



RAINFALL PROBABILITY IN OSMANABAD DISTRICT OF MARATHWADA REGEION

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Abstract: *Osmanabad district of Marathwada region of Maharashtra state is spread over 17°35' 18°40' N latitude and 75°16' to 76°40' E longitude. Mean annual rainfall of Osmanabad district is in the range 550-750 mm. Out of total annual rainfall about 80-87% rainfall was received in SW monsoon season only, while remaining 12-18 % from NE monsoon. Though the mean annual rainfall of Osmanabad district comes in the category of assured rainfall zone but, the inter taluka variation are wide so the intra seasonal behavior warrants timely management for sustainable crop production.*

Key words: *Rainfall probability study, Osmanabad, Marathwada.*

Introduction

Efficient cropping system for a specific location can be evolved by understanding the rainfall pattern. Random nature of rainfall occurrence suggests need for sound statistical analysis and logical interpretations. Study of rainfall over a long period reveals general pattern of rainfall at a particular place, which helps in understanding the amount, intensity, distribution & other rainfall characteristics. Rainfall studies particularly, its probability analysis are of great use in crop management practices, plant protection measures and other related farm practices for sustainable crop production in area under reference. Such information strongly contributes to the early warning systems. The application of agrometeorological warnings and advices by farmers has resulted in an increase of crop yield to the tune of 20-40% and also helped to minimize climatic hazards. Osmanabad district of Marathwada region of Maharashtra state is spread over 17°35' 18°40' N latitude and 75°16' to 76°40' E longitude. The altitude of Osmanabad district is 600-611m above mean sea level. Mean annual rainfall of Osmanabad district is in the range 550-750 mm.

Though the mean annual rainfall of Osmanabad district comes in the category of assured rainfall zone but, the inter taluka variation are wide

so the intra seasonal behavior warrants timely management for sustainable crop production.

Material and Method

In rainfed conditions, it is essential to study the behavior of rainfall for suggesting crop planning for sustainable production in any particular district at taluka level. The important aspects include onset of monsoon, distribution of monsoon and break in monsoon, probability of occurrence of rainfall on weekly basis, withdrawal of monsoon length of growing period, starting and ending of rainfall periods etc. Rainfall characterization of Osmanabad district of Marathwada region Maharashtra is studied for above mentioned aspects so as to suggest the crops and cropping system for each taluka in different soil types. The methodologies and techniques used are described in this chapter under appropriate heads.

The historical daily data of rainfall at each taluka of Osmanabad district were collected from State Department of Agriculture, Collectorate of Osmanabad, Department of Agricultural Meteorology, College of Agriculture, Parbhani. And Agriculture Research Station, Tuljapur.

The rainfall data from the newly created taluka namely Lohara and Washi were for a very short period and hence they are not included in present study. However daily rainfall data for

Osmanabad, Tuljapur, Omarga, Kalamb, Paranda and Bhoom were available for last 26 years which were used for further analysis.

The data collected for each taluka of Osmanabad district were subjected to statistical analysis such as standard deviation, coefficient of variation, Extreme lowest and highest, starting, ending and duration of rainy season, initial and

conditional probability using Markov and Marshall chain probability model. Dry and wet spell probability using Markov and Marshall chain probability model, starting and ending of rainy season by frequency analysis of weekly rainfall were estimated from the computerized Programme developed by CIRIDA, Hyderabad and different formulae used for analysis were as follow.

Probability analysis

Formula for initial and conditional probabilities

I. Initial rainfall probability (%) W.

$$W_x = \frac{\text{Initial rainfall probability of getting } >20 \text{ mm rainfall.}}{\text{Number of year during which } > 20 \text{ mm Rainfall in x week}} \times 100$$

$$W_x = \frac{\text{Total number of year}}{\text{Total number of year}} \times 100$$

II. Conditional rainfall probabilities (%) (W/W)

Conditional rainfall probability (%) of getting 20 mm rainfall during next week also than there was rainfall >20 mm during this week (x).

$$W_x = \frac{\text{Number of year during which next received } >20 \text{ mm rainfall when this week also received } > 20 \text{ mm rainfall}}{\text{Number of year during which this week (Wx) received } >20 \text{ mm rainfall}}$$

