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The Study of Meteorological Drought Due to Rainfall Variability in Latur District of Maharashtra State (India)

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Abstract :

Meteorology is the branch of science which deals with the study of atmospheric phenomenon. Rainfall is one of the phenomenons of atmosphere. It plays key role in climate of any region but is widely variable throughout the world. It plays key role in the life of living and nonliving things. It also affects on the various economic activities of man, such as Agriculture, mining, animal herding, Inland fishing etc. the agricultural activities are mostly depends on climatic parameters like Rainfall, temperature, humidity etc. Understanding of rainfall variability is suitable for planning in agricultural activities, basically in rain fed region. Rainfall data of 33 years (1985 to 2017) of Latur district is analyzed to assess the monthly, seasonal and annual meteorological drought occurrences. Overall mean of annual rainfall in Latur district is 817.23mm. observed. The minimum and maximum rainfall is recorded in the year 2015 and 2016 respectively with 490.17mm. and 1142.30 mm. after the analysis it is observed that among 33 years, all years are wet years in monsoon, 20 years (62.50%) recorded rainfall less than the mean rainfall in pre-monsoon and post-monsoon season. Annually assessment of drought is results that, 11 years found with no drought, 19 years were with mild drought and three (2009, 2014, and 2015) years were faced for moderate drought condition. The study region doesn't experienced to sever and extreme drought condition.

Keywords: Meteorology, Drought, Frequency, Latur.

Introduction:

Rainfall is the key playing parameter of climate and atmosphere. It is directly and indirectly affecting on the life of biotic elements which present on or beneath of earth surface. The human life mostly depend on rainfall through various ways, agricultural activity is one of them. Indian economy is depends on agriculture and agriculture is on monsoon rainfall. Near about 65% area under cultivation and is rainfed. The rainfall determines various activities in agriculture. The amount of receiving rainfall is varies by place and time over India. Some time rainfall receives less than the average and region experienced the drought situation, it badly affecting on agricultural production. A day is considered as dry, where the rainfall receives less than 2.50mm, when the rainfall receives 6.3 mm or less than the day is considered as agricultural drought day. It is useless for plant growth. Due to the less amount of rainfall the soil, which is around the roots will not be able to provide the sufficient water for plant growth. Sangita Mishra and other studied the meteorological drought in Mumbai City. It is concluded that the district experiencing widely variation in rainfall distribution spatially and temporally. Karate and Sena

are investigated the rainfall analysis for soil planning and water conservation in Gujarat. Sharma and others have analyzed the weekly, monthly and yearly drought for different regions based on actual rainfalls of region.

Study Area and its Location:

The study region of present study is the Latur District. Location of any region plays an important 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 m above msl..

It is bounded on the north by Beed and Parbhani districts, on the north-east by Nanded district, 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 geographical area and it covers 2.39 percent of the total geographical area of Maharashtra. The study region as a hole located on the Balaghat Plateau of Deccan traps. It is 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.

Objectives:

Major objective of the present study is to study the distribution of rainfall and to assess the meteorological drought in Latur district.

Data Base and Methodology:

Present research work is mainly based on secondary sources of data. This data is collected from Department of Agriculture, Maharashtra State. Rainfall data of 33 years i.e. from 1985 to 2017 have been used. Rainfall intensity and frequency of Latur district have been analyzed. Based on this rainfall data, seasonal and annual meteorological drought assessed. The drought seasons and years were determined with the help of IMD's standard procedure (1971)

$$Di = \frac{Pi - \mu}{\mu} \times 100$$

Where as Di = Percentage of deviation from long term mean

Pi = Annual Rainfall in mm

μ = Log term mean of annual rainfall

If the seasonal rainfall is deficient by more than twice the mean deviation of the season then the season experiences Drought situation.

The seasons are considered as Pre-Monsoon (January to May), Monsoon (June to September) and Post-Monsoon (October to December).

