. K. Kale, [4]). Due to global warming, precipitation amount, type and timing are changing or are expected to change because of increased evaporation, especially in the tropics (Ritter, [10]). The analysis of rainfall records for long period provides information about rainfall pattern and variability (Lazaro *et al.*, [8]). The main objective of this paper is to analyses the rainfall data to study variation in rainfall pattern.

II. STUDY AREA

The Dhatarwadi Irrigation scheme is situated on river Dhatarwadi near village Bhakshi of Rajula Taluka of Amreli District. The latitude and longitude of the site are 71° 26' and 21° 18' respectively as shown in figure 1. The river has number of tributaries on its way. The river Surajwadi is one of the major tributaries which meets river Dhatarwadi just upstream of dam.

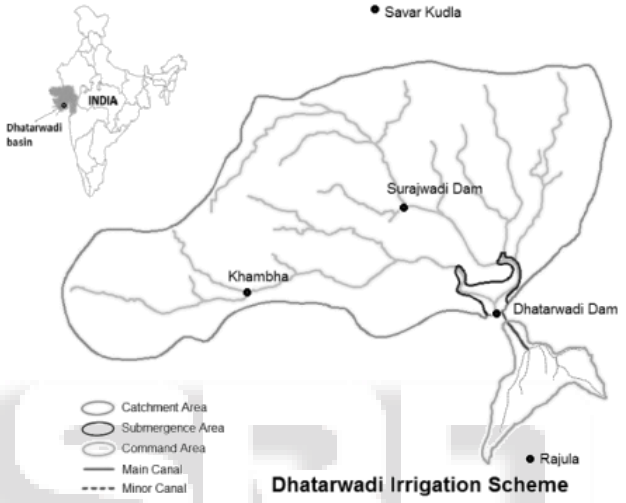

Fig. 1: Map of Dhatarwadi Reservoir Catchment, Amreli.

The average rainfall in the Dhatarwadi river basin is 565 mm. The winter season start from the month of November and ends in the middle of March with minimum temperatures being 18.88 ^{0}C and 19.44 ^{0}C respectively, during the coldest month is January. The summer comprises of the months from middle of March to middle of June, mid-April to mid of June being hottest period during year. The rainy season commences from the mid of June and ends in Sept.-October are of seldom occurrence.

III. DATA AND METHODOLOGY

The data used in this paper are monthly average of total mean rainfall (mm), maximum rainfall intensity of the month (mm/day) and rainy days during 1961 – 2011. The yearly averages were calculated from monthly readings which are provided by the State Water Data Centre (SWDC), Gandhinagar and Irrigation Department, Bhavnagar. For average depth of rainfall over basin, Thession polygon methods were used. The trend is determined by the relationship between the two variable as rainfall and time. The statistical method such as linear regression analysis and coefficient of determination R^2 are used. The equation of a linear regression line given as:

$$\mathbf{y = ax + b}$$

Where, y is the observation on the dependent variable, x is the observation on the independent variable, a is the slope of the line and b is an intercept of the vertical axis.

The drawing of the scattered diagrams and fitting of the regression lines were done in Microsoft Excel.