III. Conditional rainfall probabilities (%) (W/D)

Conditional rainfall probability (W/D) of getting 20 mm rainfall during next week than this next week was dry i.e. the rainfall <20 mm rainfall.

$$W_x = \frac{\text{Number of year during which next week received } >20 \text{ mm rainfall when this week (x) also received } < 20 \text{ mm rainfall}}{\text{Number of year during which this week was dry received } <20 \text{ mm rainfall}}$$

Result and Discussion

Probability of rainfall occurrence

The probability analysis provides a tool for the assurance of fix quantity of rainfall in particular week for given talukas. Probability of rainfall occurrence at 20, 30 & 40 mm is given in Table No. 4.12. As the major amount of annual rainfall is

concentrated during SW monsoon that is MW 23-41 are considered for this study. The data presented in Table-4.12 indicated that the probability of occurrence of rainfall decreases as the quantum of rainfall increases in almost all talukas and all week considered.

From MW 29 onwards the amount of rainfall is either equal or exceeding the weekly PET values and the crop sown in MW 24 or 25 coincide this period with the grand growth to reproductive stages. The rainfall may be lost as surface of runoff, if appropriate water conservation measures are not adopted.

Probability of occurrence of 20mm rainfall in Osmanabad taluka ranged 34-73 per cent with highest percentage in MW 39 & lowest in MW 41. For 30 mm rainfall percentage range is 26-53 with higher value in MW 39 & lowest in MW 35, for 40 mm rainfall range is 23-42 percent with higher in MW 34 & lowest in MW 25.

Probability of occurrence of 20mm rainfall in Tuljapur taluka ranged 34-80 percent with highest percentage in MW 39 & lowest in MW 25. For 30 mm rainfall percentage range 30-65 with higher value in MW 39 & lowest in MW 25 while for 40 mm rainfall range is 19-61 percent, highest in MW 38 & lowest in MW 25.

Probability of occurrence of 20mm rainfall in Omerga taluka ranged 30-65 per cent with highest percentage in MW 39 & lowest in MW 25. For 30 mm rainfall percentage range was 23-50 with higher value in MW 32 & lowest in MW 26 while for 40 mm rainfall range is 19-42 percent with highest value in MW 37.

Probability of occurrence of 20mm rainfall in Kalamb taluka ranged 34-69 per cent with highest percentage in MW 39 & lowest in MW 41. For 30 mm rainfall percentage range was 30-57 with highest value in MW 29 while for 40 mm rainfall the range is 23-46 percent with higher value in MW 39.

Probability of occurrence of 20 mm rainfall in Paranda taluka ranged 19-65 per cent with highest percentage in MW 39 & lowest in MW 25. For 30 mm rainfall percentage range was 7-50 with higher value in MW 37 & lowest in MW 31 and for 40 mm rainfall range is 3-46 percent with higher value in MW 37 & lowest in MW 31.

Probability of occurrence of 20mm rainfall in Bhoom taluka ranged 30-57 per cent with highest percentage in MW 24 & 38 and lowest in MW 32.

For 30 mm rainfall percentage range 23-57 with highest value in MW 38 & lowest in MW 29 while for 40 mm rainfall range is 15-50 percent with highest in MW 38.

Probability of Dry & Wet spells

During SW monsoon period occurrence of dry spell is common phenomenon in Osmanabad district. A break in the occurrence of rainfall during crop growing period affects the crop growth and ultimately the yield is affected, which is called as dry spell. It may be of any duration ranging from 2 days to more than 20 days and even in some events it is 30 day, during this period the crops survive till soil is sufficiently wet to meet the evaporative demand of atmosphere. The dry spell is common feature of Osmanabad district. Hence the probability at each taluka was calculated for 20, 30 & 40 mm rainfall per week during rainy season and presented in Table 4.13 revealed that the probability of 2 days dry spell per week. For 20 mm rainfall data, it ranged between 11-51 per cent with more chance of occurrence at MW 34 while less chance in MW 38 in Osmanabad taluka. In Tuljapur very less chance of dry spell. In Omerga at 20 & 30 mm rainfall dry spell probability is less. For Paranda & Bhoom there is always chance of dry spell in all probability levels i.e. 20, 30 & 40 mm.

