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RAINFALL TREND AND VARIABILITY ANALYSIS IN DHULE DISTRICT (M. S.)

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Abstract:

In present paper, the trend and variability of rainfall is analyzed for four tehsils of Dhule district. Monthly and Annual rainfall data for four tehsilswas obtained from Department of Agriculture and India Meteorological Department. Mann-Kendall's test was employed for a rainfall trend analysis. Standardized rainfall anomaly index and coefficient of variation are used to describe rainfall variability. The trend analysis revealed decreasing rainfall trend in allDhule, Shirpur, Sakri and Shindkhe-da tehsils. However, rainfall trends were statistically significant ($p > 0.05$). The coefficient variation of Dhule (26.66%), Shirpur (35.43%), Sakri (29.67%) and Shindkheda (25.82%) tehsils are moderate which showed average interannual variability. The standardized anomalies of annual rainfall revealed negative anomalies 47% in Dhule and Shirpur tehsils, 26% in Shindkheda tehsil and 31% in Sakri Tehsil. Almost in all the tehsils annual rainfall has shown negative anomalies. Present study was conducted at tehsil level rainfall trend and variability analysis, so future study should include watershed or regional levels.

Key words: *Rainfall Trend, Variability Analysis, Standardized rainfall anomaly index, Coefficient of Variation, Mann-Kendall's test.*

Introduction: Climate variability and change are among the major environmental challenges of the 21st century (Parry et al, 2007). Temperature, Rainfall, evaporation, vegetation, crops, cropping pattern, extreme events like floods and droughts are prime indicators of the climate changes. There are the greatest challenges to recognize and understand climate change. Climate change affect with increased average annual temperatures, reduced and increased variability in rainfall reduces crop yield and threatens food security in low income and agriculture based economies (Maybeck et al, 2012). It is revealed that precipitation has been changed from IPCC (2014) Report. However, changes in precipitation and other elements of climate are varying with time andspace. Spatial variation in climate may be enormous in different areas. Climatic changes affect agriculture to a great degree which is main economic activity of more than half of Indian population.

Aim and objectives:

Aim: Aim of the present paperis to assess variation in rainfall over period of time.

Objectives: -

i) To assess the trend of seasonal and annual rainfall in Dhule district.
ii) To analyse variability of annual rainfall in Dhule district.
iii) To determine standardized rainfall anomaly index.
iv) To estimate frequency of normal and extreme events such as droughts and floods.

Study area: Present research was conducted for four tehsils of Dhule district namely Dhule, Shirpur, Shindkheda and Sakri. Study area is westerncontinental region of India. It is located in the north western part of Maharashtra State. It is a part of Deccan Plateau with an area of 8063.11 sq. km. Northern part of the district is composed by Satpura ranges, southern part is made up of deccan basalt while middle portion is occupied by rift valley of Tapi river. Altitude of the district ranges from 120 m to 611 m. Average annual rainfall of the

