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Earth Science

STATISTICAL AND TREND ANALYSIS OF RAINFALL OF KATANGORE MANDAL OF NALGONDA DISTRICT, TELANAGANA STATE

Dr. K. Madhusudhan Reddy — Department of Geology, Mahatma Gandhi University, Nalgonda District 1 Action for Food Production, Hyderabad 2

Dr. K. Krishnakumar* — Department of Geology, Mahatma Gandhi University, Nalgonda District 1 Action for Food Production, Hyderabad 2*Corresponding Author

ABSTRACT Rainfall is the one of the important source for the all needs to the people in the study area. It lies on the national highway no 65; situated 100 kilometers from the Hyderabad. The present study deals with the statistical analysis of 29 years rainfall data, seasonal, annual, monthly trend of the rainfall by applying linear regression model. The study reveals that coefficient of skewness is positive. Highest mean, median, standard deviation, variance, coefficient of variance, and coeeficient of skewness is 159.8 mm, 156.8 mm, 124.3 mm, 15454.5, 2.84 and 2.08 respectively. Of the average total rainfall 70% was contributed in monsoon; and in post monsoon 20%, in pre monsoon 8% and winter 2% was contributed in the study area. It is observed that decreasing trend is happened in annual, monsoon, winter and pre monsoon seasons where as in post monsoon there was no trend. Average highest monthly rainfall was received in the month of September in the monsoon season and lowest rainfall was recorded in the month of December in the post monsoon.

KEYWORDS : Rainfall, Trend, statistical analysis, Katangore mandal

INTRODUCTION

Climate change is the alarming issue for the world. Nation like India which is based on the agriculture economy depends on the rainfall. If any change in rainfall in a year may affect the economy and also cause threat to the food security of the country (Sabyasachi Swain et al, 2015). Rainfall is the most important meteorological parameter for analysis of wide range of applications and predictions of flood events, climate analysis, climate diagnostic studies and global energy and water budget studies (S. G. Narkhedkar et al, 2010). Rainfall is the one of the impartment climate parameters affects the stream flow, rain fed agriculture. The global average precipitation is likely to increase, although at regional and continental scales, this may either increase or decrease (N.S. Abeysingha, et al, 2014). Of all the climatic parameters rainfall is an important input, which controls the total cropped area under rained conditions. The timely accuracy of the rainfall is important for crop growth. Any serious departure from the normal rainfall leads to a great stress (Rana Bora et al, (2015). The trend analysis of rainfall and other climatic variables on different spatial scales will help in the construction of future climate scenarios (Sharad K. Jain, et al, 2012).

Study area

The study area Katangore is one of the mandal of Nalgonda district of Telangana State situated 100 kilometers away from the Hyderabad on the nation highway number 65.

MATERIAL AND METHODOLOGY

Twenty nine years monthly rainfall data i.e. from June 1988 to May 2017 has been collected from the district groundwater department to analyse the trend and statistical analysis of the region. The statistical parameters such as mean, median, standard deviation, variance, and coefficient of variation have been calculated in MS Excel. Trend analysis is generated by linear regression in MS Excel.

Linear Regression Model:

The linear regression line was fitted using the most common method of least squares. This method calculates the best fitting line for the observed data by minimizing the sum of the squares of the vertical deviations from each data point to the line. If a point lies exactly on the straight line then the algebraic sum of the residuals is zero. Residuals are defined as the difference between an observation at a point in time and the value read from the trend line at that point in time. A point that lies far from the line has a large residual value and is known as an outlier or, an extreme value.

The equation of a linear regression line is given as $y = a + bx$

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

The estimate of intercept 'a' and the regression coefficient 'b' by the least square method; i.e.

$$\hat{a} = \bar{y} - \hat{b}\,\bar{x}$$

$$\hat{b} = \Sigma \frac{(x-\bar{x})(y-\bar{y})}{\Sigma (x-\bar{x})^2}, \text{ and}$$

Coefficient of determination, R2 = (SS due to Regression) / (Total SS)

$$= \frac{\Sigma(\hat{y}i-\bar{y})^2}{\Sigma(yi-\bar{y})^2}$$

In order to fit regression lines of the in rainy season monthly average Rainfall (dependent variables) against time (independent variable) in years were plotted. Linear regression lines were then fitted to determine the trends of rainfall. The drawing of the diagrams and the fitting of the regression lines were done in Microsoft Excel (Mallika Roy, 2013)

