Cosmos Multidisciplinary Research E-Journal
Online Available at www.cmrj.in
Recognized International Peer Reviewed Journal
Impact Factor 4.94
ISSN No. 2456-1665

Rainfall Variability in Marathwada Region Through PCI

Dr. Sominath Sarangdhar Khade
Dept. of Geography
Rastramata Indira Gandhi Arts, Science & Commerce College,
Jalna, Maharashtra
sominath.khade@gmail.com

Abstract:
Rainfall is the key element in agricultural and other activities of man related to economic development. The rainfall varies temporally and spatially over the world. Due to the variation in rainfall, the economic activities are different in different places. While studying the climate change may be locally, regionally or globally it is necessary to understand the variation among the climatic parameters. The main aim of the present research is to quantify the variation in rainfall over Marathwada for 37 (1980-2016). The Marathwada occupies 64434 sq. km. and is 20.95% of states area. The agriculture is the major occupation of their livelihood. The data rainfall is gathered from IMD and Hydrological Project Division of Water Resource Dept. of Maharashtra Govt., Nashik. Further the data has been analyzed using Olivers method of Precipitation Concentration Index on seasonal and annual scale. The spatial variation is presented through maps. The Marathwada region hasn‟t uniform distribution in annual time scale. The seasonal distribution of rainfall is clear that nearly 80% part of Marathwada in Pre Monsoon, winter and Post monsoon experiences moderate concentration. On the other hand less than 10% part of Marathwada experiences high concentration in winter, Pre monsoon and Post monsoon. Only in the Monsoon season whole region of Marathwada the rainfall is distributed uniformly.

***Key words**: Marathwada, Variability, Spatio-temporal, PCI, Concentration.*

Introduction:
Rainfall is the key element in agricultural and other activities of man related to economic development. The rainfall varies temporally and spatially over the world. Due to the variation in rainfall, the economic activities are different in different places. While studying the climate change may be locally, regionally or globally it is necessary to understand the variation among the climatic parameters. According to McCartney and Shakhty in variability of rainfall is the result of climate change and insufficient capacity to manage it. It promotes to insecurity in food and poverty of society. The Marathwada is located in inland location on eastern side of Sahyadri Mountain; due to the locational factors the region experiences frequently drought conditions. Therainfall duration of region is very less it gets during June to September months. The cropping systems of Marathwada is depends on it therefore the agriculture practices are seasonal. The yield of corps particularly in rain fed area depends on the rainfall pattern, which makes it important to predict the probability of occurrence of rainfall from the past record of hydrological data using statistical analysis (G. Arvind and et al. 2017)[2]. Rathod and Aruchami stated that rainfall variability is defined as the deviation of rainfall from the mean itself or the ratio of standard deviation to the mean or the variation of coefficient of variation.

Study Region:
The study area of present research is Marathwada region of Maharashtra state in India. It lies in upper Godavari basin and extends from 17^0 35‘ north to $20^0$40‘ north latitude and $74^0$40‘ east to $78^0$19‘ east Longitude. The study region occupies 64434 sq. km. which is 20.95% of states area. According to 2011 census study region has 1.87 crores population. The study region has been divided in eight districts for smooth administration with 76 tahsils. The land of region

characterized by Deccan trap mostly found basalt rock. Most part of Marathwada covered by deep black soil, it formed from basalt rock. The climate of study region is typical hot and dries with high temperature. It ranges from 20^0C to 40^0C some time it goes more than 40^0C in summer and also it falls down below 20^0C in winter season. The study region receives 771.80mm averageannual rainfall. It receives from south western monsoon winds. Near about 70% rainfall receives during June to September i.e. monsoon season.

Objective:
The main aim of present study is to focus on the variability of rainfall in Marathwada region.