If the annual rainfall is deficient by 20-60%, the yearly average rainfall and if it is more than 60% then is known as drought year (Dhar and Others).

Discussion:

The rainfall data have been assessed by seasonal and annual that is temporal assessment. It is found that widely varies throughout the district and over the study period of time.

Seasonal Drought:

Pre-Monsoon Rainfall Distribution:

Pre-monsoon season considered as January to May. The period of pre-monsoon is weatherly the time of preparation of monsoon season over Indian sub-continent. The month of May is recorded more rainfall than the other four months and the February month recorded less rainfall than average. It is observed that there are 20 years recorded less rainfall than twice of mean deviation in the pre-monsoon season. It shows that 20 years experienced with drought condition. It proportionate 60.61 percent of study period.

Table No. 01. Drought Intensity based on percentage of rainfall departure from normal.

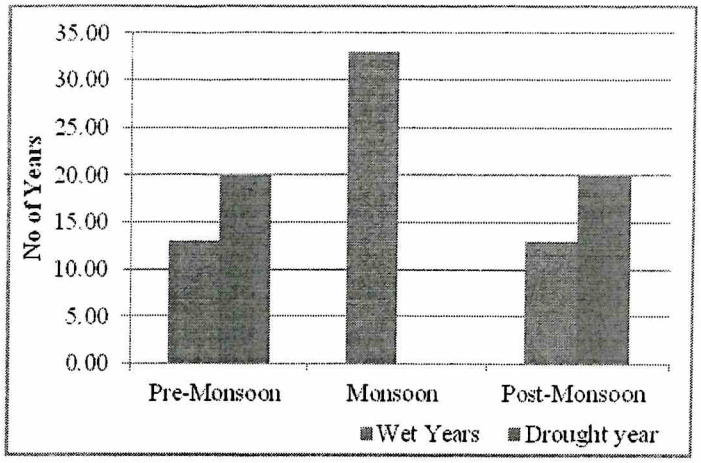
Percentage of departure of Rainfall from Normal	Intensity of Drought	Codes	No. of Years	Years
0.0 or above	No Drought	M0	11	1985, 1988,1990,1995,1996,1998, 2000,2005,2010,2013,2016
0.0 to -25.0	Mild Drought	M1	19	1986,1987,1989,1991,1992,1993,1994, 1997,1999,2001,2002,2003,2004,2006,
-25.0 to -50.0	Moderate	M2	3	2009,2014,2015
-50.0 to -75.0	Severe	M3	0	Nil
-75.0 or less	Extreme	M4	0	Nil

Monsoon Season :

The monsoon season determines from June to September for all years. All 33 years recorded more rainfall than the twice of mean deviation, so there were no drought situation occurred in monsoon season throughout the study period. Averagely the August month receives higher (171.29mm) rainfall than the other months. But it is less than the season's average (665.24mm). The highest rainfall recorded in 2016 (949.00 mm) in monsoon season and lowest in 2015 (361.90mm). It is also observed that there are 18 years recorded more rainfall than the seasonal long term mean average and others are less than the long term mean, its range from 39.31 to 303.34 mm.

Table no. 2 Seasonal Drought Intensity

Season	Wet Years	Drought year	Mean RF	% of Years
Pre-Monsoon (Jan.-May)	13.00	20.00	45	60.61
Monsoon (June-Sept.)	33.00	0.00	665.24	0.00
Post-Monsoon (Oct.-Dec.)	13.00	20.00	60.76	60.61



Post-Monsoon:

The rainfall in post monsoon season for different years varies from 0.6mm to 226.81mm for the years 2007 and 1996 respectively. The post-monsoon season drought assessed for the month of October to December for 33 years. Among the 33 years 20 years found with drought condition. These years recorded the rainfall less than twice of mean. The proportion of these years is 60.61 percent to study period. The mean rainfall of this season is 60.76mm.