Probability of 2 day wet per week is common at 20, 30 and 40 mm at Osmanabad, Tuljapur, Omerga & Kalamb taluka. While chance of 2 days wet per week is less in Paranda & Bhoom taluka. Data are presented in Table – 4.14. Same results are found in Maniyar *et al* (2005) i.e.

Conclusion

The timely onset and probability of good quantum of rainfall in succeeding weeks provide opportunity for dry seeding in this district in all talukas. The probability of higher amount of rainfall is lesser as compared to lower amount. The probabilities of 40 mm rainfall per week increase gradually with intermittent breaks in monsoon activities. thus may poses the moisture stress in short duration crops like Green gram, Black gram etc. as well as early growth stages of medium and long duration crops like sorghum, cotton, Arhar etc The

crops requirement of water for meeting can be met through life saving irrigations (1-2).
evapotranspirative demand, under stress conditions

Table 1: Probability of occurrence of wet spell at taluka level of smanabad district during rainy season at Probability limit 20, 30, 40 mm

Wk. No.	Osmanabad			Tuljapur			Omarga			Kalamb			Paranda			Bhoom		
	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40
23	.3462	.2692	.1154	.3077	.1923	.1538	.2308	.1154	.0385	.2692	.1538	.0769	.1538	.1538	.1154	.1923	.1154	.0385
24	.2308	.1154	.0385	.1923	.1154	.0385	.1154	.0385	.0385	.2308	.1538	.1154	.0000	.0000	.0000	.2308	.1923	.1154
25	.1923	.1538	.0769	.1923	.1154	.0385	.0769	.0000	.0000	.2308	.1538	.1154	.0000	.0000	.0000	.1923	.1538	.0769
26	.2692	.1154	.1154	.2692	.2692	.1154	.2308	.1538	.0769	.1538	.0769	.1538	.0769	.0385	.0385	.0769	.0385	.0000
27	.3077	.2308	.1923	.3462	.3077	.2308	.2692	.1923	.1538	.2692	.1538	.0769	.1923	.1154	.0769	.3077	.1154	.0769
28	.1923	.0769	.0769	.1923	.1538	.1154	.2692	.0769	.0769	.2692	.2308	.1154	.1154	.0769	.0769	.2692	.1538	.0385
29	.3462	.2308	.1538	.2692	.1923	.1538	.3077	.2692	.2308	.3846	.3462	.1154	.2308	.1538	.0385	.1923	.1154	.0769
30	.3462	.2692	.2308	.3846	.3077	.2308	.3077	.2308	.1154	.2692	.2308	.1154	.0769	.0000	.0000	.2692	.2308	.1154
31	.3462	.2308	.1538	.3462	.1923	.1154	.2308	.1538	.0385	.3077	.1538	.0385	.0769	.0385	.0000	.1538	.0385	.0000
32	.3077	.2308	.1923	.3846	.2308	.1923	.2692	.1538	.0769	.3077	.0769	.0769	.1154	.1154	.0769	.1923	.1154	.0769
33	.1923	.1538	.0769	.3077	.1154	.1154	.1154	.0769	.0385	.2692	.2692	.1923	.1154	.0385	.0385	.1154	.0769	.0385
34	.2692	.1923	.1538	.3462	.2692	.1923	.2692	.1923	.1538	.2692	.2308	.1923	.1923	.1538	.0769	.2308	.1923	.1538
35	.1923	.1154	.0769	.2308	.1923	.1538	.2692	.0769	.0769	.3462	.1923	.1154	.1154	.1154	.0769	.1154	.0769	.0385
36	.3462	.2692	.1538	.3077	.3077	.2308	.3462	.2692	.1538	.3846	.3077	.2308	.1923	.1538	.1538	.2308	.1923	.1538
37	.3846	.2692	.2308	.3846	.3462	.2692	.3462	.3462	.1923	.3077	.3077	.2308	.3846	.2308	.1923	.3077	.2308	.1923
38	.4615	.3462	.1923	.5385	.5000	.4231	.4615	.3462	.1923	.3846	.2308	.1923	.3077	.2308	.1538	.3077	.3077	.3077
39	.3846	.2692	.2308	.4231	.2692	.1538	.3077	.2308	.2308	.3462	.2692	.2308	.2692	.1538	.1154	.3077	.1538	.1538
40	.2308	.1923	.0769	.2308	.1923	.1154	.2308	.1923	.1923	.1538	.1538	.1154	.2692	.2308	.1538	.2692	.1154	.0769
41	.1554	.1154	.0385	.1538	.1154	.1154	.1538	.1538	.1538	.1923	.1154	.0385	.1538	.0769	.0385	.1923	.1154	.0769