Trend

By secular trend or simply trend we mean the general tendency of the data to increase or decrease during a long period of time. Rainfall data are made over time and therefore are referred to as time series data, which is defined as a sequence of observations that varies over time. Trend is defined as the general movement of a series over an extended period of time or it is the long-term change in the dependent variable over a long period of time. Trend is determined by the relationship between the two variables rainfall and time. To observe the trend of annual and seasonal average rainfall for the study area and trend values have been calculated by using least square method (Asmita Ramkrishna Murumkar, 2014; Ishappa Muniyappa Rathod (2010).

Mean: Mean is an arithmetic average of a set of values. It can be measured by the following formula:

$$\text{Mean (X)} = \Sigma x \div N;$$

Where x is the rainfall variability; and N is number of years

Median: The median value in a set of numbers is that value that divides the set into equal halves when all the numbers have been ordered from lowest to highest. Thus, when the median value has been derived, half of all the numbers in the set should be above that score, and half should be below that score.

Standard deviation: The standard deviation gives an approximate value of the average amount each number in a set varies from the centre value.

Standard deviation (σ) = $\sqrt{\sum(x-X)^2/N}$

Variance: It has an intimate mathematical relationship with standard deviation. Variance is defined as the average of the square of the deviations of a set of scores from their mean.

Variance (S) = $\sqrt{\sum(x-X)^2/N\text{-}1}$

Coefficient of variation (CV):
The coefficient of variation (CV) is a measure of relative variability. It is the ratio of the standard deviation to the mean(average).

Coefficient of Skewness (CS): Skewness formula is: (mean-mode)/σ

RESULTS AND DISCUSSIONS

Statistical analysis

The results shows that of the 29 years, highest mean (159.8 mm) and median (156.4 mm) monthly rainfall of the study area occurred in the month of September i.e., in pre monsoon season; and highest standard deviation (124.3) and variance (15454.5) is recorded in the month of October i.e., in post monsoon season where as highest coefficient of variation (2.84) happened in November i.e., in post monsoon where as highest coefficient of skewness (2.08) recorded in August i.e. monsoon season and data is positively skewed (Table 1), (G Arvind et al, 2017).

Table 1: Results of statistical analysis of monthly rainfall

Month	Mean	Median	Standard Deviation	Variance	CV	CS
June	76.9	64.0	51.5	2647.6	0.67	0.19
July	151.2	145.6	97.3	9461.7	0.64	1.55
August	148.4	148.2	71.5	5109.0	0.48	2.08
September	159.8	156.4	99.8	9959.9	0.62	1.60
October	117.7	92.0	124.3	15454.5	1.06	0.95
November	28.5	19.2	33.0	1088.4	1.16	0.86
December	6.1	0.0	17.2	296.4	2.84	0.35
January	10.6	0.0	21.1	445.5	1.99	0.50
February	7.8	0.0	17.4	302.0	2.22	0.45
March	12.4	0.0	23.9	569.1	1.92	0.52
April	13.3	4.0	20.3	412.9	1.53	0.65
May	36.8	18.8	47.4	2245.5	1.29	0.78

Seasonality analysis

Of the 29 years, 70 percent of rainfall had been contributed in the monsoon season i.e. 536.3 mm of average annual rainfall (769.6 mm). In post monsoon 20 %, i.e. 152.3 mm; in winter season 2%, i.e. 18.4 mm and remaining 8%, i.e. 62.5 mm in pre monsoon season (Figure 1).

