

INTENSIFICATION AND RESSION OF DROUGHTS IN A  
DRY FARMING REGION

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ABSTRACT

The Dry Farming Region of India, characterised by 40 to 100 cm annual rainfall, stretches from extreme north to the southern tip of the country and comprises of 87 districts. Rainfall is the prime weather factor which controls agricultural production in this region where irrigation plays a minor role. Using percentiles of monthly rainfall, during southwest monsoon months (June - September), for a period of 30 years from 1956 to 1985, intensification and recession of droughts has been studied in the Dry Farming Region of Maharashtra State comprising of 12 districts. A simple approach has been suggested and adopted to identify intensification and recession of droughts. Years and areas of maximum and minimum intensification/recession have been identified. Probabilities of monthly and seasonal drought have also been analysed. A few suggestions are mentioned to monitor agricultural drought using modern techniques.

1. INTRODUCTION

Rainfall is an important weather parameter which affects various human activities. In India, over 75 percent of annual rainfall is received during southwest monsoon season (June to September). Deficiency of rainfall in any year, leads to drought conditions of varying intensities and disrupts the agricultural and hydrological operations. The impact of drought is of more serious concern in areas of dry land farming where crops mainly depend on seasonal rainfall and irrigation plays only a minor role. The Dry Farming Region (DFR) of India, stretching from extreme north to the southern tip of peninsula, is characterised by 40 to 100 cm of annual rainfall (FIG. 1 a). It comprises of 87 districts and is spread over a number of States, viz., Haryana, Punjab, Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamilnadu (9).

About 40 percent of the total food production of the country comes from this area. Agricultural production in this region is mainly dependent on rainfall and it suffers from the instability and low out put of food production. Evidently, the study on variability of monthly and seasonal rainfall would provide useful information for

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evaluating climatic potential for agricultural production. With this aim in view, the present study has been undertaken to analyse the intensification and recession of droughts during southwest monsoon months in the Dry Farming Region of Maharashtra State comprising of 12 districts, viz, Nanded, Amravati, Parbhani, Akola, Jalgaon, Osmanabad, Buldhana, Bir, Aurangabad, Sangli, Sholapur and Ahmednagar. (FIG. 1 b)

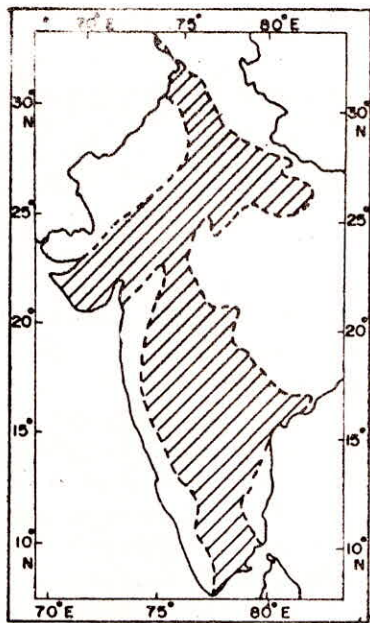


FIG. 1(a): DRY FARMING REGION (DFR) OF INDIA (AFTER SARKER ETAL, 1982).

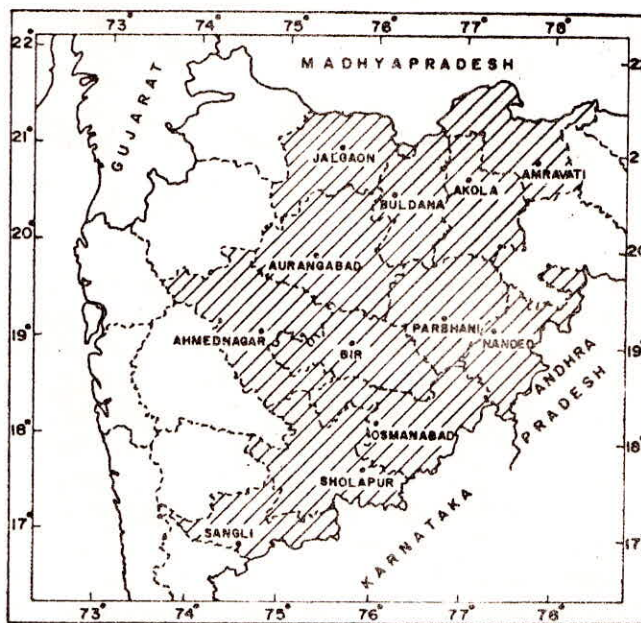


FIG. 1(b): DFR DISTRICTS OF MAHARASHTRA STATE.

