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A CASE STUDY

Estimation of yearly, monthly and weekly drought for Aurangabad district of Maharashtra

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SUMMARY : The rainfall distribution of Aurangabad district of Maharashtra state is quite erratic in space and occurrence of drought is common. In this study 21 years (1991-2011) of rainfall data of Aurangabad district have been analyzed on yearly, monthly and weekly basis for predicting the water drought, normal and surplus events for crop planning in the region. Weekly drought normal and surplus events give a more precise idea about crop planning than yearly and monthly events. The analysis has revealed that the percentage of drought weeks was more than normal and surplus weeks. It has been also revealed that there is a need of assured supplemental irrigation facility in *Rabi* and summer season crops.

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Key **W**ords **:**
Crop planning, Drought, Supplemental irrigation

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The occurrence of rainfall greatly varies across the country and frequent dry spell observed in the many parts of Maharashtra state. Most of the central Maharashtra districts have reported drought conditions of varying magnitude at different points of time. Generally, drought occurs when a region receives below average rainfall. The scenario of agricultural drought in Aurangabad district comes under contingent drought, which results from variable and irregular pattern of rainfall. The adequacy of rainfall to meet water requirement of the crop and other consumptive and non-consumptive need of water is a basic requirement for crop planning. The rainfall is one of the most important and governing factors in the planning and operation strategies of any agricultural programme for any given area. As such, proper and specific information about the rainfall distribution pattern over a period for a particular place is quintessential for proper and optimal planning of requisite irrigation system and cropping pattern. The major share of conjunctive water need of the country during entire calendar year is met by the rainfall, which occurs in the monsoon period. There is large variation in distribution of rainfall from year to year. In last two decades many drastic climatic changes observed in Maharashtra. In respect of this twenty-one year's rainfall has been analyzed to determine the period of water deficit, surplus and normal for crop planning at various levels such as yearly, monthly and weekly bases.

EXPERIMENTAL METHODOLOGY

The study was carried out for Aurangabad district of Maharashtra state at an altitude of 556 m above mean sea level. Aurangabad is intersected by $19^0$53'N latitude and $75^0$23'E longitude. Daily rainfall data collected from Water Resources Department, Hydrology Project (surface water), Government of Maharashtra, Nasik. Daily rainfall data were converted on yearly, monthly and weekly basis and event were classified as drought, surplus and normal. If 'A' is the mean weekly rainfall for 21 years of data from 1991 to 2011, then a week receiving rainfall less than 75 per cent of 'A' value is termed as drought week and week receiving rainfall greater than 125 per cent of 'A' value is a surplus week. Week having rainfall between 75 per cent of 'A' value and 125 per cent of 'A' value is considered as

normal week. Same criteria were applied for monthly and yearly events.The last day of every year (365th day) and last 2 days of a leap year are accounted in the 52nd week.

EXPERIMENTAL FINDINGS AND DISCUSSION

In order to stabilize the crop production at a certain level even in low rainfall years, it is essential to plan agricultural operation on a scientific basis by making the best use of rainfall potential of the area. It is necessary to know the minimum assured rainfall at the time of different farming operations and growth stages.

Table 1 reveals that the average annual rainfall for Aurangabad was 754.2 mm with a standard deviation of 130.4 mm with co-efficient of variation 17.3 per cent. The mean annual rainfall varied from the minimum of 613.1 mm in the year 2008 to the maximum of 1159 mm in the year 2006. About 95.24 per cent were normal years, 4.76 per cent as surplus years and none of drought year. There were 20 normal years and only 1 surplus years. Yearly rainfall only gives general idea about climate and it is less important regarding crop planning point of view.

From Table 2 it is revealed that the distribution of monthly rainfall pattern indicated that on an average January, February and April months did not receive effective rainfall and August received the highest rainfall (187.32 mm). The average monthly rainfall during 1991-2011 was 62.85 mm with an average standard deviation of 40 mm and 201.98 per cent co-efficient of variation. The number of drought event were more than that of normal and surplus event for all months. The drought events were observed in January, February, March, April, May, November and December months whereas normal event observed in October month and most of the surplus events from June- September. On an average, occurrence of drought, normal and surplus months were 62.7, 15.1 and 22.2 per cent, respectively. The precautionary moisture conservation measures should be adopted during the post monsoon period to ensure better crop condition in *Rabi* season.

