



RESEARCH PAPER

Rainfall and rainy day trends at Aurangabad district of Maharashtra state

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Abstract : Rainfall data of 34 years (1983-2016) was obtained from agro meteorological observatory, water and land management institute (WALMI) Aurangabad and was analyzed for rainfall and rainy days trends. The trend indicates that the tract received a mean annual rainfall of 745.4 mm in 43 rainy days with maximum contribution (83.5%) from south west monsoon (June to September). July was the rainiest month with 165.9 mm average rainfall. In last fifteen years, occurrence of slight drought and moderate drought has been increased. The annual rainfall variability during last 34 years (1983-2016) indicated that, site received 22 years normal rainfall (- 0.21 to 55.49 %), faced 6 years of slight drought (- 12.92 to -25.46 %) and 6 years moderate drought (-33.91 to -44.42%).

Key Words : Rainfall trend, Rainy days, Moderate drought, Normal rainfall

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INTRODUCTION

Water and land management institute (WALMI) is located in on the Aurangabad – Paithan Highway at latitude of 19° 82' N, longitude of 75.29° E and altitude of 581 meters (MSL) with hot summers and cool winters, with mean annual rainfall of 745.4 mm (1983 to 2016). The area experiences arid and semiarid climate with a distinct seasons, summer, rainy season and the winter. The relative humidity is generally high as over 80 per cent in the monsoon season and less in non-monsoon periods. Rainfall variability is a major factor influencing the agricultural productivity and sustainability in tropics

(Virmani, 1994). The development of improved crop production technology in the rainfed areas to increase food production requires understanding of spatial and temporal variation of rainfall during crop growth. The annual and seasonal rainfall received and its variability directly influences the success or failure of crop through its favourable or adverse effect on crop growth and yield. Therefore, the study of variability of annual and seasonal rainfall is essential in selection of suitable crops and to take appropriate mitigating measures based on rainfall characteristics of a given location and dependability. Such analysis is helpful in prediction of annual and seasonal

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rainfall probability for the next one or two years, in turn crop planning. Similarly, rainfall variability analysis at Akola was done by Tupe *et al.* (2010) and Singh *et al.* (2009) reported for Bihar and Krishnakumar and Prasad Rao (2008) for Kerala and Hanumanthappa *et al.* (2010) reported the rainfall variability in coastal district of Karnataka. Therefore, the study of general trend and distribution of monthly rainfall and rainy day is essential in selection of suitable crops and to take appropriate mitigating measures based on rainfall characteristics of a given location and dependability. Rainfall and rainy days are important weather inputs that limit the crop productivity in a particular location. Hence, it is essential to understand characteristics of these parameters for better agricultural planning.

MATERIAL AND METHODS

The annual and monthly rainfall and rainy days data of 34 years (1983-2016) is available. Daily rainfall data of last 34 years (1983-2016) were collected from Agro-meteorological Observatory, Faculty of Agriculture, Water and Land Management Institute (WALMI) Aurangabad (19° 82' N to 75.29° E, 581 MSL.) were used in this study. The variability of rainfall and rainy days on monthly and annual basis was studied by using standard statistical methods (Panse and Sukhatme, 1985). The percentage contribution of rainfall during different seasons and months were worked out. The normal range of annual rainfall was also computed by using Indian Meteorological Department (IMD) classification: N: Normal RF (mean ± 10%), SLD: Slight drought (-11 to -25 %), MD: Moderate drought (-26 to -49 %) and SD: Severe drought (-50 % and above) was studied.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Annual rainfall:

Analysis of 34 years (1983-2016) rainfall data indicated that the mean annual rainfall of Aurangabad was 745.4 mm. The maximum rainfall was 1159 mm in 2006 followed by 1131.8 mm in 1998 and the minimum was 414.3 mm in 1985 followed by 445.4 mm in 1984. The normal range *i.e.* between ± 10 of mean annual rainfall was 670.84 mm and 819.92 mm. Out of 34 years,

only two years *viz.*, 2006 and 1998 received excess of 55.49 per cent and 51.84 per cent rainfall, respectively. Whereas, three years *viz.*, 1985, 1984 and 1986 received less than -44.62 per cent, -40.25 per cent and -38.78 per cent, rainfall, respectively than the normal range and these three years were declared as moderate drought (Table 1 and Fig.1). In general, the annual precipitation receipt in Aurangabad was normal. The rainfall of 34 years (Table 2 and Fig. 1) ranged from 414.3 mm to 1159.0 mm with a mean of 745.4 mm.