Meteorological and agricultural droughts, in India, have been studied by various workers (2,3,4,5,6,7,8). A number of indices are in use to identify droughts. Rainfall is, invariably, directly or indirectly, involved in drought analysis. In the present paper, percentiles of rainfall have been utilised in classifying drought and wet conditions of varying degree. A simple approach has been suggested and adopted to analyse the spread, intensification and recession of droughts from year to year. Both monthly and seasonal (June-September) drought indices have been analysed. Probabilities of drought of different intensities have also been computed and analysed.

## 2. DATA AND METHOD

The basic data used consists of district averages of monthly rainfall for the four monsoon months from June to September, in respect of the 12 districts of Maharashtra State in the Dry Farming Region of India, for a period of 30 years from 1956 to 1985.

The use of percentiles of agroclimatic indices, viz, Yield Moisture Index (YMI) and Generalised Monsoon Index (GMI) has been suggested (1, 10) for making the qualitative assessment of drought related food shortages in South and Southeast Asia. These indices are computed by using actual monthly rainfall as one of the factors. In the present paper, the method involves in the computation of percentiles of monthly as well as seasonal (June to September) rainfall. The percentiles have been classified as follows to represent drought, normal and wet conditions of different intensities,

Rainfall Percentiles	Intensity
0 - 20	Extreme Drought (ED)
20 - 40	Moderate Drought (MD)
40 - 60	Normal (N)
60 - 80	Moderate Wet (MW)
80 -100	Extreme Wet (EW)

Evidently, drought (D) and Wet (W) conditions are revealed by the ranges of percentiles lying between 0-40 and 60-100 respectively.

For Intensification of droughts, following criteria has been adopted,

- (i) fall of percentiles in decending order during at least three consecutive monsoon months from June to September ending in either extreme or moderate drought condition,
- (ii) Change of drought conditions from moderate to extreme during at least three consecutive monsoon months from June to September.

Similarly, recession of drought has been identified by using the following criteria,

- (i) rise of percentiles in ascending order during at least three consecutive months of monsoon season from June to September, commencing with drought condition and ending in either extreme or moderate wet condition, or
- (ii) Change of drought conditions from extreme to moderate during at least three consecutive monsoon months from June to September.

The intensification and recession of drought has been identified during the period from June to August, July to September and June to September (seasonal).

Probabilities of monthly and seasonal drought of moderate and extreme intensities have also been analysed to determine the climatic drought-proneness of the region under study.

### 3. RESULTS AND DISCUSSION

#### 3.1 Intensification

Table 1 shows the occasions of intensification of 4 and 3 consecutive months of monsoon season in the Dry Farming Region of Maharashtra State. The districts have been arranged in decreasing order of their seasonal normal rainfall (1956-85).

TABLE 1

Occasions of Intensification and Recession of droughts of 4 and 3 months' duration in the DFR districts of Maharashtra State

S. No	DFR Districts	Seasonal Normal rainfall (mm) (1956-85)	Intensification			Recession		
			4 Months (a)	3 Months (b)	Total (a)+(b)	4 Months (a)	3 Months (b)	Total (a)+(b)
1.	2.	3.	4.	5.	6.	7.	8.	9.
1.	Nanded	827	1	7	8	2	2	4
2.	Amraoti	817	2	1	3	0	4	4
3.	Parbhani	756	1	3	4	2	3	5
4.	Akola	707	2	5	7	1	3	4
5.	Jalgaon	678	1	3	4	1	3	4
6.	Osmanabad	677	1	5	6	1	1	2
7.	Buldhana	664	2	3	5	0	1	1
8.	Bir	586	2	2	4	1	4	5
9.	Aurangabad	578	3	3	6	3	1	4
10.	Sangli	488	0	4	4	0	5	5
11.	Sholapur	483	2	3	5	1	2	3
12.	Ahmednagar	432	2	2	4	1	4	5