The estimation of weekly rainfall and drought was more significant for crop planning and on farm water management practices in rain-fed and irrigated areas. Weekly available moisture variation was more critical to crop growth. The number of drought, normal and surplus weeks observed gave a clear idea about crop management practices. From Table 3, the number of drought weeks was more than the normal and surplus weeks. Average weekly rainfall during 1991-2011 was 15 mm with an average standard deviation of 18.2 mm and co-efficient of variation 191.2 per cent. On an average, 1-20th weeks were the dry and 32nd week was the highest surplus. During summer season, all weeks were drought ; during monsoon season total weeks were surplus; During winter season only week number 39, 40 and 41 were surplus weeks, 42, 43 as a normal weeks and remaining season was drought. It was indicated that the overall drought week were 73.5 per cent while the surplus weeks were 21.9 and 4.5 per cent normal weeks. Therefore, most of the weeks in winter and summer seasons need supplemental irrigation to mitigate soil moisture stress during crop

Table 1 : Yearly rainfall of Aurangabad district

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rainfall (mm)	766.6	804.5	901.8	691.4	636.4	735	733.9	932.9	695	693.5	651.7
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Rainfall (mm)	689.1	639.21	698.8	895.71	1159	786.8	613.1	642.2	802.9	668.8	754.2

Table 2 : Monthly rainfall of Aurangabad district

Month	Rainfall (mm)	Standard deviation (mm)	Co-efficient variation (%)
January	0.33	1.32	394.97
February	0.05	0.22	458.26
March	5.62	12.62	224.61
April	0.80	2.04	256.81
May	4.36	12.10	277.63
June	148.90	103.13	69.26
July	167.35	92.67	55.38
August	187.32	85.94	45.88
September	162.10	76.30	47.07
October	59.28	49.40	83.34
November	10.63	26.51	249.39
December	7.47	19.50	261.18
Average	62.85	40.15	201.98

Table 3 : Weekly rainfall of Aurangabad district

Week	Rainfall (mm)	Standard deviation (mm)	Co-efficient of variation (%)
1.	0.0	0.0	0.0
2.	0.3	1.3	458.3
3.	0.0	0.0	0.0
4.	0.0	0.0	0.0
5.	0.0	0.2	458.3
6.	0.0	0.0	0.0
7.	0.0	0.0	0.0
8.	0.0	0.0	0.0
9.	0.0	0.2	458.3
10.	1.5	4.7	319.5
11.	0.3	1.2	365.2
12.	0.0	0.0	0.0
13.	0.3	1.3	458.3
14.	0.3	1.4	458.3
15.	0.0	0.0	0.0
16.	0.3	1.4	458.3
17.	0.0	0.0	0.0
18.	0.7	2.0	277.0
19.	0.0	0.0	0.0
20.	0.2	1.1	458.3
21.	2.7	9.4	345.4
22.	6.2	15.8	252.8
23.	41.5	75.0	180.6
24.	36.9	33.1	89.7
25.	34.7	42.5	122.7
26.	31.0	40.2	129.7
27.	37.2	37.0	99.5
28.	36.3	43.8	120.5
29.	33.8	42.4	125.6
30.	45.3	40.1	88.4
31.	43.6	44.3	101.5
32.	55.2	61.2	110.9
33.	28.4	26.4	93.1
34.	40.9	41.6	101.7
35.	53.7	71.8	133.7
36.	51.5	54.9	106.7
37.	26.5	30.0	113.2
38.	32.5	30.1	92.8
39.	32.2	32.3	100.3
40.	24.7	40.6	164.4
41.	7.6	13.7	179.6
42.	18.1	32.3	178.8
43.	5.1	12.9	251.5
44.	3.0	7.8	260.0
45.	2.1	4.4	212.7
46.	3.9	9.9	256.3
47.	1.5	5.3	346.4
48.	4.0	12.2	305.9
49.	5.9	18.8	319.8
50.	0.0	0.0	0.0
51.	0.1	0.4	458.3
52.	0.8	2.7	330.6
Average		18.2	191.2

growth. It was clear from the analysis that crop planning on weekly basis is more appropriate than that at monthly or yearly basis. It is observed that within a month there were week-to-week rainfall variations causing temporary drought spells, which are not reflected in monthly or yearly data analysis. If these drought weeks coincide with the critical stage of crop growth, there will be considerable damage to the valuable standing field crops.

Shin and Salas (2000) made the regional drought anylis based on the neural network Pandey *et al.* (2002) made the analysis of meteorological drought based on rainfall data of Almora of Uttarakhand. Similarly, Kumar *et al.* (2002) worked on the assessment and management of meteorological drought for crop planting in Uttarakhand. Similar work related to the topic was also done by Appa Rao *et al.* (1979); Challa and Wadodkar 1996 in Maharashtra, George (1972); Jeyseelan and Thiruengadachari (1986); Palmer (1965) and Tiwari *et al* . (2007).

Conclusion :

During 1991 to 2011, on an average the drought, normal and surplus years were 0.00, 95.24 and 4.76 per cent, respectively. The percentage of drought normal and surplus months were 62.7, 15.1 and 21.9 per cent, respectively; occurrence of drought, normal and surplus weeks were 73.5, 4.5 and 21.9 per cent, respectively. This trend indicates that on short term basis the occurrence of drought was more apparent in Aurangabad district. Hence, the analysis of short-term (weekly) rainfall data must be used for better crop planning in Aurangabad district.

The percentage of drought event increased from yearly to weekly basis rainfall analysis.

The number of drought weeks were more than that of normal and surplus weeks, for timely germination and proper growth of *Rabi* and survival of summer crops the facility of assure irrigation is necessary.

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