

A note on drought and rice productivity in Chhattisgarh state

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ABSTRACT

In the Chhattisgarh state rice is grown mostly under rainfed condition in about 3.8 million hectares. The average seasonal rainfall of 1200mm is just sufficient to take a medium duration (120-130days) rice crop. For other biophysical and socio-economic reasons farmers grow long duration rice (145-155 days) varieties which flower in mid October and mature in mid November while the southwest (SW) monsoon withdraws by the end of September. Dry spells during the crop season and terminal drought adversely affect the crop growth. Results on drought analysis using aridity index show that due to recurring feature of drought spells in October it is advisable to avoid raising of long duration rice cultivars under rainfed condition in the region.

Key Words : Drought, Dry spell, Rice productivity.

Drought and floods are natural disasters, which have a direct impact on socio-economic aspects due to marked impact on food production. They are known as the two faces of a coin 'moisture regime'. Frequency of drought is generally higher than that of the floods in a given area. Drought and its impact on crop production had been reported earlier (Parthasarathy *et.al.*, 1988, 1987, Ramana Rao. *et. al.*, 1981, Ramakrishna *et.al.* 1984, Sastri and Patel, 1984, Sastri, 1985, Chaudhary *et.al.*, 1989) in our country.

In the Chhattisgarh plains of the state rice is the predominant crop grown under rainfed condition. Farmers broadcast the seeds immediately after the onset of monsoon in a pre-ploughed field. They

usually take long duration (more than 140 days) varieties, which flower in mid October and mature by mid November while south west monsoon withdraws by end of mid September. Hence, terminal drought is a recurring feature in this area. Also, due to intermittent dry spells, water stress conditions occur during crop growth period.

In view of this, an analysis of drought in relation to rice productivity was carried out for Raipur Division, which comprises of Raipur, Durg and Rajnandgaon districts.

MATERIALS AND METHODS

Daily rainfall data of 27 rain gauge stations in Raipur district and three district headquarters (Raipur, Durg and Rajnandgaon) has been collected from India

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Meteorological Department, Pune. The daily data ranging from 27 to 40 years were converted into weekly, monthly and annual totals for analysis. With a daily loss of 3-4mm of water through evapotranspiration and percolation the rice crop requires about 50mm of water per week. This combined with less than 100% coefficient of variation was considered as "Stable rainfall period".

Intermittent dry spells during the growing seasons are another constraint for rice production in this region. Farmers usually impound in the field 10-15cm of water, which lasts for about 7 days without affecting crop growth. Hence, a dry spell of greater than 7 days duration is detrimental for the growth and development of rice crop. Frequencies of dry spells of different duration ranging from 7 to greater than or equal to 10 days were analyzed for all blocks of Raipur district.

Drought intensity due to rainfall deficiency (annual rainfall departures from the normal values) was worked out as follows:

Intensity	Range of annual rainfall departure (%)
Mild	1 to 25
Moderate	26 to 50
Severe	>50

Frequency of droughts in different decades from 1901-1990 in respect of selected stations in Raipur district was computed. Drought intensity was also expressed in terms of aridity index I_d , as defined by Thornthwaite (1948).

Drought was classified following Subrahmanyam and Subramaniam (1964) as below:

Intensity	Departure of I_d from normal values
Mild	0 to $-1/2\sigma$
Moderate	$-1/2\sigma$ to $-\sigma$
Severe	$-\sigma$ to -2σ
Disastrous	$\geq -2\sigma$

Where σ is the standard deviation of I_d .

The frequencies of droughts were computed for the decades during 1951-80.

Table 1 : Stable rainfall periods for rice cultivation in Raipur division.

District	Stable rainfall period		Average weekly rainfall(mm) during Duration(Days) this period
	Period		
Raipur	22 June-13 September	84	75.2
Durg	a) 21 June-6 July b) 31 July-1 September	16 59 43	69.6
Rajnandgaon	22 June-24 August	64	85.5

RESULTS AND DISCUSSION

Stable rainfall periods

The stable periods for rice cultivation in Raipur division are shown in Table 1. At Durg the stable rainfall period is not continuous like in other two districts but shows unreliability for about 26 days in between. Thus, rice crop in Durg district is prone to water stress during seedling stage.

Dry spells

Compared the frequency of dry spells of greater than 7 days duration in July and August, it is quite high in October followed by September months (Table 2). Protective irrigation is provided during end of September and October months to avoid terminal drought.

