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AN ASSESSMENT OF DYNAMICITY OF RAINFALL IN LATUR DISTRICT OF MAHARASHTRA

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Abstract:

Rainfall is one of the significant element of climate. It controls various climatic processes which are directly or indirectly effects on environment. This research work engrossed on the rainfall dynamicity and concentration over Latur district. The district has been located on the south east border fringe area of Maharashtra state. The rainfall data for 41 years has been gathered from Indian Meteorological Department, Pune, Hydrological Project Department, Nashik and Socio-economic abstract of Latur districts. The distribution and its discrepancy is inspected for 10 stations. The stations have been selected based on their equal spatial location in the study region. The numerous statistical measures have been applied to assess the rainfall distribution and its variation like arithmetic mean, standard deviation, coefficient of variation, PCI etc. The mean minimum is ranges from 0.3 mm over Takali and Ahemadpur to 16.4 mm at Taka. The mean maximum rainfall during this period is observed between 54.4 mm to 113.4 mm at Takali and Ausa respectively. The SD of rainfall varies 9.9 to 23.3 at Kasarshirsi and Ausa and CV is 245.1 at Takali to 384.7 % at Wadhona. The nature of rainfall concentration is seen as moderate over Ahemadpur, Ausa, Rohina and Wadhona whereas irregular concentration over Jawala bk., Nitur, Taka, Takali and Udgir and Kasarshirsi is strongly irregular.

Keywords: Rainfall dynamicity, annual, seasonal variation, Coefficient of Variation, PCI Latur.

Introduction:

Rainfall distribution can vary over time at specific areas as well as in various climatic zones. The variation in rainfall patterns is brought on by climate change. Human activities like industry, urbanisation, etc., the release of different gases into the atmosphere, and the envelop of poisonous green gases around the globe all have an impact on the climate. It also plays pivotal role in climatic condition. It provides the water in the various forms such as surface water, water vapour, underground water, moisture content in soil and other substance etc. the rainfall is in dynamic in amount and nature over place and time. Preferably agriculture, agro-economic and other related fields are more concern to rainfall. Hence the people who works in such sectors needed to study and understand the nature of rainfall to plan and act accordingly. The rainfall not only varies in terms of amount and probability of occurrences but in rainy days also. 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 widely used to comprehend the distribution, intensity, and variance of climate change. Thus, in light of changes connected to climate change, proposals, and agricultural adaptation measures, these are primarily taken into account to analyse the annual and seasonal spatio-temporal trend of climatic parameters. Long-term climate change, including the alteration in temperature and rainfall patterns, is encouraging both drought and flood conditions in all locations. 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). Amogne Asfaw and et al (2018) inspect the variability and time series trend of rainfall and temperature in north central Ethiopia. Amit Dhorde and et al. (2017) were investigated the spatial distribution of temperature trend and extrems over Maharashtra and Karnataka state of India. Kishor Shinde and Parag Khadke (2019) have assessed the station wise, seasonal and

annual rainfall variability of latur for 35 years. Wani and Khairkar (2012) were analyzed the monthly, seasonal and annual rainfall and temperature trend over Srinagar city. Researchers have also conducted a variety of studies on the trend, distribution, and variability of rainfall as well as its impact on crop development and production worldwide, including in India.

Study Area:

Latur District is the investigational area of the present study. The location of any region plays a pivotal role into origin and development of that region. The district is situated in the south-east part of the Maharashtra and it lies between 17^0 52' north latitude to 18^0 50' north latitudes and 76^0 12' east longitudes to 77^0 18' east longitudes. An altitude is of 556 mt. above msl.

It is bounded by by Beed and Parbhani districts on the north, by Nanded district on the north-east, on the south-east and south by the Karnataka state and on the north-west, west and south by Osmanabad district. The district has 7157 sq.km total geographical area and it covers 2.39 % portion of the Maharashtra. The study region is wholly located on the Balaghat Plateau of Deccan traps. It has rugged topography.

The climate of the study region is generally temperate and 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 upto 45^0 C. The region receives 754.2 mm average annual rainfall. The soil of 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 population in the decade 2001 to 2011 is 15.24 percent.

Objectives:

Major objective of the present study is to study the dynamicity of rainfall and its variability over Latur district.

Data Base and Methodology:

This work is carried out based on secondary source data. The data have been collected from IMD, Hydrological Project, Nashik and Socio-economic survey of Latur District. The rainfall data for 10 rain gauge stations is used for 41 (1980 to 2020) years. The rain gauge stations were selected based on spatial distribution and availability of data.