IV. RESULT AND DISCUSSION

A. Trend Analysis of Monthly Mean of Total Mean Rainfall (TMRF)

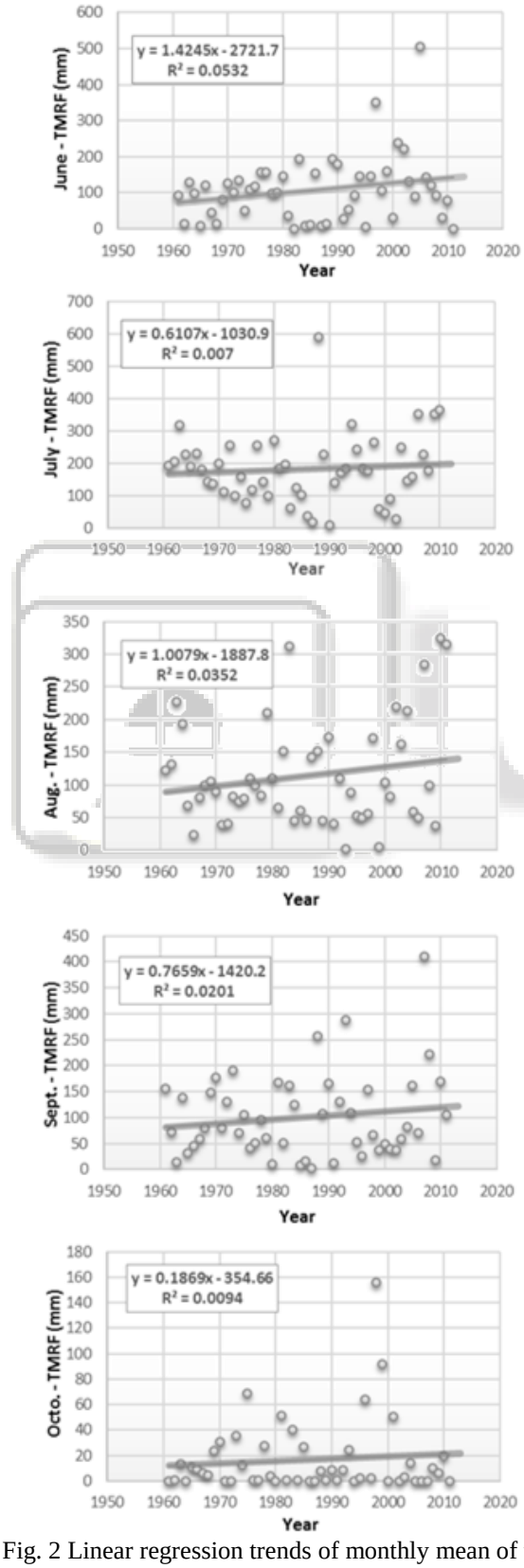

Fig. 2 Linear regression trends of monthly mean of total mean rainfall.

The trends of monthly mean of total mean rainfall over different years were obtained using linear regression best fit lines. The linear regression trends with their linear regression equations and coefficient of determinations for the months from June to October (Monsoon season) are represented in figure 2.

It is evident from figure 2 that monthly mean of TMRF have increased significantly for the months June to October but highest increase in TMRF occurs in June and has increased by 71.225 mm during last 50 years.

B. Trend Analysis of Annual Mean of total Mean Rainfall (TMRF)

From the figure 3, the annual mean of total mean rainfall observed an increasing trend having an increase 3.7594 mm per year. This implies that in Dhatarwadi reservoir catchment annual rainfall has increased by 187.97 mm during last 50 years.

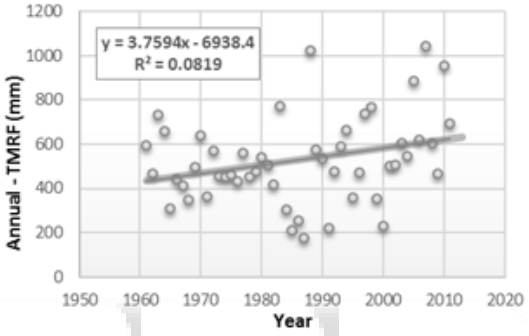

Fig. 3: Linear regression trends of annual mean of total mean rainfall.