Annual Drought Assessment:

The assessment of annual drought is based on the percentage of departure of rainfall from the normal rainfall. The intensity of drought have been grouped into five groups i.e. No Drought, Mild Drought, Moderate Drought, Sever Drought and Extreme Drought with 0.0 or above, 0.0 to -25.00, -25.00 to -50.00, -50.00 to -75.00 and -75.00 or less respectively. These groups coded by M^0, M^1, M^2, M^3 and M^4 respectively. The 11 years recorded the 0.0 or above percentage of rainfall departure from normal rainfall. It means there were no drought (M^0) and condition is normal. The years are 1985, 1988, 1990, 1995, 1996, 1998, 2000, 2005, 2010, 2013 and 2016. The mild drought (M^1) is observed in 19 years and Moderate drought (M^2) experienced in 3 years (2009, 2014 & 2015) with -35.47, 43.11 and 43.71 percent of departure from normal rainfall of annual rainfall. Severe and extreme drought condition is not observed in the study region in 33 years.

Table no. 3. Yearly intensity of Drought in Latur District.

Years	% deviation	Drought Intensity	Drought Code	Years	% deviation	Drought Intensity	Drought Code
1985	0.93	No Drought	M0	2002	-19.22	Mild Drought	M1
1986	-21.07	Mild Drought	M1	2003	-9.75	Mild Drought	M1
1987	-14.03	Mild Drought	M1	2004	-1.51	Mild Drought	M1
1988	13.56	No Drought	M0	2005	19.78	No Drought	M0
1989	-5.75	Mild	M1	200	-0.30	Mild Drought	M1

		Drought		6			
1990	3.00	No Drought	M0	2007	-3.75	Mild Drought	M1
1991	-18.68	Mild Drought	M1	2008	-17.30	Mild Drought	M1
1992	-18.06	Mild Drought	M1	2009	-35.47	Moderate Drought	M2
1993	-16.97	Mild Drought	M1	2010	20.70	No Drought	M0
1994	-0.03	Mild Drought	M1	2011	-18.51	Mild Drought	M1
1995	11.34	No Drought	M0	2012	-12.77	Mild Drought	M1
1996	13.70	No Drought	M0	2013	10.83	No Drought	M0
1997	-8.35	Mild Drought	M1	2014	-43.11	Moderate Drought	M2
1998	0.00	No Drought	M0	2015	-43.71	Moderate Drought	M2
1999	-0.25	Mild Drought	M1	2016	31.03	No Drought	M0
2000	0.93	No Drought	M0	2017	-10.51	Mild Drought	M1
2001	-13.21	Mild Drought	M1				

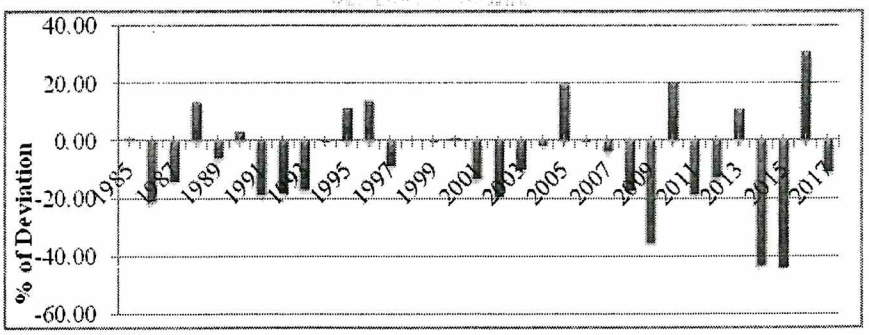


Fig. no. 2 Yearly rainfall variation in Latur district during 1985 to 2017

Conclusion:

It is concluded that in the present study it is found that the pre monsoon and post monsoon season of 20 years experienced with drought condition because of rainfall deficiency. On the other hand the monsoon season of all (33 years, 1985 to 2017) found with no drought, means the rainfall received more than the average. The year, 2009, 2014 and 2015 are experienced due to high deficiency of rainfall, its range from -25 to -50.5 % departure of rainfall from normal.

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