Analysis of Station Wise Rainfall Distribution and its Variation over Latur District (Maharashtra)

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Abstract: *The study of climatic parameters is the need of time, because it changing over a time and place. The climate is directly connected to primary activities and indirectly to secondary and other activities of society. The present research work focused on the rainfall distribution and variation theirin over Latur district. The district has been located on the south east border fringe area of Maharashtra state. The rainfall data for 37 years has been from Indian Meteorological Department, Pune and Hydrological Project Department, Nashik. The distribution and it's variation is investigated for 12 stations. The stations have been selected based on their location and general equal spatial distribution over study region. The several statistical methods have been used to assess the rainfall distribution and its variation like arithmetic mean, standard deviation, coefficient of variation etc. It is observed that the Wadhona, Rohina, Taka and Takli stations have recorded very low variation in annual distribution with 0.1, 0.4, 4.8, and 11.6 percent respectively. But on the other hand those stations observed very high variation in seasonal distribution in per monsoon and winter season particularly. The coefficient of variation is more than 30 percent it is the indication of high variation with 222.4%, 172.6%, 116.2 and 201.7%; 301.9%, 249.4%, 174.4% and 273.7% orderly.*

Keywords: *Rainfall distribution; high variation; seasonal; Coefficient of Variation; Latur.*

I. INTRODUCTION

Rainfall Distribution may occur varied in different climatic regions and also at individual locations over time. The variation in rainfall distribution is occurred due to the changes in climate. The humanactivities influence on the climate such as industrialization, urbanization etc. the emission of various gasses in atmosphere the envelope of toxic green gasses around the earth. The formation of such envelop, is responsible for rate of raising temperature with high speed than the natural process throughout the world. This affects on the climatic processes. The smallholder farmers worst hit by the climate change due to their low adaptive capacity and their dependence on rainfed agriculture which is very sensitive to climate variation (IfejikaSperanza, 2014; Easterling, 2011). In 2014 UNDP stated that the adverse impact of climate change will be felt most actually by the small holder farmers in developing countries because they are largely dependent on natural systems for growing crops and raising livestock.

According to IPCC (2007) precipitation and temperature are two most important elements in the field of climatology and hydrology. These are frequently used to understand the distribution and magnitude of climate change ant its variation. So these are most considered to assess the annual and seasonal spatio-temporal trend of climatic parameters in the view of change related changes, suggestions, adaptation strategies in agriculture. The long term climate change, the change in rainfall pattern and temperature particularly, is promoting to not only drought but also flood situations in any regions. With concern to rainfall occurrences and temperature the Indian Meteorological Department (IMD), Pune has defined four meteorological seasons. That is Winter (January to February), Pre-monsoon (March to May), Monsoon (June to September) and Post-Monsoon (October to December).AmogneAsfaw and etl. (2018) inspect the variability and time series trend of rainfall and temperature in northcentral Ethiopia. Amit Dhorde and etl. (2017) were investigated the spatial distribution of temperature trend and extrems over Maharashtra and Karnataka state of India. Kishor Shinde and Parag Khadke (2018) have assessed the monthly, seasonal and annual meteorological drought in Marathwada region of Maharahstra. Wani and Khairkar (2012) were analyzed the monthly, seasonal and annual rainfall and temperature trend over Srinagar city.Also there are number of studies have been carried out by researchers on rainfall trend, rainfall distribution, rainfall variability, effect of rainfall on crops growth, crop production in the world and India also.

Objectives

- The main aim of the present study was to analyze long tern Inter-annual and seasonal rainfall distribution of rainfall. And to understand the variation therein over 37 years.

II. STUDY AREA

Latur District is selected for the present study as study area. Location is key parameter of region which plays a crucial role into social and economic development of region. The district is placed in the south-eastern part of the Maharashtra and it extends between 17^0 52' N latitude to 18^0 50' N latitudes and 76^0 12' E longitudes to 77^0 18' E longitudes. An average altitude is of 556 m above msl.

The district touches on the north to Beed and Parbhani districts, on the north-east to Nanded district, on the south-east and south to the Karnataka state and on the north-west, west and south to Osmanabad district. The district has 7157 sq.km geographical area and it covers 2.39 percent of the total geographical area of Maharashtra state. The study region completely located on the Balaghat Plateau of Deccan traps, it is a part of eastern extended ranges of Western Ghat.So it characterized by rugged topography.