Materials and Methods:
The present research work is carried out based on secondary source data. The data havebeen collected from IMD and Hydrology project, Water Resource Department, Govt. of Maharashtra, Nashik. The rainfall data for 96 rain gauge stations is used for37 (1980 to 2016)years. The rain gauge stations were selected based on spatial distribution and availability of data. The PCI (precipitation concentration Index) method is used to understand the rainfall variability; it is most widely used method. This method proposed by Oliver in 1980. It is an indicator of rainfall concentration and rainfall erosivity. In 1992 Michaels and others applied thePIC and calculated it's annual and seasonal values. The following formula is used to statistical
measures of precipitation concentration.
Annual PCI = $100*(\sum Pi^2/(\sum Pi)^2)$,Seasonal PCI = $25*(\sum Pi^2/(\sum Pi)^2)$
Whereas Pi =Rainfall amount of i^{th} month,
$\sum$=summation over the number of month being assessedTable no. 01 Interpretation of PCI value

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

Result and Discussion:
As shown in table 02 the PCI values has been computed for seasonal and annual period oftime and presented in fig.01.

a) Winter season:
The concentration of precipitation of winter season depicts in fig. 01(B). In winter seasonis classified in to two classes(10-20 and more than 20%) there are 78 stations covering more than 80% area of Marathwada are observed with moderate to irregular concentration and 18 stations observed with the PCI value more than 20% so the 20% area of Marathwada represent more concentration of precipitation.

b) Pre Monsoon season:
The PCI values of 30 stations are observed below 10% it is indicate that the rainfall distribution is uniform. There are 64 stations rainfall is moderate to irregular concentrated and only 02 stations (Dhorkin and Limbaganesh) PCI value is more than 20%. It means the rainfall variation is highly irregular. The fig. 01(c) shows the spatial pattern of precipitation concentration of Marathwada in per monsoon season.

Table no.02 - Seasonal and Annual Precipitation Concentration Index (PCI)

Stations	Ann	Wint	PM	M	PoM	Stations	Ann	Wint	PM	M	PoM
A'bad	21.0	12.7	9.7	6.8	16.4	Taka	20.1	19.1	10.8	6.6	20.0
Chikalthana	18.0	12.7	13.9	6.3	14.8	Takali	18.2	17.4	11.6	4.6	17.7
Dhorkin	20.5	12.6	20.2	6.6	17.1	Udgir	18.8	15.2	10.3	5.1	16.5
Gangapur	18.7	12.6	13.3	6.4	15.3	Wadhona	19.9	18.1	9.7	5.2	21.2
Hiwarkheda	20.0	16.5	8.5	6.3	16.9	Bhokar	20.0	17.0	8.6	6.4	17.7
Kannad	18.2	17.9	10.2	6.3	16.4	Billoli	20.2	15.7	8.6	6.6	19.5
Khultabad	20.0	14.0	9.3	6.3	13.4	Degloor	20.2	18.9	9.8	6.2	18.3
Ladsangvi	20.9	12.8	16.3	6.4	17.6	Jamb bk	19.4	14.2	15.2	6.5	20.8
Loni kh	20.3	12.6	14.7	6.4	15.1	Kandhar	19.9	13.3	9.3	6.5	18.0
Nagamthan	16.1	12.7	11.1	6.3	14.6	Kesrali	20.8	17.0	12.2	6.7	18.8
Palaswadi	22.1	25.0	9.2	6.4	19.2	Kinwat	21.8	19.0	8.9	6.6	18.9
Phulambri	20.0	13.5	17.7	6.3	20.2	Limboti	19.3	15.7	9.6	6.5	19.9
Pishor	20.5	13.0	16.4	6.5	15.9	Lohgaon	21.7	13.8	14.9	6.7	20.1
Shivna	19.6	13.4	13.1	6.4	13.7	Mahur	23.7	25.0	8.6	6.8	22.2
Sillod	18.5	13.1	9.0	6.4	13.5	Malegaon	20.0	15.1	9.9	6.5	19.8
Soygaon	19.7	14.0	9.7	6.4	13.4	Mukhed	19.7	15.5	10.4	6.5	19.1
Vaijapur	18.4	16.0	14.0	6.3	13.5	Nanded	20.5	13.9	8.6	6.6	15.7
Ambejogai	19.3	19.0	6.8	6.3	16.7	Patoda N	19.3	15.3	13.9	6.3	15.4
Ashti	18.5	13.7	10.5	6.4	15.1	Sarkhani	23.2	25.0	8.9	6.8	22.3
Beed	18.9	12.8	10.3	6.4	15.7	Shivani	22.5	17.5	12.1	6.8	21.8
Georai	18.3	16.1	11.9	6.3	14.5	Sundgi	20.7	13.8	9.9	6.6	18.6
Hirapur	19.8	13.7	12.1	6.5	18.2	Tamsa	21.2	15.1	12.0	6.5	18.7
Kuppa	19.9	18.7	10.8	6.4	18.4	Umri	21.5	14.2	10.2	6.6	19.5
LimbaGanesh	19.3	25.0	20.1	6.4	17.9	Alni	19.1	19.6	11.1	6.5	19.0
Majalgaon	18.4	20.7	9.6	6.4	16.6	Awadshirpur	19.5	13.6	10.1	6.6	19.1
Murti	21.1	25.0	18.4	6.7	17.2	Bembli	19.2	13.7	13.0	6.4	19.6
Patoda B	17.5	14.1	10.9	6.4	13.9	Bhoom	18.0	22.1	12.7	6.4	15.4
Vida	19.6	20.1	14.4	6.5	17.7	Chandani	19.1	20.9	13.0	6.7	18.1
Jawlabazar	20.5	19.8	12.8	6.4	15.4	Kalamb	18.0	16.8	12.2	6.4	16.6
Takalkhopa	22.0	15.3	18.8	6.5	15.0	Karajkheda	19.4	24.0	10.2	6.5	19.8
Ambad	19.3	13.4	11.3	6.3	14.6	Lohara	22.6	22.7	10.1	6.6	17.5
Bhavnepangri	20.3	14.8	14.9	6.4	17.2	O'bad	18.7	12.6	9.3	6.4	18.8
Bhokardan	18.7	13.0	13.1	6.3	14.4	Omerga	17.9	13.6	9.8	6.4	17.0
Golpangri	19.7	16.7	19.1	6.3	18.6	Padoli	18.5	21.6	11.5	6.4	18.6
Jafrabad	19.9	14.0	11.6	6.4	20.1	Paranda	17.6	20.4	12.6	6.5	15.5
Partur	19.4	14.0	10.2	6.4	17.4	Sarola	18.5	15.6	13.6	6.4	17.6
Ranjni	21.3	19.9	13.4	6.5	18.6	Suratgaon	18.5	20.5	12.1	6.4	18.4
Salegaon	21.1	25.0	19.0	6.4	19.2	Surdi	19.7	21.0	10.0	6.6	18.8
Shahagad	19.5	14.0	16.2	6.4	15.0	Tawrajkhed	19.0	19.5	11.6	6.5	19.9