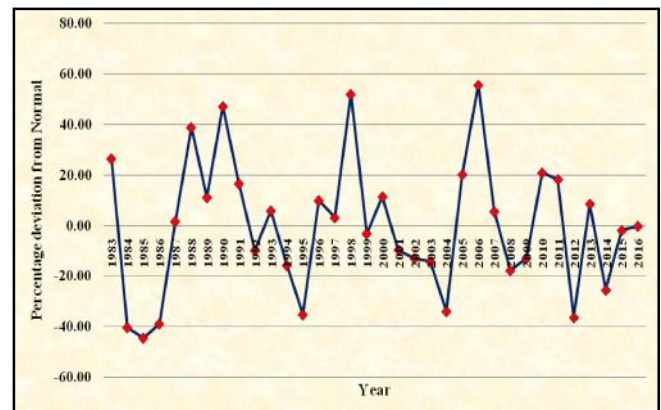


Fig. 1 : Annual rainfall deviation from the normal from 1983 to 2016

Rainy day:

Rainy day (a day with rainfall greater than 2.5 mm) indicated that the mean rainy day of this region was 43 days spread with co-efficient of variation of 78.29 per cent. The maximum rainy days were 62 from (1131.8 mm) in 1998 followed by 58 (1034.3 mm) in 1988 and 57 rainy days in 2006 with highest rainfall of 1159 mm. The minimum was 27 rainy days (868.8 mm) in 1991 followed by 29 in 2002 (649.1 mm). Out of 34 years, four years

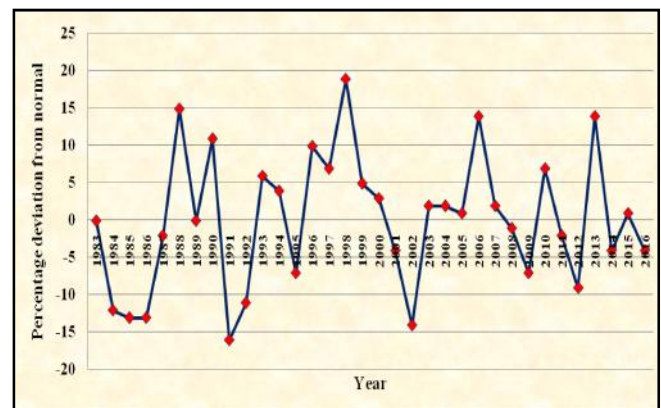


Fig. 2 : Annual rainy days deviation from the normal from 1983 to 2016

Rainfall & rainy day trends

i.e. 1998, 1988, 2006 and 2013 received 19 days, 15 days, 14 days and 14 days, respectively that are excess of 43.85 per cent, 34.57 per cent and 32.25 per cent and 32.25 per cent higher than the normal rainy days. Whereas four years *i.e.* 1991, 2002 and 1985, 1986 received 16 days, 14 days and 13 days that are less than

-37.35 per cent, -32.71 per cent and -30.39 per cent than the normal range (Table 1 and Fig. 2).

The rainfall of 34 years (Table 2 and Fig. 1) ranged from 114.20 mm to 2672.1 mm with a mean of 745.37 mm. The standard deviation (SD) was higher (583.53) with a co-efficient of variation (CV) of 78.3 per cent,

Table 1: Mean annual rainfall and rainy days from 1983 to 2016 and deviation from the normal

Sr. No.	Year	Rainfall	Deviation from normal	Per cent deviation from normal (mm)	Category	Rainy days	Deviation from normal	Per cent deviation from normal
1.	1983	942.31	196.93	26.42	N	43	-0.1	-0.23
2.	1984	445.40	-299.98	-40.25	MD	31	-12.1	-28.07
3.	1985	414.30	-331.08	-44.42	MD	30	-13.1	-30.39
4.	1986	456.30	-289.08	-38.78	MD	30	-13.1	-30.39
5.	1987	757.70	12.32	1.65	N	41	-2.1	-4.87
6.	1988	1034.30	288.92	38.76	N	58	14.9	34.57
7.	1989	828.30	82.92	11.12	N	43	-0.1	-0.23
8.	1990	1096.20	350.82	47.07	N	54	10.9	25.29
9.	1991	868.80	123.42	16.56	N	27	-16.1	-37.35
10.	1992	672.10	-73.28	-9.83	N	32	-11.1	-25.75
11.	1993	789.01	43.63	5.85	N	49	5.9	13.69
12.	1994	628.41	-116.97	-15.69	SLD	47	3.9	9.05
13.	1995	483.30	-262.08	-35.16	MD	36	-7.1	-16.47
14.	1996	818.98	73.60	9.87	N	53	9.9	22.97
15.	1997	768.80	23.42	3.14	N	50	6.9	16.01
16.	1998	1131.80	386.42	51.84	N	62	18.9	43.85
17.	1999	721.70	-23.68	-3.18	N	48	4.9	11.37
18.	2000	830.70	85.32	11.45	N	46	2.9	6.73
19.	2001	673.80	-71.58	-9.60	N	39	-4.1	-9.51
20.	2002	649.10	-96.28	-12.92	SLD	29	-14.1	-32.71
21.	2003	639.21	-106.17	-14.24	SLD	45	1.9	4.41
22.	2004	492.60	-252.78	-33.91	MD	45	1.9	4.41
23.	2005	895.71	150.33	20.17	N	44	0.9	2.09
24.	2006	1159.00	413.62	55.49	N	57	13.9	32.25
25.	2007	786.80	41.42	5.56	N	45	1.9	4.41
26.	2008	613.10	-132.28	-17.75	SLD	42	-1.1	-2.55
27.	2009	648.50	-96.88	-13.00	SLD	36	-7.1	-16.47
28.	2010	900.70	155.32	20.84	N	50	6.9	16.01
29.	2011	881.50	136.12	18.26	N	41	-2.1	-4.87
30.	2012	474.60	-270.78	-36.33	MD	34	-9.1	-21.11
31.	2013	809.12	63.74	8.55	N	57	13.9	32.25
32.	2014	555.60	-189.78	-25.46	SLD	39	-4.1	-9.51
33.	2015	731.30	-14.08	-1.89	N	44	0.9	2.09
34.	2016	743.80	-1.58	-0.21	N	39	-4.1	-9.51
Mean		745.38	0	0		43.12	0	0