The climate of the study region is generally dry except during the south-west monsoon season. The temperature of region ranges from 15^0 C to 40^0 C. Sometimes the maximum temperature may rise to about 45^0 C. The average annual rainfall is 754.2 mm. Soil of the region is mainly derived from Deccan trap rocks so it is medium black clay.

According to 2011 census, population of the study region is 2454196. The general growth rate of population is 15.24 percent in 2001 to 2011.

III. MATERIALS AND METHODOLOGY

The present research work is based onsecondary type of data. The daily and monthly rainfall measured data of 12 stations have been obtained from Indian Meteorological Department, Pune and Hydrological Project; Water Resources Department, Government of Maharashtra, Nashik. The rainfall data is obtained for 37 years from 1980 to 2016.

The collected daily rainfall data tabulated as per requirement and statistically analyzed by using standard statistical methods i.e. mean ($\bar{X}$), Standard Deviation (σ) and Coefficient of Variations (CV).

Standard deviations is compute by $\sigma = \frac{\sqrt{\sum d^2}}{\bar{X}}$

Where as

σ= Standard Deviation,

$\sum d^2$= Sum of squer of difference in actual rainfall and mean rainfall

$\bar{X}$ = Mean rainfall

For the understanding of variation of rainfall the Coefficient of variation is employed as a statistical measure.

Coefficient of variation is calculated using following formula CV =$\frac{\sigma}{\bar{X}} * 100$

Ingeneral when the CV value is less than 20 it indicates the uniform rainfall distribution, if the CV is 20 to 30 that means moderate rainfall variation and if the value is more than 30 it means very high variation of the rainfall.

The bar graphs and multiple line graphs are used to depict the pictorial presentation more effectively.

IV. RESULTS AND ANALYSIS

The collected rainfall data have been analyzed by seasonally and annually.

Seasonal Rainfall distribution and Variation

The rainfall data of 12 stations in Latur district have analyzed for 37 years from 1980 to 2016. As per the guidelines of IMD there are four meteorological seasons in India. Over the Indian subcontinent monsoonal impact is more on climatic situation. It is the result of occurrence of rainfall in monsoon season. About 95 percent rainfall received in this season. The location and morphological structure of country and state are more responsible to concentration of rainfall within a short period of time. i.e. June to September of every year and other remaining period goes dry.Some time in post monsoon season some part of country receives rainfall from retreating monsoon winds with little amount. The below table clearly shows the mean, standard deviation and coefficient of intra seasonal and annual rainfall. The table also shows the stations which have recorded annual mean rainfallmore than districts (802.5mm) normal rainfall. Seasonal distribution is observed very varied.

Table no. 1. Station wise intra seasonal and Annual Rainfall Variation of Latur District (1980-2016)

Seasons	Winter			Pre-Monsoon			Monsoon			Post-Monsoon			Annual		
Stations	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
AuradSh	10.4	19.0	181.7	36.8	52.0	141.1	619.6	202.3	32.6	93.2	68.0	72.9	730.7	244.8	33.5
Jadhala	6.0	15.6	261.7	15.4	25.1	163.3	615.7	309.8	50.3	66.7	75.9	113.9	703.8	337.5	48.0

Jawala BK	7.8	19.6	252.4	31.3	42.9	136.7	684.9	331.7	48.4	99.5	119.9	120.5	823.5	402.2	48.8
Kasarshirshi	9.5	16.9	177.9	14.2	22.1	155.0	628.6	259.3	41.3	89.1	80.2	90.0	741.4	276.4	37.3
Nitur	11.6	6.4	1.9	17.7	32.2	182.6	577.8	201.6	34.9	92.4	85.3	92.4	699.5	238.7	34.1
Rohina	11.6	35.0	301.9	16.3	36.2	222.4	673.6	243.2	36.1	82.3	83.6	101.6	783.7	5.9	0.4
Taka	7.0	17.4	249.4	15.4	26.6	172.6	449.7	239.3	53.2	59.7	60.0	100.5	498.4	1.7	4.8
Takali	12.4	21.8	176.4	39.7	46.2	116.2	662.2	209.5	31.6	103.0	81.7	79.3	817.3	10.0	11.6
Wadhona	10.1	27.6	273.7	24.7	49.7	201.7	773.3	255.0	33.0	118.9	110.4	92.9	927.0	1.9	0.1
Ahamadpur	23.6	27.9	117.9	32.6	34.6	106.2	809.5	233.6	28.9	63.1	63.3	100.3	899.1	262.4	29.2
Ausa	9.9	24.4	247.2	42.9	44.5	103.9	569.0	217.0	38.1	23.6	71.8	303.8	711.5	250.2	35.2
Udgir	6.1	12.3	202.0	39.1	41.5	106.2	723.1	236.2	32.7	110.7	79.0	71.4	878.9	254.9	29.0