Shevali	21.0	16.3	14.1	6.4	20.1	Yermala	19.5	16.5	12.4	6.4	19.5
Ahemadpur	19.1	14.8	9.9	5.0	19.7	Gangakhed	20.6	12.8	9.7	6.4	19.3
Aurad Sha	18.1	16.6	12.6	6.3	16.9	Jintur	21.1	14.4	11.0	6.4	20.6
Ausa	17.5	12.7	8.9	4.3	19.0	Karajkhed	20.1	17.4	10.0	6.5	19.7
Jadhala	21.2	12.8	10.6	6.8	21.8	Palam	20.4	12.5	9.5	6.5	20.5
Jawala bk	19.3	19.3	10.9	9.9	21.4	Parbhani	18.9	13.4	9.1	6.5	16.1
Kasarshirshi	20.1	25.0	9.0	9.2	18.8	Pathri	20.3	19.0	19.5	6.4	18.9
Nitur	19.0	17.3	11.0	4.2	19.5	Supegaon	21.7	20.4	11.3	6.6	22.9
Rohina	20.1	15.9	10.6	5.3	21.2	Zari	20.0	17.1	11.2	6.3	17.2

Compiled by Author

c) Monsoon season:

The rainfall distribution in monsoon se is shown in fig. 01(D). All the stations observed uniform Distribution with PCI value less than 10%. It indicates that the region doesn't found withconcentration of precipitation.

d) Post Monsoon season:

The concentration of rainfall during post monsoon season is representing in fig. 01(E). It is observed that the PCI value is more than 10 %. Hence the whole region throughout the season belongs to moderate to irregular and highly irregular distribution. There are 80 stations found that those have 10 to 20% PCI value and 16 stations located in North eastern , south central and northern part of study region. Those are observed with high Irregular distribution means high concentration of rainfall.

e) Annual Concentration:

Annual distribution or concentration of rainfall is also observed with moderate to Irregular and highly irregular distribution. It indicates that the concentration of rainfall is moderate to high. The PCI value ranges from 10 % to 23.7 %. The central A'bad, Jalna, North Parbhani, Hingoli, Latur and eastern Nanded region observed with more than 20% PCI value. It represents highly irregular distribution means high concentration of rainfall. On the other hand northern A'bad, north south Jalna, central Parbhani, Latur ,Western Beed and south western Nanded are found 10-20% PCI value, represent moderate to Irregular concentration of rainfall(fig.01(A) & table 02).