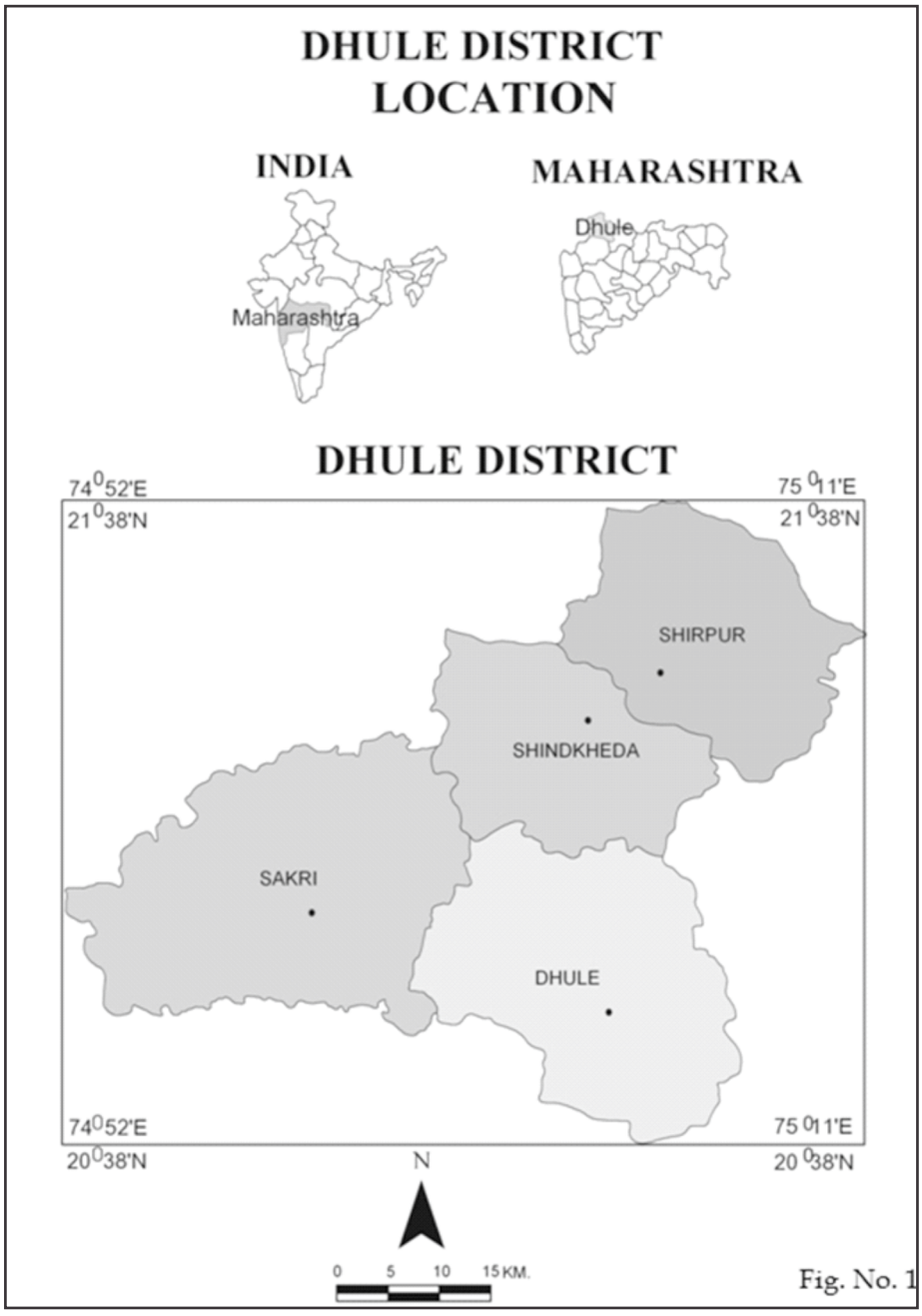
DHULE DISTRICT
LOCATION
INDIA
MAHARASHTRA
Maharashtra
Dhule
DHULE DISTRICT
74 0 52'E
21 0 38'N
75 0 11'E
21 0 38'N
SHIRPUR
SHINDKHEDA
SAKRI
DHULE
74 0 52'E
20 0 38'N
75 0 11'E
20 0 38'N
N
0 5 10 15 KM.

Fig. No. 1

Table No.2 Annual Rainfall Trends

Tahsil	Annual Rainfall Trends			Standard Deviation
	Trends	p - value	Mean	
Dhule	- 6.45	0.79	564.3	150.5
Shirpur	- 15.06	0.58	788.2	279.3
Shindkheda	- 9.35	0.43	610.8	181.2
Sakri	- 8.25	0.70	635.9	149.8

Table No.3 Seasonal Rainfall Trends

Tahsil	Monsoon (June to September)		Winter (October to January)		Summer (February to May)	
	Trends	p-value	Trends	p-value	Trends	p-value
Dhule	- 6.08	0.66	0.00	0.76	- 0.29	0.20
Shirpur	- 16.45	0.61	- 0.06	0.77	- 0.90	0.46
Shindkheda	- 9.41	0..34	- 0.01	0.92	- 0.46	0.48
Sakri	- 8.00	0.55	- 0.05	0.95	- 0.75	0.49

Rainfall variability analysis:

The mean annual rainfall of the study area (four tehsils) ranges from 564.3 to 788.2 mm (Table No.4). The main season contributes about 90 % while winter and summer contribute only 10% of annual rainfall in Dhule and Sakri tehsils while in Shirpur and Shindkheda tehsils monsoon season put up 92% and summer season gift 6% of annual rainfall.