The collected daily rainfall data is organized in well-mannered in tables as per requirement and statistically computed by using standard statistical measures 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 $CV = \frac{\sigma}{\bar{X}} * 100$

In general 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 PCI (Precipitation Concentration Index) is another method is used to understand the rainfall variability. This method proposed by Oliver in 1980. It is an indicator of rainfall concentration and rainfall erosivity. In 1992 Michaels and others applied the PIC and calculated it's annual and seasonal values. The following formula is used to statistical measures of precipitation concentration.

$$\text{Annual PCI} = 100*(\sum Pi^2/(\sum Pi)^2)$$

$$\text{Seasonal PCI} = 33.3*(\sum Pi^2/(\sum Pi)^2)$$

Where as Pi =Rainfall amount of i^{th} month

$\sum$=summation over the number of month being assessed

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Table no. 01 Interpretation of PCI value

PCI values	Interpretation
<10	Uniform Distribution
11-20	Moderate to Irregular precipitation concentration
20 <	High Irregular precipitation concentration

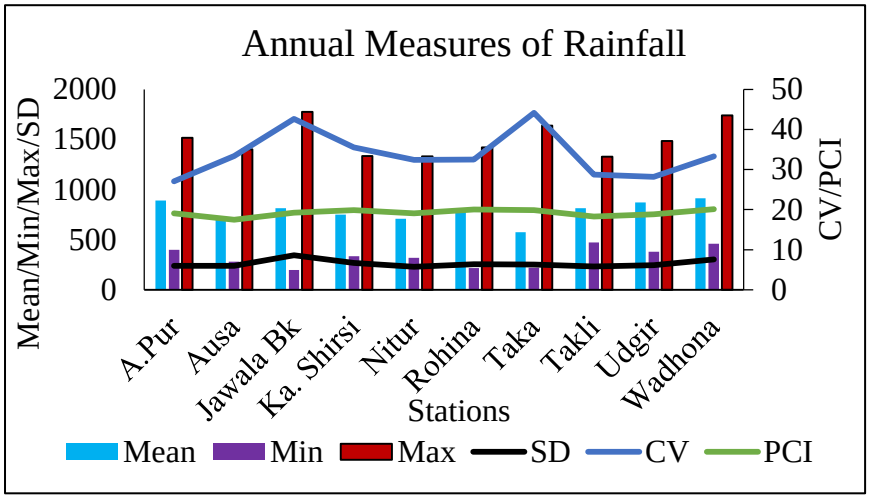
Michiels et al. (1992).

Result and Discussion:

The dynamicity of rainfall means the variation of rain according to space and time. According to Cruze and other (2007), the change in rainfall amount, effects on agricultural sectors in Asia and Pacific contories. Suchit Kumar Rai and others have been studied that rainfall variability and probability changes in central India with respect to crop planning. The rainfall variation of Latur district is computed for 10 stations for 41 years (1980 to 2020). The data has been collected is assessed on annual and seasonal scale.

Annual Rainfall Variation and Concentration of Rainfall:

The variation of annual mean rainfall is observed from 27.0% at Ahemadpur to 44.1 % at Taka station of Ausa taluka. The highest mean rainfall is recorded 913mm at Wadhona, is the more than the districts average. As far as concern to mean minimum rainfall, it is recorded at Jawala B.K. by 196.7 mm and long mean maximum annual rainfall is noted 177.4 mm at the same station.

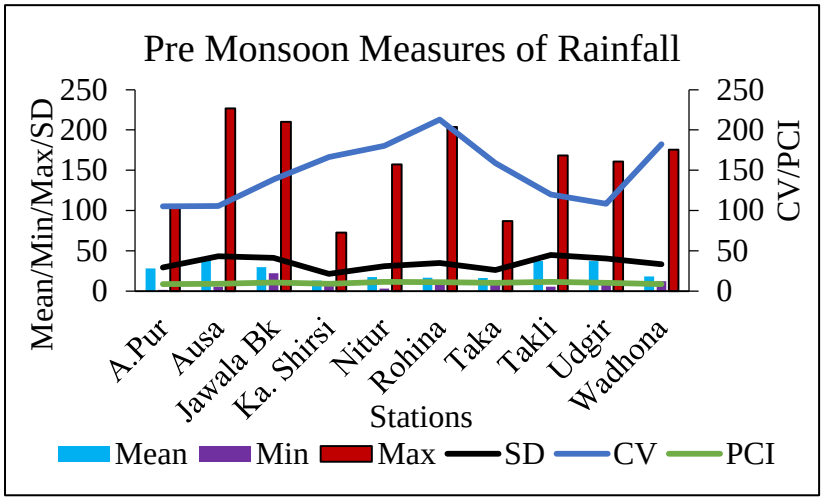


The precipitation Concentration Index (PCI) is also used to understand the concentration of rainfall in the study region during the study period. The Ahemadpur, Ausa, Jawala B.K., Nitur, Udgir, Kasarshirsi, Taka and Rohina are found moderate concentration whereas the Wadhona is observed high irregular concentration of Rainfall during the study period.

