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A study on effective monsoon and dry spells of short return periods during monsoon months in two north Bengal districts

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सार — इस अध्ययन में पश्चिम बंगाल के तराई क्षेत्र वर्षा के विभिन्न प्राचलों की प्रकृति का अध्ययन करने के लिए इस क्षेत्र के मुख्यतया वर्षा पर आधारित कृषि वाले दो जिलों, कूच-बिहार (1971-90) तथा जलपाईगुड़ी (1972-90) के दैनिक वर्षा आंकड़ों (अप्रैल से अक्तूबर) का प्रयोग किया गया है। यह पाया गया कि इस क्षेत्र में मानसून के प्रभावी होने (ओ० ई० एम०) की औसत तिथि केरल में सामान्य मानसून की तिथि से एक महीने पूर्व है। तथापि मानसून की वापसी यहाँ पर तथा केरल में लगभग एक ही समय में होती है। मानसून ऋतु के दौरान वर्षा न होने की नाजुक स्थिति के बारे में कुछ जानकारी प्राप्त करने के लिए वर्षा न होने की अवधि के वर्गीकरण का इसमें अध्ययन किया गया है। इस अध्ययन में इसकी भी जांच की गई है कि विभिन्न वापसी अवधियों में औसतन मानसून गतिरोध कितनी लम्बी अवधि का है। 2, 5, 10 तथा 20 वर्षों की वापसी अवधियों के लिए वर्षा न होने की सम्भावित अवधि (दिनों में) का आकलन प्रत्येक स्थान के लिए समुचित वक्र रेखाओं की सहायता से किया गया है।

ABSTRACT. This article uses daily rainfall data (April-October) of Cooch Behar (1971-90) and Jalpaiguri (1972-90), the two predominantly rainfed farming districts of Terai zone of West Bengal, to study the nature of different rainfall parameters of this area. It was observed that the mean date of Onset of Effective Monsoon (OEM) of this region is about one month in advance from the normal occurrence of monsoon over Kerala. However, the monsoon rains, here, retreat at about the same time with those of Kerala. Distribution of the duration of dry spell has been studied to have some idea of the nature of critical dry spells during the monsoon season. The article also examines how prolonged, on the average, are the monsoon breaks for different return periods. Expected length of dry spell (in days) for 2, 5, 10 and 20 years return periods have been estimated with the help of suitably fitted curves for each location.

Key words — Effective monsoon, Dry spells, Runs, Rank number, Rainfall, Evaporation

1. Introduction

In the present study, daily rainfall data from April to October of 20 years (1971-90) for the district of Cooch Behar and those of 19 years (1972-90) for Jalpaiguri district were critically analysed to find out Onset of Effective Monsoon (OEM), End of Effective Monsoon (EEM) and some other relevant statistics following the technique of Ashoke Raj (1979).

2. Methodology

(*a*) *OEM & EEM*

Raman (1974) has defined the terms 'OEM' and 'EEM' to work out some meteorological parameters in the case of Maharashtra state. But the Terai zone of West Bengal being predominantly high rainfall (on the average more than 60 mm/week) area, the second criterion of Raman's definition has been modified accordingly to suit the situation of two north Bengal districts under consideration. The modified definitions of OEM and EEM as used in the present article are as follows :

Suppose during the monsoon months of a year, a particular region having average daily evaporation of 'e' mm, gets 'x' mm rainfall at the first day during the commencement of seven days' spell with total rainfall of 'X' mm. Then, this seven days' spell satisfying the following three criteria may be defined as the OEM week :

(*i*) $x \geqslant e$,

(*ii*) $X \geqslant (7e + 10)$ and

(*iii*) at least four of the seven days have daily rainfall $\geqslant 2.5$ mm.

Similarly, if the region receives x' mm rainfall on the last day during an end of seven days' spell with total rainfall of X' mm, then this seven days' spell may be defined as the EEM week, provided the following criteria are satisfied :

(*i*) $x' \geqslant e$,

(*ii*) $X' \geqslant (7e + 10)$ and

(*iii*) at least four of the seven days have daily rainfall $\geqslant 2.5$ mm.

TABLE 1

Estimated parameters of rainfall characteristics of Cooch Behar and Jalpaiguri

Particulars	Cooch Behar	Jalpaiguri
Mean date of OEM	29 April	26 April
Median date of OEM	27 April	25 April
Mean deviation from mean (OEM dates)	9 days	6 days
Quartile deviation (OEM dates)	9 days	8 days
Earliest probable date of OEM (p = 0.50)	20 April	18 April
Latest probable date of OEM (p = 0.50)	8 May	04 May
Mean date of EEM	2 October	30 September
Median date of EEM	1 October	3 October
Mean deviation from mean (EEM dates)	8 days	6 days
Quartile deviation (EEM)	8 days	9 days
Earliest probable date of EEM (p = 0.50)	25 September	21 September
Latest probable date of EEM (p = 0.50)	11 October	9 October
Average number of dry spell/year (4 days or more)	6	5
Average deviation of dry days/year	6 days	6.4 days
Average number of CDS/ year	0.5 day	0.5 day
Average amount of rainfall in OEM week	110.9 mm/ week	92.4 mm/week
Range (rainfall during OEM weeks)	56-193 mm	37-171 mm
Average amount of rainfall in EEM week	158.3 mm/ week	154.2 mm/week
Range (rainfall during EEM weeks)	45-462 mm/ week	76-283 mm/week

(*b*) *Critical Dry Spell*

A sequence of days with nil or trace (< 2.5 mm) amount of daily rainfall is called a period of dry spell. Such a sequence of ten days or more is termed in this article as a period of Critical Dry Spell (CDS).