Coefficient of variation: The coefficient of variation of is moderate in Dhule (26.66%), Sakri (25.82%) and Shindkheda (29.67%) but it is slightly high in Shirpurtehsil(35.43%). It exhibits the lower inter annual variability in Dhule, Sakri and Shindkheda tehsils but inter annual variability of rainfall is moderate

Table No. 4 Annual and Seasonal Rainfall Variability (C. V.)

Tahsil	Annual		Monsoon (June to September)			Winter (October to January)		
	Mean	C. V.	Mean	%	C. V.	Mean	%	C. V.
Dhule	564.3	26.66	490.35	87	30.46	56.61	10	1.19
Shirpur	788.2	35.43	725.45	92	35.14	49.62	6	1.14
Shindkheda	610.8	29.67	561.33	92	31.16	37.12	6	1.19
Sakri	635.9	25.82	510.26	88	27.22	57.01	10	1.01

study area is 586 mm. June to September is the rainy season. October to January is winter season while summer extends from February to May. Agriculture is main occupation of the people. Majority of thefarmers are marginal farmers with mixed crops.

Material and methods: Present study is based on secondary data. Monthly and Annual rainfall of four tehsils of Dhule district for 19 years wasconsidered in the present study. The rainfall data for four tehsil were obtained from website of Agriculture Department, Maharashtra state. June to September (Kharip) is the main rainy season while October to January and February to May are winter and summer seasons respectively. Data wasused to analyze the trends and variability in the rainfall of four tehsil. Following methods were adopted to achieve desired goals.

Rainfall trend and variability analysis: In this particular study, Mann-Kendall's test was employed. Mann-Kendall's test is a non-parametric method, which is less sensitive to outliers (Mann, 1945). Mann-Kendall's test checks the hypothesis of no trend versus the alternative hypothesis of the existence of increasing or decreasing trend.

Sr. No.	SAI Value	Category
1	-0.60 or less	Extreme Drought
2	0.30 to -0.60	Severe Drought
3	0.30 to 0	Moderate Drought
4	0 to 0.30	Mild Drought
5	0.30 to 0.60	Normal
6	0.60 to 0.90	Severe Wet
7	0.90 & above	Extreme Wet

Results and discussion:

Annual and seasonal rainfall trend analysis: The results of statistical analysis at 95% confidence level for annual rainfall data using Mann Kendalls test have negative trend in all four tehsils. The results obtained for rainfall series of Dhule, Shirpur, Sakri and Shindkheda showed negative trend. Annual rainfall trend analysis is statistically significant. It has also indicated temporal variation may exist between four tehsils.

The main season (June to September) revealed negativetrends in all four tehsils. This season gives the largest amount of rainfall to annual series (Table No. 2).Similarly seasonal rainfall trend analysis result from October to January and February to May also shows negative trend in four tehsils (Table No. 3). However analysis of seasonal rainfall trend analysis for the period of 1998 to 2016 shows decreasing trend for all seasons and it is statistically significant. Rising trend of Monsoon season provides moisture for the kharip season.

in Shirpur Tehsil. More over coefficient of variation of variation of Monsoon season ranges from 27.22% to 35.14%. Coefficient of variation of monsoon season has been slightly increased except Shirpur tehsil. Study area is totally dependent on rainfall for agricultural activities hence inter annual and annual variability in rainfall distribution influenced crops. Variation in the amount and distribution of rainfall in monsoon season could negatively impacted by current climatic variability.

Standardize Anomaly Index (SAI): Analysis of the standard anomaly index for four tehsils is represented in Table no. 5. It demonstrates the intensity and frequency of drought and inter-annual variation time scales and area. Negative anomaly index was high for Dhule (47.32%) and Shirpur tehsil (47.30%) while other tehsils namely Sakri (31.53%) and Shindkheda (26.33%) exhibits low anomaly index for dry period during 1998 to 2016. The differences between frequencies of the dry and wet years range from the study area were small. Negative Anomaly Index (Dry) was observed in 2000, 2002, 2005 and 2012 in all tehsils. While 1998, 2003, 2004 and 2013 were observed as wet years in most of the tehsils.