Conclusion:

The higher value of Precipitation concentration Index shows the higher concentration of rainfall. It means that the high irregularity in distribution of rainfall. Due to the concentration of rainfall region experiences drought condition, lack of water resources. It affects on agricultural activities, local human life. In the present research work as concern to annual precipitation distribution A‘bad, north Jalna, Hingoli, North Eastern Nanded, south Parbhani and north Latur parts of Marathwada observed with high concentration of rainfall. And remaining part recorded moderate concentration. It clears that, the Marathwada region haven‘t uniform distribution. Hence Beed, Hingoli, Parbhani, Latur, O‘bad districts are facing very high scarcity of water.

The picture of seasonal distribution of rainfall is clear that nearly 80% part of Marathwada in Pre Monsoon, Winter and Post monsoon experiences moderate concentration. Less than 10% part of Marathwada experiences high concentration in winter, Pre monsoon and Post monsoon. Only in the Monsoon season whole region of Marathwada the rainfall is distributed uniformly.

References:

1. Amogne Asfaw, Belay Simane, Ali Hassen and Amare Bantider (2018): Variability and Time Series trend analysis of rainfall and temperature in north central Ethiopia:A case study in Woleka sub basin; Weather and Climate Extremes, 19, 29-40.
2. Arvind P., Ashok Kumar P., GirishKarthi S., and Surbibahu C R.,(2017):Statistical Analysis of 30 years Rainfall Data: A Case Study, Conf. Series: Earth and Environmental Sciences 8(012067).
3. Chowdhary A. Dandekar M.M. (1998); Variability in drought incidence over India-A Statistical Approach, Mausam, 40 (02), 207-214.
4. Duhan D and Pandey A (2013); Statistical Analysis of long term spatial and temporaltrend of precipitation during 1901-2002 at Madhya Pradesh, India, Atmospheric Research,122, 136-149.
5. Francis Ndamani and Tsunemi Watanabe (2015); Influence of rainfall on crop production and suggestions for adaptation, International Journal of Agricultural Sciences, Vol. 5(1), 366-374.

a. Krishnakumar K.N. Rao G.P. and Gopalkumar C.S. (2009); Rainfall Trend in Twentith Century Over Kerala, Indian Atmosphere Environment 43 (11), 1940-1944.

6. Mohopatra M. and Mohanty U.C. (2006); Spatio Temporal Variability of Summer Monsoon Rainfall Over Orissa in Relation to Low Pressure System, Journal of Earth System Science 115 (2), 203-218.
7. Nagesh W. Goel N.K. Jain M.K. (2013); Temporal and spatial Variability of annual and seasonal rainfall over Ethiopia, Hydrol. Sci. Journal, 58 (2), 11, 354-373.
8. Oliver J.E.(1980); Monthly Precipitation distribution; A comparative Index, prof. Geography, 32 (3),300-309.
9. Pal D., Mazumdar S. and Chakraborty P.K.(2015); District wise Trend Analysis of Rainfall Pattern in Last Century (1901-2000) over Gangetic Region in West Bengal, India,Journal of Applied and Natural Sciences 7(2), 750-757.
10. Rasmita Kumari Sahu and Deepak Khare (2015); Spatial and Temporal Analysis of Rainfall Trend for 30 Disrticts of Coastal State (Odisha) of India, Int. jour. Of Geology, Earth and Env. Science, 5 (1), 40-53.
11. Singh S.K. Singh K.M., Singh RKP, Abhay Kumar and Ujjwal Kumar(2014); Impact of rainfall on Agricultural Production in Bihar:A Zone wise Analysis, Environment and Ecology 32 (4A0, 1571-1576