Seasonal Variation and Concentration of Rainfall:

The seasonal Variation and Concentration of Rainfall is mostly affected on agricultural activity in Latur district, it results the cropping system is varies there in. Hence the seasonal variation of Rainfall is studied.

Pre-monsoon Variation:



The pre monsoon season considered for the month of March to May. The mean of pre monsoon is varies from 12.9 mm at Kasarshirsi to 40.7 mm at Ausa station. The mean minimum rainfall is observed as 1.5 mm at Ahemandpur to 22.0 mm at Jawala B. K. whereas mean maximum rainfall during this study period is found as 72.04 mm at Kasarshirsi to

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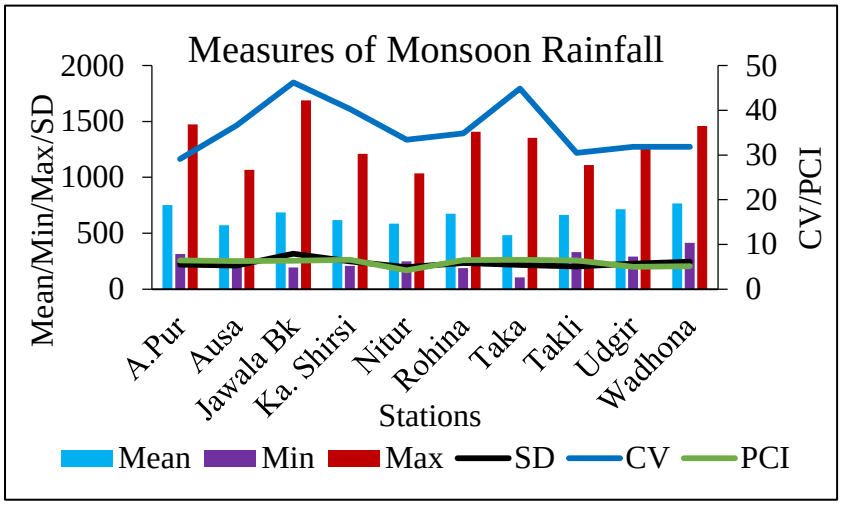
227.0 mm at Ausa. The lowest standard deviation is 21.4 at Kasarshirsi and highest 44.6 at Takali. As far as concern to coefficient of variation, it observed as 105.0% at Ahemadpur and 212.7% at Rohina shows that the highest variation in Latur district.

The rainfall concentration represents as Kasarshirsi, Ahemadpur, Ausa, Wadhona stations found mostly uniform whereas Jawala bk., Nitur, Rohina, Taka and Udgir are observed moderate to irregular concentration of rainfall.

Monsoon Variation and Concentration:

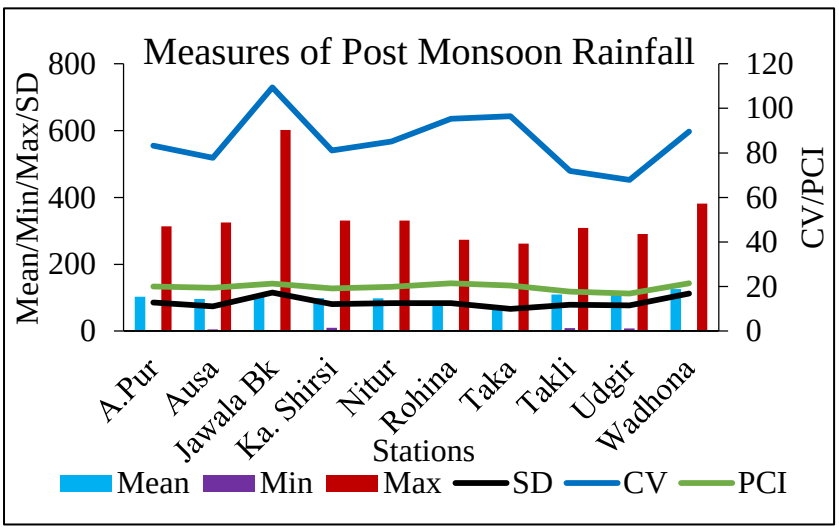


The monsoon season is the period of rainfall in the study area. It is stipulated from June to September month. During this season the long mean of rainfall is varies from 482.8 mm at Taka to 765.4 at Wadhona which is less than the mean rainfall of Latur district. The mean minimum rainfall ranges from 1036 mm at Taka to 413.2mm at Wadhona station, whereas the mean maximum rainfall varies from 1035.6 mm at Nitur to 1688.8 mm at Jawala bk. The deviation of rainfall from mean is observed as 195.3 to 316.6, while studying the coefficient of variation, the Jawala bk. is observed more variation and Ahemadpur has less variation.