The maximum occasions of intensification of 4 and 3 consecutive months occurred in Nanded (32%) followed by Aurangabad and Akola (26 % each). The minimum occurred in Amraoti (11 %). The maximum occasions of intensification during only 4 months were noticed in Aurangabad, whereas Sangli did not display any intensification. During 3 consecutive months, the maximum and minimum occurred in Nanded and Amraoti respectively. FIG. 2 shows the number (total) of districts affected by intensification and recession of 4 and 3 months' duration.

It was noticed that intensification of 4 and 3 month' duration took place in more than 50 percent of districts under study during the years 1960, 1961, 1965 and 1985. Maximum number of districts were affected by 4 months of intensification during 1985, whereas similar figure for 3 months' duration appeared in 1965 followed by 1960. It may be remarked that large scale drought was experienced

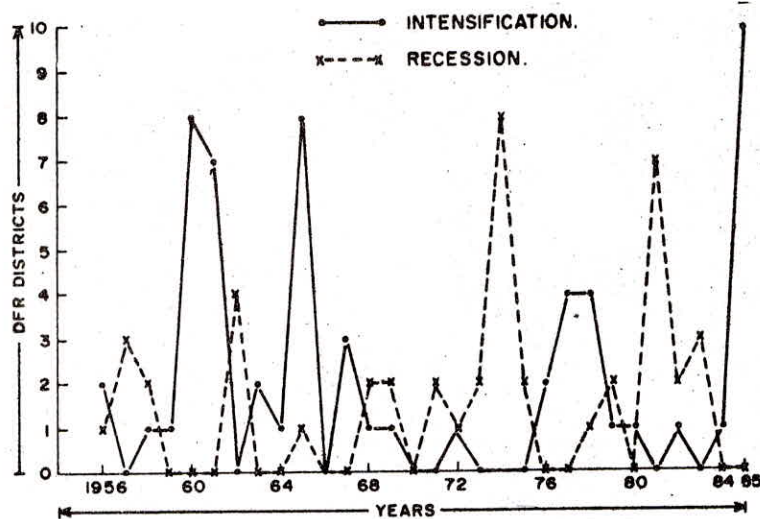


FIG. 2: DFR DISTRICTS OF MAHARASHTRA STATE AFFECTED BY INTENSIFICATION AND RECESSION OF DROUGHTS DURING 1956-85.

over the country during both the years 1965 and 1985. The intensification of drought in the DFR districts during 1985 is shown in FIG. 3(a).

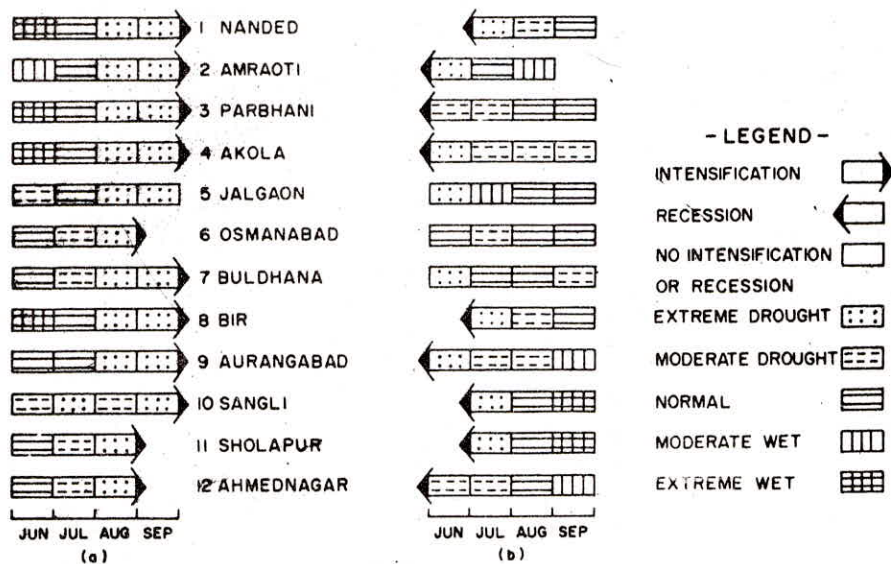


FIG. 3(a) INTENSIFICATION (1985) AND (b) RECESSION (1974) OF DROUGHT IN DFR DISTRICTS OF MAHARASHTRA STATE.