C. Trend Analysis of Annual Maximum Daily Rainfall Intensity and Annual Rainy Day

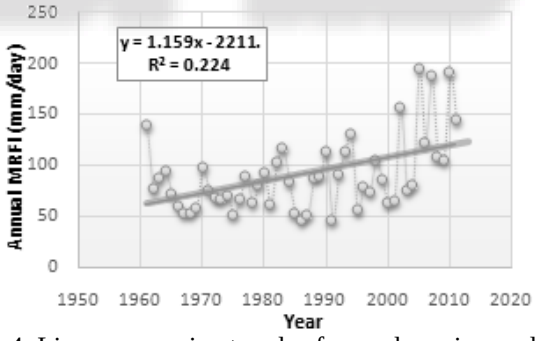

Fig. 4: Linear regression trends of annual maximum daily rainfall intensity (mm/day)

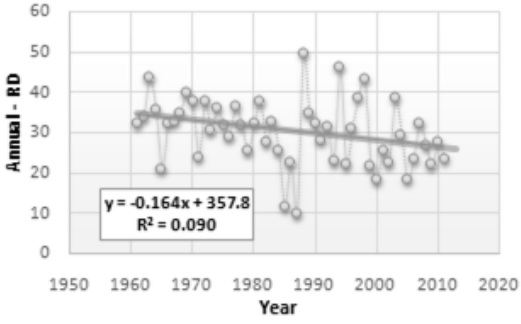

Fig. 5: Linear regression trends of annual rainy days.

Figure 4 indicate the trend for annual maximum rainfall intensity (mm/day) is increasing, which implies that there is a positive linear relationship between Annual MRFI and

Time.

Figure 5 indicate the trend for annual rainy days is decreasing, which implies that there is a negative linear relationship between Annual Rainy Day (RD) and time.

D. Monthly Rainfall Pattern

From table 1 and figure 6 indicate that rainfall variation for first 20 years (1961-1980) and second 20 years (1981-2000) are similar rainfall pattern whereas it differs for last decade (2001-2011) because of the change in magnitude however the overall trend is similar.

Month	Monthly Average Rainfall (mm)		
	1961-1980	1981-2000	2001-2011
June	95.09	95.08	150.52
July	179.91	166.84	215.84
August	103.87	93.92	167.96
September	88.32	99.80	133.94
October	12.41	24.34	9.42

Table 1: Monthly rainfall variation for 1961-1980, 1981-2000 and 2001-2011

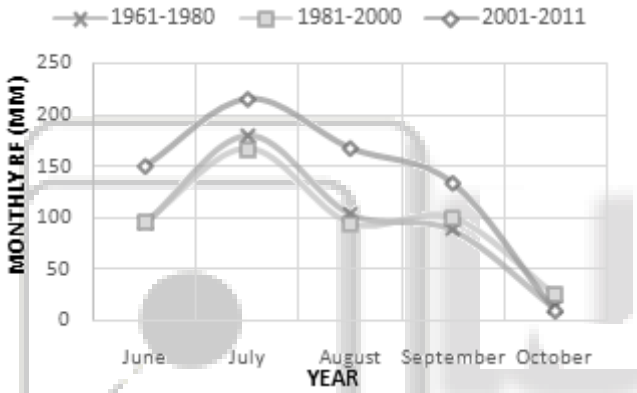

Fig. 6: Monthly rainfall variation for 1961-1980, 1981-2000 and 2001-2011.

Climate change is a continuous process but it is analysed in this study that there is a significantly change in rainfall over last decade.

V. CONCLUSION

Long term data analysed for 50 years (1961-2011) annual data suggest that there is a significantly change in rainfall over last decade. However an annual rainfall is the erratic with wide range from 1077 mm maximum and 157 mm minimum in Dhatarwadi reservoir catchment, Amreli. It observed that Monthly mean of total mean rainfall (TMRF) have increased significantly for the months June to October but highest increase in TMRF occurs in June and has increased by 71.225 mm during last 50 years. And also annual maximum daily rainfall intensity increased by 1.1593 mm per year and annual rainy days decreased by 0.1648 mm per year. From the average monthly rainfall analysis, it is observed that rainfall variation for first 20 years (1961-1980) and second 20 years (1981-2000) are similar rainfall pattern whereas it differs for last decade (2001-2011) because of the change in magnitude however the overall trend is similar. Average monthly rainfall analysis indicates there is maximum rainfall in month of June and minimum rainfall in month of October.

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