Rainfall deficiency

From Table 3, considerable spatial variability is seen as well as in the intensity of drought in Raipur district. A slight increase in dry spells is noted during the decade 1971-80.

Aridity index

Drought frequency based on aridity index for a few stations in Raipur district and for different decades are shown in Table 4. Results show that mild to moderate droughts are more frequent in the region.

Drought in relation to rice productivity

A perusal of the Table 5 reveals no trend on the impact of drought intensity on the productivity of rice crop. For obtaining a better picture, trends of rice productivity

Table 2 : Frequency of dry spells of different duration during the growing season at some representative stations in Raipur district.

Station	Data Base (Year)	Frequency of dry spell of different duration (days) in month of																	
		July			August			September			October								
		7	8	10	7	8	10	7	8	10	7	8	10						
Raipur	40	3	2	2	0	1	1	1	1	1	1	11	6	3	1	53	44	40	36
Dhamtari	27	7	6	6	5	0	8	5	3	1	1	15	11	9	8	42	39	36	32
Bhatapara	27	4	2	1	1	0	10	7	4	1	1	25	24	17	15	35	33	32	32
Saraipali	40	4	3	2	1	0	5	0	0	0	0	3	6	6	6	32	27	27	25
Mahasamund	39	5	4	3	2	1	7	3	2	1	1	21	14	10	8	52	41	39	37
Gariabund	40	4	3	3	2	2	9	5	5	2	2	15	13	12	11	45	39	34	31
Baloda Bazar	40	4	2	2	1	1	8	4	4	3	3	26	19	12	12	52	47	44	42

Table 3: Decadal frequency of droughts (Rainfall deficiency) of varying intensities at some representative stations in Raipur district.

Decade	Intensity	Raipur	Dhamatari	Baloda Bazar	Gariaband	Rajim	Mahasamund	Bhatagaon	Kanki	Deobhog	Pithora	Maramsili
1901-10	Mild	8	6	6	5	4	3	NA	N.A.	2	0	N.A.
	Moderate	1	1	0	1	0	0	0	0	0	0	0
	Severe	0	0	0	0	0	0	0	0	0	0	0
1911-20	Mild	3	3	4	1	2	2	NA	N.A.	4	2	N.A.
	Moderate	2	2	0	2	1	0	0	0	1	0	0
	Severe	0	0	0	0	0	0	0	0	0	0	0
1921-30	Mild	5	3	4	5	5	3	NA	N.A.	3	5	N.A.
	Moderate	1	1	1	1	0	1	0	0	3	2	0
	Severe	0	0	0	0	0	0	0	0	0	0	0
1931-40	Mild	3	1	4	5	1	4	3	3	5	3	3
	Moderate	0	1	1	0	3	0	0	0	2	0	0
	Severe	0	0	0	0	0	0	0	0	0	0	0
1941-50	Mild	6	3	3	2	4	4	3	7	5	7	5
	Moderate	1	2	1	1	0	1	1	0	0	0	3
	Severe	0	0	0	0	0	0	0	0	0	0	0
1951-60	Mild	8	4	4	6	7	5	3	3	6	5	8
	Moderate	0	2	3	3	1	2	0	1	0	2	1
	Severe	0	0	0	0	0	0	0	0	0	0	0
1961-70	Mild	3	4	3	2	2	1	2	3	0	1	4
	Moderate	4	6	2	1	5	4	3	3	6	5	3
	Severe	1	0	2	4	0	2	0	1	4	1	0
1971-80	Mild	5	5	3	5	2	2	3	4	2	4	N.A.
	Moderate	3	5	2	2	3	3	2	2	2	1	0
	Severe	0	0	3	2	0	5	0	0	6	1	0
1981-90	Mild	1	0	0	2	2	2	2	2	2	2	N.A.
	Moderate	1	4	6	2	2	2	2	2	2	2	0
	Severe	0	2	0	0	0	0	0	0	0	0	0

N.A.= Data Not available.