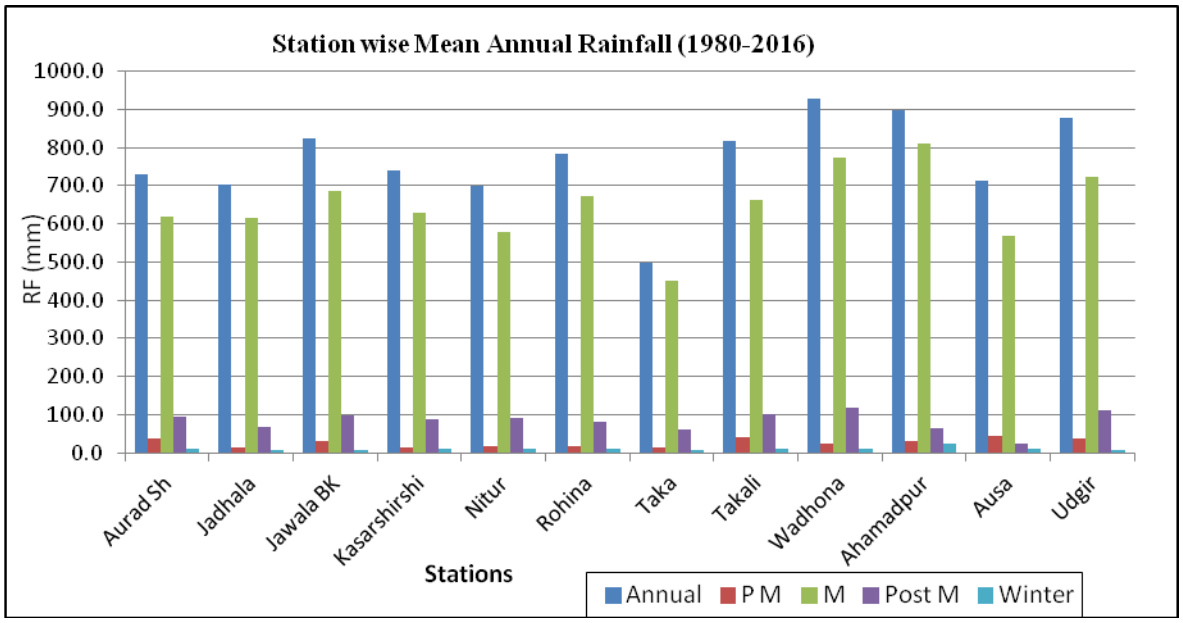

Fig. 1 long term mean annual and seasonal rainfall

Pre monsoon season defined from March to May. The long term meanrainfall of this season ranges from14.2mm to 42.9 mm at Kasarshirsi and Ausa station in respective manner. The standard deviation of these stations also recorded in the same manner. The value of coefficient of variation of Ausa station is observed high as per guidelines but it is less than the other stations i.e.103.9 % it is the indication of high variation of rainfall. The Kasarshirshi station has long term mean rainfall in pre-monsoon season is 14.2 mm and coefficient of variation is 222.4 % it is very high variation in rainfall. All twelve stations are observed that the value of coefficient of variation is high. It represent that mean seasonal anomaly of rainfall is highly varied in whole district.