Table 2: Probability of occurrence of dry spell at taluka level of Osmanabad district during rainy season at Probability limit 20, 30, 40mm

Wk. No.	Osmanabad			Tuljapur			Umarga			Kalamb			Paranda			Bhoom		
	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40
23	.1923	.4231	.4615	.1154	.2692	.5385	.1538	.2692	.4615	.1923	.3077	.4231	.1923	.4231	.5769	.2308	.2308	.3462
24	.2308	.4231	.5000	.1923	.3077	.5769	.2308	.3462	.5000	.2308	.3077	.4231	.3846	.4231	.5385	.3077	.3846	.5000
25	.1923	.4615	.6145	.2692	.3462	.5000	.3846	.5000	.5769	.3846	.5385	.6154	.5385	.5769	.7308	.3846	.5385	.6538
26	.1923	.3462	.5000	.1538	.3077	.5000	.3077	.5000	.6154	.2692	.4615	.5769	.3846	.5000	.6923	.1923	.3077	.6154
27	.3462	.4615	.5000	.3846	.3846	.6154	.3077	.4615	.5769	.3057	.5000	.5769	.5385	.5769	.6923	.3462	.3846	.6538
28	.2692	.4231	.5000	.3462	.3462	.5000	.3846	.4231	.5000	.1154	.3077	.5000	.4615	.5769	.7308	.3846	.5769	.6538
29	.2692	.4231	.5000	.3077	.3077	.5000	.2308	.5385	.5769	.2308	.2692	.3462	.5000	.5769	.5623	.3077	.5000	.6923
30	.1923	.3462	.5769	.2692	.4231	.4615	.2308	.4231	.4615	.2308	.3462	.4615	.5000	.6154	.7692	.3462	.5769	.7308
31	.2308	.3462	.4615	.2308	.3846	.3846	.2692	.3077	.4615	.3077	.4231	.5000	.5000	.6923	.8077	.4615	.5385	.6923
32	.3077	.3462	.5385	.3077	.4615	.5385	.3077	.4231	.5769	.3846	.3462	.5385	.4615	.6154	.8077	.3746	.5769	.7308
33	.1923	.3077	.4231	.3077	.4231	.5000	.2308	.3846	.5000	.3462	.4615	.5000	.5000	.5769	.7308	.2308	.4231	.5000
34	.3462	.5000	.5000	.4615	.5769	.6154	.3846	.5385	.5385	.2692	.4231	.4615	.5385	.6154	.6154	.4615	.5000	.5000
35	.2692	.3462	.3846	.3077	.3846	.5000	.3077	.4231	.5385	.3077	.3077	.4231	.5385	.6154	.6154	.4231	.4231	.5000
36	.3077	.3462	.3462	.2692	.3846	.4615	.3077	.3846	.4615	.2692	.3846	.4615	.3077	.4615	.5000	.4615	.5000	.5385
37	.2692	.3462	.4231	.1923	.2308	.2692	.1923	.2308	.3846	.1154	.3846	.4231	.3077	.3462	.3462	.2692	.2692	.3077
38	.1154	.3077	.3077	.0769	.1923	.2308	.1923	.2692	.4231	.2692	.2308	.3077	.2308	.3846	.3846	.2308	.3077	.3846
39	.1538	.2308	.4231	.1538	.2308	.2692	.2308	.3462	.4231	.4231	.4231	.4231	.1538	.3077	.5000	.3077	.3846	.4231
40	.3846	.3846	.4231	.3846	.4615	.4615	.3846	.3846	.3846	.2308	.4615	.4615	.4231	.5000	.6154	.3462	.5385	.5385
41	.5769	.6538	.6538	.5000	.5385	.5769	.5000	.5769	.5769	.5385	.5769	.5769	.5769	.5769	.6538	.4615	.6154	.6538