Table 4 : Decadal frequency of droughts of different intensities using aridity index at some stations in Raipur district

Decade	Intensity	Some selected blocks of Raipur district									
		Raipur	Dhamtari	Deobhog	Gariaband	Pithora	Bhatagaon	Baloda Bazar	Kanki	Mahasamund	Rajim
1951-60	Mild	2	0	1	3	2	0	3	1	2	0
	Moderate	2	1	2	0	1	5	2	0	2	1
	Severe	0	2	1	1	1	0	0	2	0	2
	Disastrous	1	0	0	1	0	0	0	1	0	1
1961-70	Mild	2	1	2	0	0	1	2	3	0	0
	Moderate	1	1	3	1	2	6	1	3	1	3
	Severe	3	1	1	2	0	0	2	1	0	1
	Disastrous	0	0	1	0	0	0	0	0	1	0
1971-80	Mild	3	2	3	5	0	1	1	3	1	4
	Moderate	1	2	3	3	5	0	1	3	1	4
	Severe	1	2	0	0	1	1	3	0	2	2
	Disastrous	0	0	0	0	2	0	0	0	0	0

Table 5 : The drought intensity and rice productivity in three districts.

Year	Rice yield (qha ⁻¹)		
	Raipur	Durg	Rajnandgaon
1977	12.2	10.6	9.1
1978	9.1(Mild)	7.3(Mild)	7.2
1979	5.5 (Severe)	5.3(Severe)	6.1(Moderate)
1980	9.4	8.5	8.7
1981	10.4	8.0	9.1
1982	8.1(Mild)	9.3(Moderate)	7.8(Mild)
1983	13.0	12.4	11.3
1984	12.2	10.3	8.2
1985	15.7	12.8	9.9
1986	10.8	5.7(Moderate)	7.5
1987	12.2 (Moderate)	11.3	5.3(Moderate)
1988	8.7 (Severe)	8.1(Severe)	4.6(Severe)
1989	13.3	8.1	6.3
1990	14.4	12.7	12.0

during normal as well as severe drought years at Raipur are shown in Fig 1. Productivity under both the situation shows increasing trend over the years that can mainly be attributed to improved technology.

Based on the above analysis the

following inferences can be drawn. From the stable rainfall period and dry spell frequencies, it was observed that the drought is a recurring feature in the month of October. Hence, long duration rice varieties under rainfed condition need supplementary irrigation.

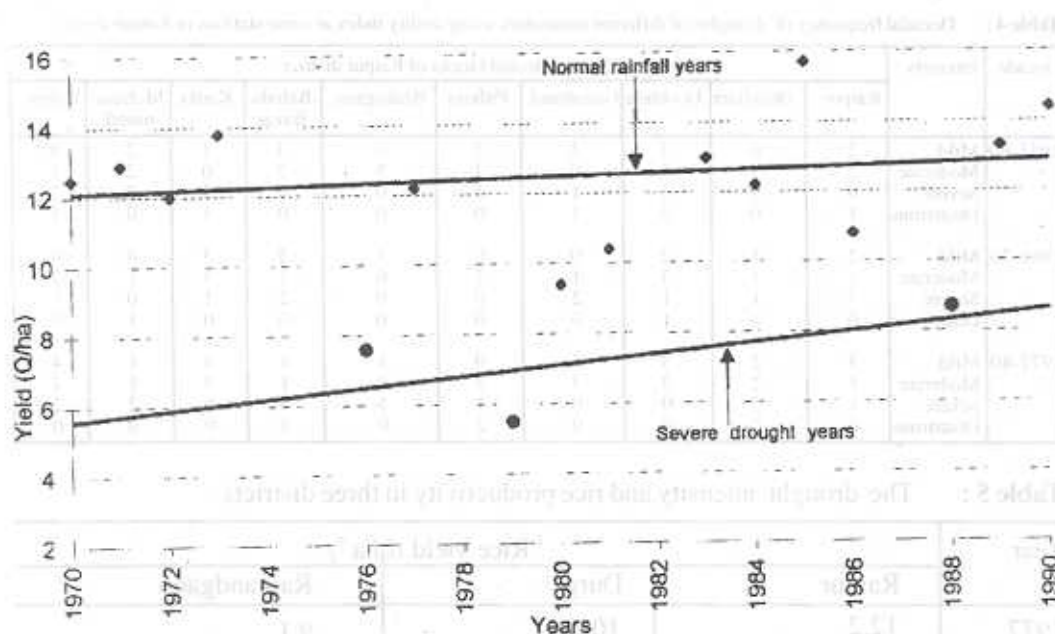


Fig. 1: Trend of rice productivity severe drought years as compared to normal rainfall years at Raipur

There is a spatial variability in frequency as well as in intensity of drought in Raipur division. The increasing trend of rice productivity in normal as well as severe drought year is attributable to improved technology.

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