(*c*) *Return Period*

Return period of run of dry days of a certain length is calculated as the ratio of the number of years of record to the rank number of the specified run. The rank of different runs is determined in the following manner as suggested by Singh (1973).

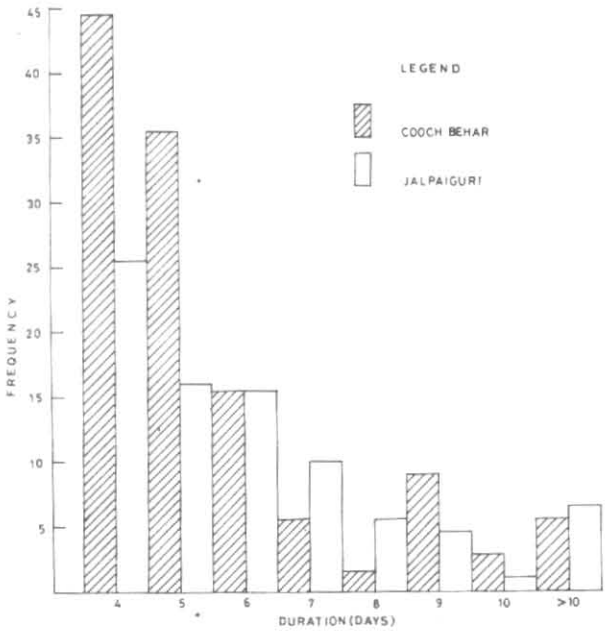

Fig. 1. Frequency distribution of duration of dry spell

All the recorded runs of dry days obtained from daily rainfall data of several years are first arranged in descending order according to their length and then given rank numbers. If the run of a particular length has occurred 'n' times and there are 'm' runs of length higher than this run, then the rank number of this particular run is taken as $m + n$.

3. Results and discussion

(*a*) *Cooch Behar*

Analysis on 20 years' rainfall data, as mentioned in earlier section, showed OEM between 26 April-2 May with an average rainfall of 111 mm/week (Table 1). The mean and medium dates of OEM were 29 and 27 April respectively. Both of the mean deviation from mean and quartile deviation of mean dates of OEM of different years were found to be 9 days. Therefore, the earliest and latest probable dates of OEM were 20 April and 8 May respectively. The effective monsoon ceased between 30 September—6 October, with an average rainfall of 158 mm/week.

The range of amount of rainfall during OEM week in different years is between 56—193 mm/week and that of EEM week between 45—462 mm/week.

TABLE 2

Yearly mean dates of OEM & EEM and duration of CDS at Cooch Behar and Jalpaiguri

Year	Date of onset		Date of end		Duration of CDS	
	Cooch Behar	Jalpaiguri	Cooch Behar	Jalpaiguri	Cooch Behar	Jalpaiguri
1971	9 April	—	10 October	—	14-23 May	—
1972	10 May	14 April	24 September	29 September	—	—
1973	23 April	27 „	1 October	3 October	—	—
1974	27 „	20 „	30 September	5 „	20-30 May 8-18 August	5-20 August
1975	23 „	23 „	1 October	30 September	—	—
1976	30 „	1 May	6 „	5 October	—	—
1977	14 „	13 April	3 „	4 „	—	—
1978	19 May	19 „	24 September	24 September	—	—
1979	13 „	14 May	8 October	8 October	17-28 September	25 May-11 June 17-29 September
1980	15 „	4 „	26 September	28 September	9-18	—
1981	27 April	14 „	20 „	11 „	—	25 May-3 June
1982	26 „	15 April	20 „	20 „	17-27 May	24 May-2 June
1983	2 May	30 „	24 „	24 „	—	—
1984	25 April	25 „	3 October	18 October	6-15 August	24 September- 5 October
1985	14 May	4 May	29 September	15 „	—	20 September- 1 October
1986	27 April	27 April	12 October	9 „	23 May-1 June	3-15 August
1987	26 „	22 „	1 „	17 „	11-21 May	12-24 May
1988	16 „	20 „	26 September	30 September	—	30 May-14 June
1989	15 May	15 May	7 October	15 October	—	—
1990	17 April	29 April	7 „	30 September	—	—

The amount of weekly rainfall for both the cases is much above 35.2 mm which is the value of $(7e + 10)$ mm, where the value of average daily evaporation (e) is 3.6 mm for Cooch Behar.