Table 3: Probability of occurrence of rainfall at taluka level of Osmanabad district during rainy season at Probability limit 20, 30, 40mm

Wk. No.	Osmanabad			Tuljapur			Umarga			Kalamb			Paranda			Bhoom		
	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40
22	.1538	.1154	.1154	.1538	.0769	.0000	.1154	.0385	.0000	.0769	.0769	.0000	.1923	.1923	.0769	.1155	.0385	.0385
23	.6154	.5000	.3462	.5385	.4231	.3462	.5000	.4231	.2692	.4615	.3077	.2308	.5385	.3462	.1923	.3846	.3462	.3077
24	.5385	.3462	.3077	.6538	.5000	.2692	.5769	.4231	.3077	.6154	.5385	.4231	.4231	.6846	.3462	.5769	.5385	.3846
25	.4615	.3462	.2308	.3462	.3077	.1923	.3077	.2692	.2308	.3846	.3077	.2692	.1923	.1923	.1154	.3462	.2692	.2308
26	.5385	.3462	.2308	.5769	.4615	.3462	.3846	.2308	.1923	.4615	.3077	.2308	.2692	.2308	.1538	.4615	.3462	.1923
27	.5385	.4231	.3846	.5385	.5000	.2692	.5385	.4231	.2692	.4231	.3077	.2692	.3846	.3077	.1923	.4231	.3846	.1923
28	.4231	.3462	.3077	.4231	.4231	.3462	.4231	.3077	.3077	.5385	.3462	.2308	.2692	.2308	.1923	.5385	.3462	.2308
29	.5000	.3077	.2692	.4231	.3846	.2692	.4615	.3462	.2692	.6154	.5769	.3846	.3846	.2692	.1538	.3462	.2308	.1538
30	.5769	.5000	.3846	.5385	.5000	.3846	.6154	.3846	.3846	.5385	.5000	.3846	.3462	.3077	.1923	.5385	.3846	.2308
31	.5769	.4231	.2692	.5769	.3846	.3846	.4615	.4231	.2692	.5000	.3846	.2692	.2308	.0769	.0385	.3846	.2992	.1538
32	.5385	.4615	.4231	.5385	.4231	.3462	.5000	.4231	.3077	.5769	.3462	.2692	.3462	.2692	.1538	.3077	.2308	.1538
33	.4615	.4231	.2308	.5385	.3462	.3077	.4615	.3077	.1923	.4231	.3846	.2692	.3077	.2308	.1154	.5000	.3077	.1923
34	.5385	.4231	.4231	.4615	.3462	.3077	.4231	.3846	.3462	.4615	.4231	.4231	.3077	.2308	.1923	.3846	.3462	.3462
35	.3846	.2692	.2308	.4231	.3462	.2692	.4615	.2692	.2692	.4615	.3846	.3077	.3462	.3077	.2692	.3846	.3462	.3077
36	.5385	.5000	.4615	.5000	.4615	.3846	.5000	.3846	.2692	.3154	.5000	.3846	.2308	.1923	.1923	.3077	.3077	.2308
37	.5000	.4231	.3462	.5385	.4615	.3846	.5385	.5000	.4231	.4615	.4231	.3846	.6538	.5000	.4615	.4615	.3846	.3846
38	.6154	.5000	.4615	.6538	.6538	.6154	.6154	.6154	.3846	.5769	.5000	.4221	.4231	.3846	.3846	.5769	.5769	.5000
39	.7308	.5385	.4231	.8077	.6538	.5769	.6538	.4615	.3846	.6923	.5000	.4615	.6538	.4615	.3846	.5000	.4231	.4231
40	.5000	.5000	.3846	.4615	.3846	.3077	.4231	.4231	.4231	.3846	.3462	.3462	.4615	.3846	.2308	.5000	.3462	.3077
41	.3462	.3077	.2692	.3846	.3462	.3462	.4231	.3846	.3846	.3462	.3462	.3077	.3846	.3462	.3077	.4231	.2308	.2308
42	.1923	.1538	.1154	.2692	.2308	.1923	.2308	.1923	.1923	.3077	.1923	.1538	.1923	.1538	.0769	.3077	.2692	.1923