The concentration index shows 4.2 to 6.6 value at Nitur and Taka stations respectively. It represent most uniform concentration of rainfall during 1980 to 2020.

Post Monsoon Variability and concentration:

This season considered from October to December month, which experiences the south western monsoon as well as north eastern monsoon rainfall. The long term mean of rainfall is observed from 69.2 mm at Taka to 125.8mm at Wadhona station. The mean minimum rain ranges from 0.6 mm to 10.0 mm at Nitur and Kasashirsi stations accordingly. On the other hand the lowest mean maximum rainfall (261.8mm) and highest mean maximum rainfall (602.2mm) received at Taka and Jawala bk. The deviation of rainfall during the study period is observed as 66.7 and 115.2 at the same stations.



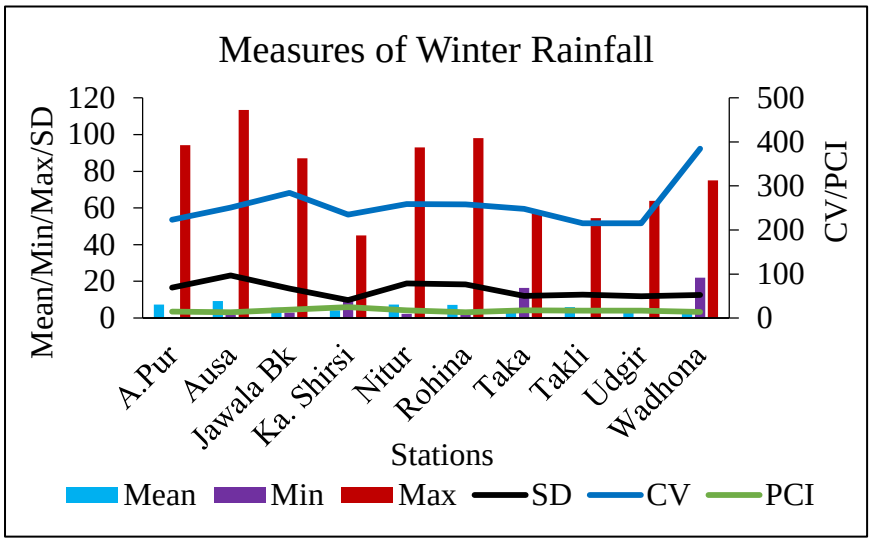
Whereas the coefficient of variation is varies from 67.8% to 109.4% at Udgir and Jawala bk.

The concentration index also shows the strong irregularity at Jawala bk., Rohina and Wadhona whereas Ausa, Kasarshirsi, Nitur, Takali, Udgir, Ahemadpur and Taka have found with irregular distribution of Rainfall.

Winter Variation and Concentration:

Winter season is the period of cool climate and without rain but some time due to some climatic calamities such as storm on Arabian sea or Bay of Bengal, the rain occurs in study period. Hence the study region have long mean rain between 3.2 mm at Wadhona to 9.3 mm at Ausa station.

The mean minimum is ranges from 0.3 mm over Takali and Ahemadpur to 16.4 mm at Taka.



The mean maximum rainfall during this period is observed between 54.4 mm to 113.4 mm at Takali and Ausa respectively. The SD the rainfall varies 9.9 to 23.3 at Kasarshirsi and Ausa and CV is 245.1 at Takali to 384.7 % at Wadhona. The nature of rainfall concentration is seen as moderate over Ahemadpur, Ausa, Rohina and Wadhona whereas irregular concentration over Jawala bk., Nitur, Taka, Takali and Udgir and Kasarshirsi is strongly irregular.

Conclusion:

It is concluded that, the study region observed variation of rainfall moderate to strong irregular concentration. The mean annual rainfall variation is ranges from 27.0 to 44.1 %. But most of area is observed moderate variation. As far as concern to season variation, the monsoon season observe the less variation it ranges from 29.1 % to 46.2%. On the other side the winter season has more variation, the variation value ranges from 215.1% to 384.7 %. It shows the rainfall distribution is much varies place to place during study period.