*Normal (N): mean \pm 10%; Slight drought (SLD): -11 to -25 %; Moderate drought (MD): -26 to -49 %; Severe drought (SD): > 50% and above

Table 2: Characteristics of monthly rainfall from 1983 to 2016 at WALMI, Aurangabad metrological station

Months	Max	Min	Mean (1983-2016)	S.D.	C.V %	% of annual
January	16.8	0	1.29	3.90	302.40	0.17
February	10.2	0	1.31	2.89	221.46	0.18
March	58.5	0	6.74	14.69	217.86	0.90
April	37.4	0	3.40	7.33	215.83	0.46
May	180.8	0	19.39	34.45	177.66	2.60
June	612.1	32.5	142.44	114.23	80.20	19.11
July	456.11	27.3	165.86	97.14	58.57	22.25
August	364	32.9	156.36	87.67	56.07	20.98
September	417.5	21.5	158.03	102.39	64.79	21.20
October	287.5	0	66.07	65.26	98.78	8.86
November	112	0	17.45	31.56	180.86	2.34
December	119.2	0	7.04	22.02	312.53	0.95
Total	2672.1	114.2	745.38	583.53	1987.01	100.00

Table 3: Annual rainfall (mm) variability from 1983 to 2016 at WALMI, Aurangabad metrological station

Period	Rain fall range (mm)	Average	SD	C.V.%
1983 to 1987	414.3 - 942.31	603.2	235.07	38.97
1988 to 1992	672.1 - 1096.2	899.9	169.25	18.81
1993 to 1997	483.3 - 818.9	697.7	140.42	20.13
1998 to 2002	355 - 1131.8	801.4	280.47	35.00
2003 to 2007	492.6 - 1159	794.7	254.7	32.05
2008 to 2012	474.6 - 900.7	703.7	183.14	26.03
2013 to 2016	555.6 - 809.12	709.9	108.41	15.27

indicating higher variability and lesser dependability on rainfall. During better rainfall years, 1983- 1987 (5 years) mean rainfall was 603.2 mm with a standard deviation of 235.07 and co-efficient of variation of 38.97 per cent (Table 3). During this there was occurrence of moderate drought in three years out of five years. During the period of 1987 to 1993 there was normal rainfall in this region. During 1993 to 1997 the average rainfall ranged from 697.7 mm with SD of 140.42 and CV of 20.13. There was one slight drought and moderate drought year was recorded during this period. Next subsequent year onwards increasing trend was observed with normal rainfall and one SLD year. On the contrary, during recent the last 9 years (2008-2016), the annual rainfall was of increasing trend, which ranged from 703.7 mm (183.4 and 26.03, SD and CV, respectively) to 709.9 mm with a SD (108.41) and CV (15.27 %), indicating higher variability and more dependability. As per IMD drought intensity classification, the region has experienced moderate drought (drought intensity > 50 %) during the three consecutive years (1984 – 1986) and excess rainfall

in the year 1988, 1990, 1998 and 2006.

Conclusion:

It is observed that there was six years of moderate drought (17.64%) and six years of slight drought (17.64%) was observed in the Aurangabad district in the last 34 years. The normal rainfall was observed in 22 years (64.70%) over the last 34 years.

There was no trend in the annual rainfall totals and rainy days over pre- monsoon, monsoon and post-monsoon in the period 1983 – 2016, except in 1984 to 1986.

In contrast, the annual total rainfall in 1983 to 1992 was 751.57 mm whereas in the year 1993 to 2002 was 749.56 mm. This trend shows there is no significant difference in the rainfall for every 10 years in the 34 years.

Similarly in case of mean annual rainy days in 1983 to 1992 was -4 days from the normal (43 rainy days) and from 2003 to 2007 was increase in rainy days this showed the significant increase in the rainy days since

1983 over the normal rainy days of 43 days of 34 years.

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