Table No. 5 Standardize Rainfall Indices with Frequency and Percentage of occurrence

Sr. No.	SAI Value	Category	Percentage & Frequency of occurrence (year)							
			Dhule		Shirpur		Shindkheda		Sakri	
			Freq	%	Freq	%	Freq	%	Freq	%
1	-0.60 or less	Extreme Drought	4	21.05	7	36.84	2	10.53	4	21.05
2	-0.30 to -0.60	Severe Drought	5	26.32	2	10.53	3	15.79	2	10.53
3	-0.30 to 0	Moderate Drought	1	5.26	2	10.53	7	36.84	4	21.05
4	0 to 0.30	Mild Drought	2	10.53	0	0.00	0	0.00	2	10.53
5	0.30 to 0.60	Normal	1	5.26	2	10.53	4	21.05	2	10.53
6	0.60 to 0.90	Severe Wet	2	10.53	1	5.26	2	10.53	2	10.53
7	0.90 & above	Extreme Wet	4	21.05	5	26.32	1	5.26	3	15.79

Present study indicates that standard anomaly index values of Extreme Drought (-0.60 or less) was occurred in 2000, 2002, 2005 and 2012. Among these four years 2000 and 2012 were driest in all tehsils during observation period. Severe Drought (-0.60 to -0.30) was experienced in 1999, 2008, 2011 and 2016 by all tehsils. The analysis of rainfall reveals that fluctuations in annual and inter annual variability of rainfall occurred in all four tehsils. Such inter annual variability problems in rainfall would negatively affect ability of farmers to cope up with climate change and variability (Ayalew et al., 2012). Similarly IPCC (2014) reported that in next few decades and the second half of the 21st century and beyond there will be risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding and precipitation variability and extremes, particularly for poor population in urban and rural settings.

Conclusion:

Present study was undertaken to understand rainfall variability in four tehsils of Dhule district. Mann-Kendall's test was employed to find out change in rainfall trends. Results of rainfall

trend analysis for Dhule, Shirpur, Shindkheda and Sakri tehsils express decreasing trends. Overall, the observed trends were statistically significant. Coefficient of variation shows that all the tehsils has moderate inter annual variability. Standard anomaly index of annual rainfall exhibits negative anomalies.ACKNOWLEDGEMENT: I am very thankful to Prof. Dinesh B. Patil for help in statistical analysis.

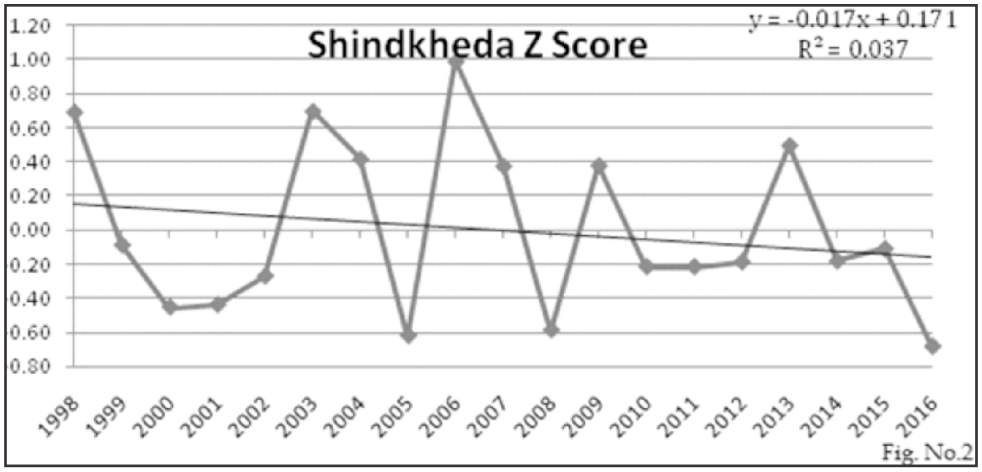

Fig. No.2

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