(*b*) *Jalpaiguri*

In Jalpaiguri, the OEM was observed between 23-29 April with an average rainfall of 92 mm/week (Table 1). Mean and median dates of OEM were 26 and 25 April respectively. Mean deviation from mean and quartile deviation obtained from the mean dates of OEM data were 6 and 8 days respectively. Therefore, the earliest and latest probable dates of OEM were found as 20 April and 2 May respectively. The monsoon rain was observed to retreat between 27 September—3 October with an average rainfall of 154 mm/week (Range : 76—283mm/week).

Here also, it was observed that the weekly rainfall during OEM and EEM weeks in different years was much above 34.5 mm, which is the value of $(7e + 10)$, where the average daily evaporation (e) of Jalpaiguri is 3.5 mm.

The frequency distribution of the duration of dry spell showed that during the monsoon months of a year in both the districts, one could expect, on the average, one dry spell of length of 6 days and another spell of either 7, 8 or 9 days' duration (Fig. 1).

In Cooch Behar, total number of CDS was found to be nine during the years 1971-90, of which five occurred during later part of May, two in the first part of August and remaining two in the later part of September. In the case of Jalpaiguri total frequency of CDS was observed to be ten during the

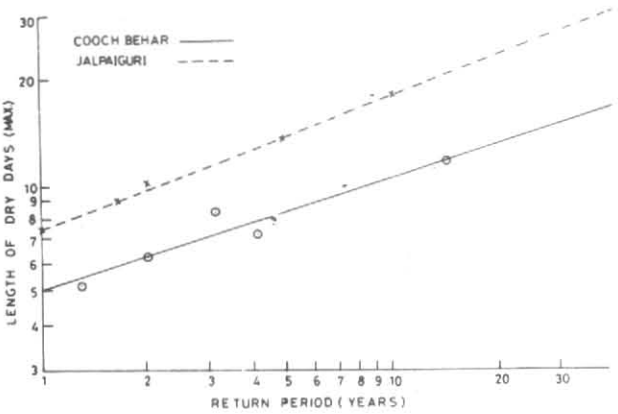

Fig. 2. Best fit curves of the length of different runs and corresponding return periods

Period 1972-90, of which five occurred towards later part of May, two in the first part of August and remaining three towards the later part of September. This showed that the distribution of the occurrence of CDS was more or less uniform in both the districts under consideration (Table 2).

The values of the length of different runs as obtained from the daily rainfall data were plotted against corresponding return periods [calculated through the procedure as described in section 2 (*c*)] on logarithmic graph paper and the curves of best fit were drawn by inspection separately for each district. In both the cases, it was found that the fitted curves had very small departure from straight lines (Fig. 2). From the fitted straight lines, 2, 5, 10 and 20 years' expected length of dry spell (in days) was estimated for both the places. The estimated values of duration of runs for various return periods are given in Table 3. In this Table, the N years values (N = 2, 5, 10 or 20) of length of run (of dry days) is the maximum duration of dry spell (in days) which will be equalled or exceeded on the average, once in N years, *e.g.*, once in every 5-year period, the maximum break in monsoon may occur, on the average, for 8 days or more at Cooch Behar and for 14 days or more at Jalpaiguri.

4. Conclusions

(*i*) The result of this study revealed that although the retreat of monsoon in this part of Terai zone of West Bengal occurs about at the same time of withdrawal of monsoon rains from the rest of India, the onset of monsoon in this area is much advance (last part of April to early May) in comparison to that of Kerala (normal monsoon date according to IMD, June 2) where the southwest monsoon hits its first spell in the Indian Peninsula. It may, therefore, be assumed that the arrival of monsoon rains over this part of West Bengal has no relation with the onset of monsoon at Kerala. As a result, contrary to other parts of West Bengal, this region experiences about 5 months' duration of monsoon rains, *i.e.*, on the average 1-2 months more than southern part of West Bengal.

TABLE 3

The estimated values of duration of runs for various return periods

Location	Maximum length of dry days likely to be equalled or exceeded once in *N* years			
N =	2	5	10	20
Cooch Behar	6.2	8.2	10.5	13.0
Jalpaiguri	9.3	14.2	18.5	22.3

(*ii*) In this region, there is possibility of occurrence of dry spell of 10 days or more once in every 4 years, on the average; the starting date of this dry spell being any time during around 3rd and 4th week of May, *i.e.*, after around 20-30 days from the day of onset of monsoon. Again, such a dry spell may appear once in every 8 years, on the average, around 2nd and 3rd week of September. There is also possibility of another such spell of dry days in this area in every 10 years, on the average, anytime during 1st and 2nd week of August.

(*iii*) It is observed that, on the average, once in 2, 5, 10 and 20-year periods, the maximum duration of monsoon break may occur for 6, 8, 10 days (or more) and 13 days respectively at Cooch Behar. During the same 4 specified periods, the maximum break in monsoon may occur for 9, 14, 18 and 22 days (or more) respectively at Jalpaiguri (Table 3).

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