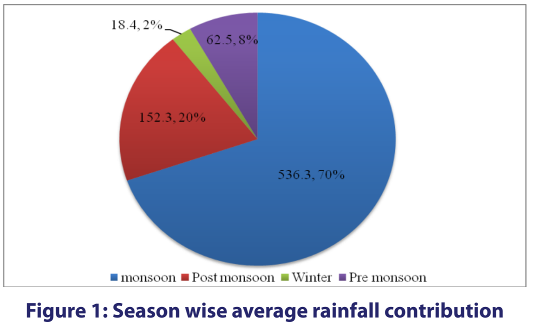

Figure 1: Season wise average rainfall contribution

Trend analysis

Seasonal trend:
According to the Indian Meteorological Department, four prominent seasons namely: 1) winter (January and February), 2) summer or pre monsoon (March to May), 3) monsoon (June to September) and 4) post-monsoon (October and December) are present in India (U.S.DE, et al, 2004). Annual and seasonal linear graphs are prepared and analysed. In the graphs trend-lines were assigned to each of these linear graphs; and the option "display R2 value on chart" is chosen to indicate the significance of the trend-line. R2 is most often seen as a number between 0 and 1.0, used to describe how well a regression line fits a set of data. R2 near 1.0 indicates that a regression line fits the data well, while an R2 closer to 0 indicates a regression line does not fit the data very well. Figure 2, reveals that trend of the annual, monsoon, post monsoon, winter and pre monsoon rainfall is decreasing with R2 value 0.02, 0.01, 0.01, 0.04, and 0.09 respectively; no trend in rainfall pattern in the post monsoon season which shown R^2 value is 0.00 (M. Rajeevan, eta al., 2006).

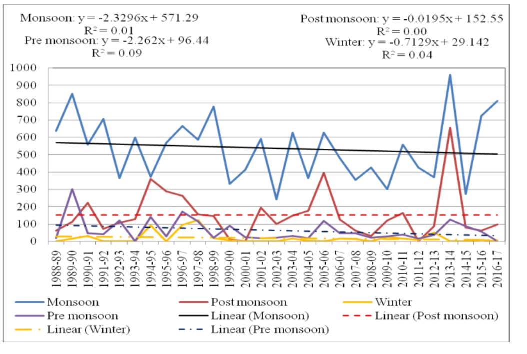

Figure 2: Seasonal rainfall trend of the Katangore mandal

Annual trend:
Figure 3 describes, of the 29 years, highest rainfall received in 2013-14 (1,741.8 mm) where as lowest recorded in 2003-04 (363.1 mm). It is clear of the about 15 years had received more than normal rainfall (753.3 mm) where as remaining years had less than normal rainfall; that indicates the study area has mixed experience regarding the rainfall received and water resources availability of the area. Linear trend of the annual rainfall shows the decreasing trend with R2 value 0.02.

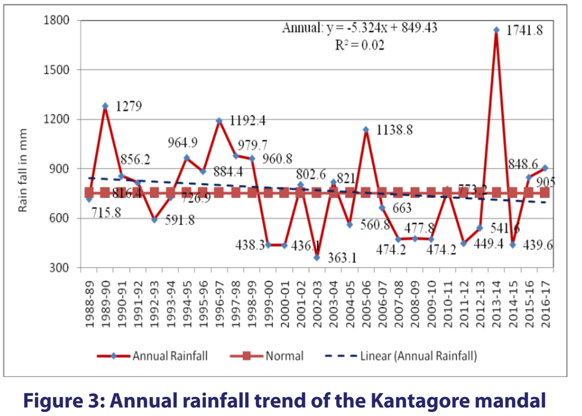

Figure 3: Annual rainfall trend of the Kantagore mandal

Average monthly trend analysis
Figure 4 depicts that of all months, in monsoon period September get the maximum rainfall (159.83 mm), followed by July (151.20 mm) and August (148.39 mm) and June (76.92 mm). In post monsoon season receiving of rainfall had been gradually decreased from October (117.68 mm), November (37.61 mm) to December (6.05 mm) which was experienced lowest rainfall. From beginning of the winter season i.e. January (10.6 mm), the trend of the rainfall was gradually increased to the end of the hydrological season i.e. May (36.82 mm).

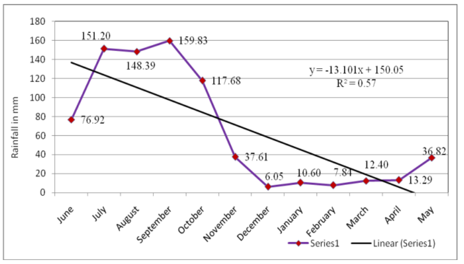

Figure 4: Average monthly rainfall trend of the Katangore mandal

CONCLUSIONS

The analysis is revealed that rainfall tend is decreasing in all seasons except post monsoon season which shows the no trend indicates upcoming situation in terms of availability of water resources. It affects the productivity of crops, water sources availability as well as livelihood of the people. Construction of water harvesting structures is useful to increase the availability of groundwater which is the major water source in the study area.

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