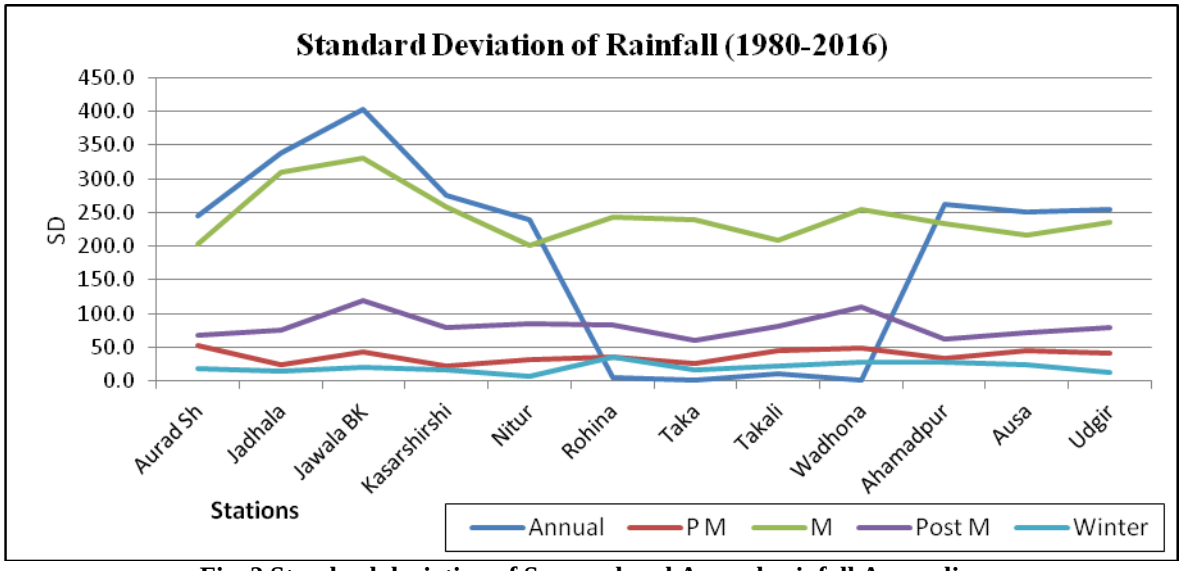

Fig. 2 Standard deviation of Seasonal and Annual rainfall Anomalies

The post monsoon season is considered from October to December. This is the period of retreating monsoonal rainfall in India. The study region receives some few amount of rainfall. In this season the highest mean seasonal rainfall is received at Wadhona (118.9mm) station and mean minimum rainfall is 23.6 mm at Ausa station. Followed by Udgir (110.7 mm) and Ttakali (103.0 mm). The coefficient of variation is also observed varies from 71.4 percent at Udgir station to 303.8 percent at Ausa station. The rainfall at Udgir station is also high variation but it is less than the other stations. The Ausa station is observed with very high value of VC it is the indication of very high variation. Not any single station is observed uniform or moderate variation of rainfall in the district.

In India the winter season is considered only two months i.e. January and February. The study region receives very less mean rainfall throughout the season. The Jadhala station recorded Very less (6.0 mm) long term mean seasonal rainfall. And other five stations observed that, they receives long term mean seasonal rainfall less than 10mm. the stations are Udgir (6.1 mm), Taka 7.0mm, Jawala bk. 7.8 mm, Kasarshirashi 9.5 mm and Ausa 9.9 mm. the highest rainfall anomaly is observed at Ahemadpur station with 23.6 mm. the coefficient of variation of winter rainfall the Nitur station observed with 1.9 percent CV it means there is very uniform variation of rainfall anomaly throughout the study period. The Rohina station recorded highest CV (301.9 %). The CV of other eleven stations is more than the 100 percent it means the rainfall variation is very high. If we look at the minimum and maximum actual rainfall, Rohina station recorded highest rainfall and Aurad Shahajani received minimum 0.3mm rainfall.