Intensification of 3 months' duration generally exceeded that during all monsoon months in all the districts except Amraoti. Further, such occasions during June to August exceeded those during

July to September only in Ahmednagar, Sholapur and Parbhani.

### 3.2 Recession

Table 2 shows the number of years and DFR districts affected by intensification and recession of droughts of 4 and 3 months' duration. Maximum number of occasions of drought recession of 4 and 3 months' duration occurred in Parbhani, Sangli and Ahmednagar (20 % each) followed closely by Bir (18 %). The minimum figure appeared for Buldhana (4%).. The secondary minima was reflected by Osmanabad (8%). Occasions of recession during only 4 months of monsoon season were maximum in Aurangabad whereas Amraoti, Buldhana and Sangli displayed no recession at all. During three consecutive months, the maximum incidences of recession occurred in Sangli and the minimum occurred in Osmanabad, Buldana and Aurangabad.

TABLE 2

Number of years and DFR districts affected by Intensification & Recession of droughts of 4 & 3 months' duration

Number of DFR districts	Intensification		Recession	
	4 Months	3 Months	4 Months	3 Months
0	23	12	24	15
1	2	10	2	5
2	2	2	2	7
3	2	3	1	1
4	0	1	1	0
5	0	0	0	2
6	0	1	0	0
7	1	0	0	0
8	0	1	0	0

The analysis revealed that more than 50 percent districts were affected by drought recession of 4 and 3 months' duration during 1974 and 1981. But the maximum number of districts reflected 4 months' recession during 1962. Similar figure for consecutive 3 months' recession appeared during 1974 and 1981. These incidently, happen to be good monsoon years. The recession of drought in the DFR districts during 1974 is shown in FIG. 3(b).

Occasions of 3 months' recession exceeded those of 4 months' duration in all districts except Aurangabad. Such events, of 3 months' period from August to June exceeded those from September to July in only one district, viz, Jalgaon. In all remaining districts, they were either equal or less.

### 3.3 Probabilities

Tables 3 and 4 show the probabilities of monthly and seasonal

drought of moderate and extreme intensity in the Dry Farming districts of Maharashtra State.

TABLE 3

Probabilities of Extreme Drought in the DFR districts of Maharashtra State.

Sr. No.	DFR Districts	June	July	Monthly August	September	Seasonal June-Sept.
1.	Nanded	.10	.20	.20	.23	.17
2.	Amraoti	.20	.17	.17	.23	.20
3.	Parbhani	.23	.20	.13	.17	.17
4.	Akola	.23	.20	.23	.13	.20
5.	Jalgaon	.20	.17	.20	.20	.17
6.	Osmanabad	.20	.27	.20	.20	.20
7.	Buldhana	.20	.13	.17	.20	.13
8.	Bir	.20	.27	.20	.23	.23
9.	Aurangabad	.17	.17	.13	.23	.17
10.	Sangli	.23	.20	.17	.20	.17
11.	Sholapur	.20	.17	.20	.17	.20
12.	Ahmednagar	.17	.17	.20	.17	.20

Highest probability of monthly extreme drought was reflected by Osmanabad and Bir during July and the lowest appeared during June in Nanded. Higher probability of monthly moderate drought emerged during September in Akola.

TABLE 4

Probabilities of Moderate drought in the DFR districts of Maharashtra State.