The concentration of rainfall at mean annual scale it is observe there is no much difference in concentration value. On the other hand in related to seasonal concentration of monsoon season has uniform concentration having the PCI value less than 10, the most irregular in per monsoon, post monsoon and winter season, the PCI value varies from 8.6 in pre monsoon to 24.9 during winter season.

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Measures of Annual Rainfall

	A.Pur	Ausa	Jawala Bk	Ka. Shirsi	Nitur	Rohina	Taka	Takli	Udgir	Wadhona
Mean	889.7	717.6	812.8	749.9	707.6	787.3	574.2	815.7	871.3	913.0
Min	399.8	280.0	196.7	334.2	319.0	218.4	218.8	470.9	379.0	461.2
Max	1517.1	1402.5	1776.4	1333.7	1330.8	1421.9	1636.4	1328.3	1483.4	1740.5
SD	240.6	239.2	346.1	266.5	229.3	255.8	253.3	234.4	245.4	303.7
CV	27.0	33.3	42.6	35.5	32.4	32.5	44.1	28.7	28.2	33.3
PCI	19.1	17.5	19.2	19.9	19.1	20.0	19.8	18.3	18.8	20.1

Measures of Pre Monsoon Rainfall

Stations	A.Pur	Ausa	Jawala Bk	Ka. Shirsi	Nitur	Rohina	Taka	Takli	Udgir	Wadhona
Mean	28.0	40.7	29.7	12.9	17.2	16.3	16.3	37.3	37.0	18.3
Min	1.5	5.4	22.0	9.4	3.2	9.0	10.4	5.5	11.5	12.0
Max	105.0	227.0	210.0	72.4	157.4	203.8	86.8	168.4	161.0	175.5

SD	29.4	43.0	41.2	21.4	31.0	34.8	25.9	44.6	40.2	33.3
CV	105.0	105.6	138.4	166.4	180.4	212.7	158.8	119.8	108.5	182.3
PCI	8.6	8.9	10.7	9.0	11.2	10.8	10.3	11.5	10.3	8.6

Measures of Monsoon Rainfall

Stations	A.Pur	Ausa	Jawala Bk	Ka. Shirsi	Nitur	Rohina	Taka	Takli	Udgir	Wadhona
Mean	751.4	571.9	685.2	617.1	585.1	673.5	482.8	662.4	715.3	765.4
Min	314.9	234.5	192.2	207.4	248.0	187.4	103.6	330.1	290.4	413.2
Max	1475.0	1068.0	1688.8	1211.2	1035.6	1406.7	1353.8	1109.6	1289.1	1460.4
SD	218.9	209.4	316.6	248.7	195.3	234.5	216.4	201.8	227.8	243.7
CV	29.1	36.6	46.2	40.3	33.4	34.8	44.8	30.5	31.8	31.8
PCI	6.4	6.3	6.4	6.5	4.2	6.5	6.6	6.4	5.0	5.1

Measures of Post Monsoon Rainfall

Stations	A.Pur	Ausa	Jawala Bk	Ka. Shirsi	Nitur	Rohina	Taka	Takli	Udgir	Wadhona
Mean	102.9	95.8	105.3	99.3	98.1	87.6	69.2	109.6	113.1	125.8
Min	1.1	5.0	3.2	10.0	0.6	3.0	2.2	9.3	8.3	2.0
Max	313.8	325.0	602.2	330.5	331.2	273.6	261.8	309.0	290.5	382.0
SD	85.6	74.5	115.2	80.5	83.5	83.5	66.7	78.9	76.7	112.7
CV	83.2	77.8	109.4	81.0	85.1	95.3	96.4	72.0	67.8	89.6
PCI	20.0	19.4	21.4	19.1	19.9	21.4	20.4	17.8	16.9	21.4

Measures of Winter Rainfall

Stations	A.Pur	Ausa	Jawala Bk	Ka. Shirsi	Nitur	Rohina	Taka	Takli	Udgir	Wadhona
Mean	7.4	9.3	5.7	4.2	7.3	7.1	4.9	5.9	5.5	3.2
Min	0.3	2.0	3.0	11.4	2.2	2.0	16.4	0.3	0.6	22.0
Max	94.2	113.4	87.0	45.0	93.0	98.0	57.6	54.4	63.8	75.0
SD	16.6	23.3	16.1	9.9	18.8	18.3	12.1	12.8	11.8	12.5
CV	223.5	251.1	284.2	234.7	258.6	257.8	247.6	215.1	215.2	384.7
PCI	14.8	12.8	18.7	24.9	17.3	13.4	17.8	16.6	16.8	13.8

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