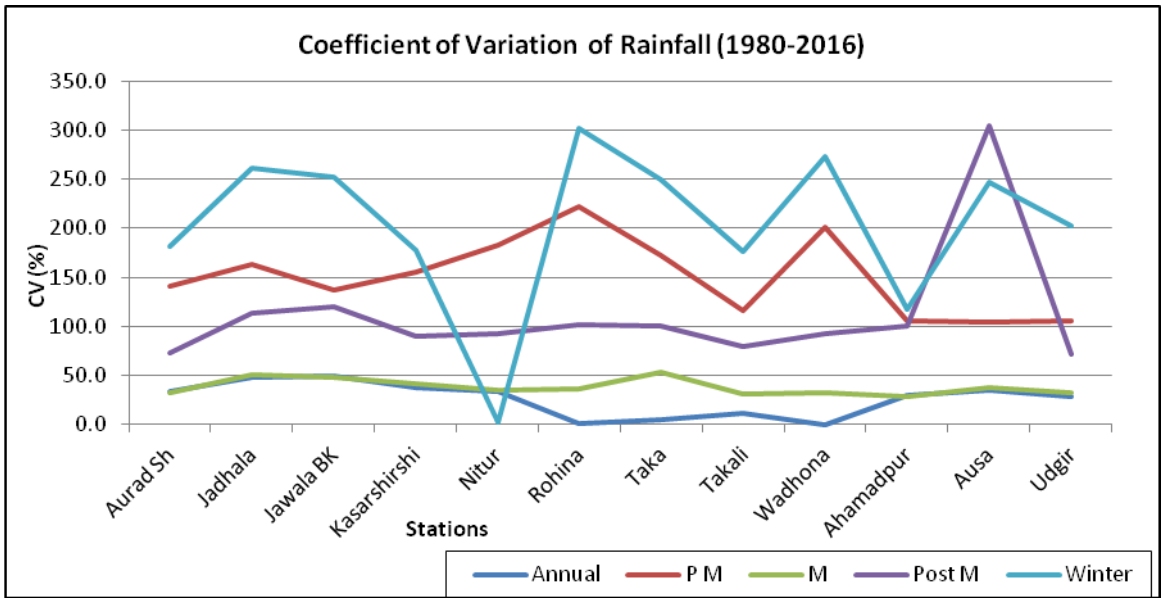

Fig. 3 Coefficient of Variation of Seasonal and Annual long term rainfall anomalies.

Annual Rainfall Distribution and its variation

The gathered data have been analyzed station wise and computed mean annual long term rainfall distribution and variation therein. The annual mean anomaly have observed from 498.4mm at Taka station to 927.0mm at Wadhona station. The district has 802.13 mean rainfall. There are five stations i.e. Wadhona(927.0mm), Ahemadpur (899.1mm), Udgir (878.9mm), Jawala bk. (823.5mm) and Takali (817.3mm) recorded long term mean annual rainfall more than the district normal. But on the other hand seven stations Taka (498.4mm), Nitur (699.5mm), Jadhala (703.8mm), Ausa (711.5mm), AuradShajani (730.7mm), Kasarshirshi (741.4mm), and Rohina (783.7mm) observed less than the district normal. The maximum rainfall in 37 years observed at Jawalabk station (2096.2mm). and mean minimum rainfall is measured at Taka (186.4mm). The highest minimum rainfall is received at Wadhona (488.0mm) station.

The annual rainfall variation is computed by coefficient of variation, it is observed vary from 0.1 % to 48.8% at Wadhona and Jawalabk stations orderly. The five stations recorded CV value below 20% i.e. Wadhona (0.1%), Rohina (0.4%), Taka (4.8%) and Takali (11.6%). The value of CV is denotes uniform rainfall variation in study period of time. The Udgir and Ahemadpur stations have CV value 29.0% and 29.2% respectively. The value indicates that moderate rainfall variation in overall study period. AuradShahajani (33.5%), Nitur (34.1%), Ausa (35.2%), Kasarshirshi (37.3%), Jadhala (48.0%) and Jawalabk (48.4%) the value of CV is higher than the 30% it means that the variation of rainfall distribution is high.

V. CONCLUSION

After the compilation of rainfall data of 37 years the researchers are come to some findings. In the seasonal analysis it is found that winter, pre-monsoon and post-monsoon seasons long term mean rainfall is very low so its CV value is very highly represented, ranging from 1.9 to 303.8 %. There is only one station i.e. Nitur found that very uniform rainfall distribution throughout the study period. But other all stations are observed with very high CV value so there is very high rainfall variation.

The monsoon season has observed mean rainfall anomaly of all stations is near to districts normal rainfall value in 37 years. The coefficient of variation of all stations are near to moderate to moderate distribution.While analyzing the mean annual rainfall distribution and its variation it is observed that about 40% stations received more rainfall and 60% stations received less rainfall than the district normal. Over all conclusions is that the Taka station is receiving less rainfall in annual and seasonal pattern. Variation of rainfall is uniform in annual but in seasonal distributional variation is very varied.

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