Sr. No.	DFR Districts	June	July	Monthly August	September	Seasonal June-Sept.
1.	Nanded	.23	.23	.23	.13	.20
2.	Amraoti	.20	.27	.20	.20	.23
3.	Parbhani	.17	.17	.27	.23	.23
4.	Akola	.13	.20	.13	.30	.23
5.	Jalgaon	.17	.07	.17	.17	.27
6.	Osmanabad	.13	.13	.23	.20	.20
7.	Buldhana	.13	.23	.23	.23	.23
8.	Bir	.23	.13	.20	.20	.20
9.	Aurangabad	.20	.20	.23	.17	.20
10.	Sangli	.13	.17	.17	.17	.23
11.	Sholapur	.23	.20	.13	.20	.17
12.	Ahmednagar	.23	.27	.27	.27	.13

The minimum occurred in Jalgaon during July. Bir and Jalgaon reflected highest probability of seasonal drought of extreme and moderate intensity respectively and the lowest appeared in Buldhana and Ahmednagar respectively.

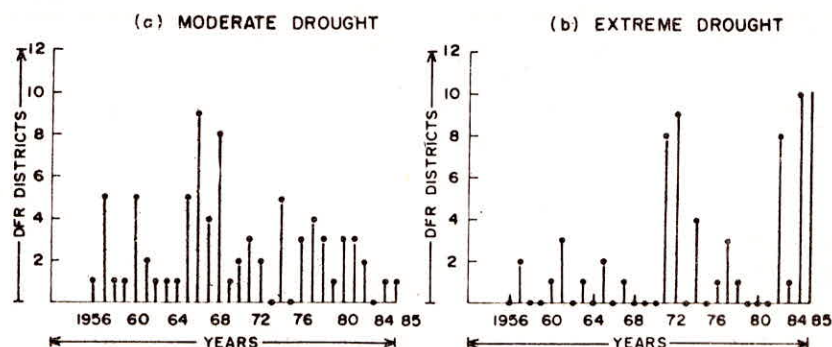


FIG. 4: DFR DISTRICTS OF MAHARASHTRA STATE AFFECTED BY (a) MODERATE AND (b) EXTREME DROUGHT DURING 1956 - 85

The seasonal drought analysis revealed that 1985 and 1966 were the worst years when maximum number of districts were affected by extreme (92 %) and moderate (75 %) drought respectively. Similarly, Bir and Jalgaon appeared as the districts affected by maximum number of extreme and moderate drought respectively during the period of 30 years from 1956 to 1985. FIG. 4 shows the number of districts affected by moderate and extreme drought during the period under study. It will be seen that all the years with either moderate or extreme drought activity did not necessarily reflect intensification. Similarly all good monsoon years did not show recession.

#### 4. CONCLUSIONS

(a) Rainfall plays a primary role in controlling agricultural practices and production in the Dry Farming Region of India where irrigation is of less significance. An analysis of monthly rainfall percentiles, on using a simple approach, revealed occasions of intensification and recession of droughts successfully in the Dry Farming Region of Maharashtra State during the period of 30 years (1956-85). Probabilities of drought have also been computed to extract climatic drought information.

(b) Maximum occasions of intensification occurred in Nanded and the minimum appeared in Amraoti. Also, maximum number of districts suffered from intensification during 1985 when large scale drought occurred over India.

(c) Maximum incidence of recession occurred in Parbhani and Ahmednagar and the minimum was reflected in Buldhana. Maximum number of districts experienced recession during 1974, which was also



a good monsoon year. But all the years with good or bad monsoon activity did not necessarily reflect recession or intensification.

(d) Occasions of intensification and recession displayed no periodic regularity.

(e) Bir appeared as the worst drought-hit area affected by seasonal drought. The maximum number of districts fell under the grip of extreme drought in 1985. The highest probability of moderate drought was found in Jalgaon and the minimum appeared in Ahmednagar.

(f) Monitoring of drought is a matter of special interest and attention for advance planning of agricultural operations, particularly in Dry Farming Regions. It is suggested that new techniques, like remote sensing and satellite imagery usage would provide an efficient and successful means to monitor agricultural drought throughout the crop-growing season.

(g) In Dry Farming Regions, drought-resistant and short duration crops may be grown to avert the severe damages caused to agricultural production by the spread and intensification of droughts.

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