551.524.36 : 551.553.21 : 551.577

MAXIMUM AND MINIMUM TEMPERATURES AS PREDICTOR ELEMENTS OF SOUTH-WEST MONSOON RAINFALL OVER GAYA : A STATISTICAL APPROACH

1. Significance of long range forecast for summer monsoon for a country like India is enormous on account of major contribution by agriculture sector to Indian economy. In prediction of summer monsoon, well in advance a milestone has been reached by the introduction of parametric and power regression models developed by Gowarikar *et al.* (1989) and its further modification in 1990. There is also a need to develop models for long range forecast of south-west monsoon for different meteorological sub-divisions.

The present study is confined to Gaya airport only for nature of rainfall during south-west monsoon season and an attempt is made to search out meteorological parameters, which are responsible for normal / deficient rainfall within Bihar plains.

2. Selection of meteorological parameters Choudhury and Sarvade (1984) have observed that during January and February, if the departures of global radiations for majority of stations (India) are negative, the year may witness drought conditions. So, we can say that cloudless sky and minimum humidity during January and February play important role for rainfall over India during succeeding south-west monsoon season. Cloudless sky and minimum humidity will lead to significant fall in minimum temperatures. Hence minimum temperature during winter season may be considered as one of the parameters to be used for developing a model for prediction purposes.

In parametric and power regression models Gowarikar *et al.* (1989) found that temperatures over east coast of India (March), central India (May), northern India (March) and northern hemisphere (January and February) have direct relationship with monsoon rainfall. Therefore an attempt has been made to find relationship of : (*i*) maximum temperature (> = 40° C) from March to 25th June with rainfall, (*ii*) minimum temperature from November to February and maximum temperature from March to 21st June with rainfall during succeeding south-west monsoon season.

3. *Data* - The study is based on the data for 27 years period from 1965-66 to 1993-94 (excluding 1992-93 and 1995 due to non- availability of full data).

4. *Methods of analysis* - Two separate methods have been adopted for prediction purposes :

(*i*) Total number of days in every year from march to 25 June with maximum temperature > = 40° C have been counted It is found that if this number is 55 or more, rainfall is likely to be deficient during succeeding south-west monsoon season and if it is less then the rainfall is likely to be normal/excess.

(*ii*) Total number of days have been counted every year, for (A) minimum temperature < = 9° C from November to February and (B) maximum temperature was > 34° C from March to 21 June. The ratio (r) of these two values has been computed as shown in Table 2 If the ratio is. < = 0.5 the rainfall will be normal/excess and if the ratio is > 0.5 it will be deficient.

5. *Discussion* - A close examination of prediction column and maximum temperatures, as illustrated by column and 9 of the Table 2, show that out of 27 years period from 1966 to 1994 the first adopted method for forecasting normal/deficient rainfall has been found correct on 22 occasions (81.5%).

On all five occasions during 1966, 1972, 1974, 1975 and 1979, when temperature > = 40° C has been recorded for 55 days and more, rainfall has been found deficient, Table 2.

But the reverse case of the adopted method has failed on 5 occasions (in 1970, 1981, 1982, 1989, 1991) out of 22 years period. As such, the percentage of success has been 100 and 77.3 in these two cases respectively (Table 1).

On examining the minimum temperature data , as per second method, it has been observed that winter conditions during 1967-68, 1972-73, 1978-79, 1979-80, 1983-84, 1984-85, 1985-86, 1986-87 and 1993-94 were not prominent as minimum temperature < = 09° C has been recorded for less than 29 days. Normal / excess rainfall has been recorded for 1968, 1973, 1980, 1984, 1985, 1986, 1987, 1994 and deficient rainfall during 1979. So during moderate winter conditions normal/excess rainfall has been found for 8 years out of 9 years period, which has been correctly predicted except for the year 1979. The ratio (r) during all the 9 years has been < = 0.3, showing ideal contrast between winter and summer conditions , Table 2. Although the ratio (r) during

TABLE 1

Max temp ≥55 days (No. of years)	Deficient rainfall (No. of years)	Percentage of success	Max temp < 55 days (No. of years)	Normal/excess rainfall (No of years)	Deficient rainfall (No of years)	Percentage of success	Total percentage of success
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
5	5	100	22	17	5	77.5	81.5

TABLE 2

Year	Min. temp < = 09° C (Total No. of days)	Max . temp >34° C (Total No. of days)	Ratio ® [2]:[3]	Total seasonal rainfall (% departure from normal)	Normal(N)/ Excess(E)/ Deficient(D) rainfall found	Weather predicted correctly by		Total No. of days temp > = 40° C recorded up to 25th of June
						1st method	2nd method	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1966	44	98	0.4	587 (-38)	D	YES	NO	60
1967	42	86	0.5	1087 (14)	E	YES	YES	51
1968	21	88	0.2	920 (-03)	N	YES	YES	38
1969	55	98	0.6	1270 (34)	E	YES	YES	40
1970	45	94	0.5	744 (-22)	D	NO	NO	41
1971	67	73	0.9	1259 (33)	E	YES	NO	8
1972	54	95	0.6	754 (-21)	D	YES	YES	55
1973	21	90	0.2	915 (-04)	N	YES	YES	53
1974	56	95	0.6	796 (-16)	D	YES	YES	57
1975	51	90	0.6	757(-20)	D	YES	YES	60
1976	53	92	0.6	1184 (25)	E	YES	NO	36
1977	41	91	0.5	1080 (14)	E	YES	YES	34
1978	34	85	0.4	1263 (33)	E	YES	YES	34
1979	24	90	0.3	748 (-21)	D	YES	NO	59
1980	22	89	0.2	953 (00)	N	YES	YES	53
1981	35	84	0.4	768 (-19)	D	NO	NO	19
1982	61	79	0.8	603 (-37)	D	NO	YES	30
1983	35	90	0.4	915 (-04)	N	YES	YES	35
1984	28	88	0.3	1558 (64)	E	YES	YES	38
1985	23	106	0.2	1013 (07)	N	YES	YES	48
1986	19	95	0.2	1038 (09)	N	YES	YES	29
1987	28	95	0.3	1494 (57)	E	YES	YES	47
1988	40	84	0.5	986 (04)	N	YES	YES	29
1989	47	85	0.6	682 (-28)	D	NO	YES	42
1990	36	72	0.5	969 (02)	N	YES	YES	29
1991	38	85	0.4	775 (-18)	D	NO	NO	31
1994	28	90	0.3	901 (-05)	N	YES	YES	26

TABLE 3

Minimum to maximum temperature ratio	Normal / Excess rainfall (No. of years)	Deficient rainfall (No. of years)	Total No. of years	Percentage of success	Total percentage of success
(1)	(2)	(3)	(4)	(5)	(6)
r > 0.5	3	5*	8	62.5	70
r< = 0.5	14*	5	19	73.7	

* Predicted correctly

1979 has been found as 0.3, but extreme summer conditions have been noticed during this year as temperature > = 40° C has been recorded for 59 days.

So, during ideal contrast situation, when r < = 0.3, and with the help of first method almost 100% correct forecast for the nature of rainfall is possible during certain years. On the whole the second method for forecasting normal/deficient rainfall has been found correct for 19 years (70%), Table 3, out of 27 years periods.

Gaya recorded 17 years excess/normal and 10 years deficient rainfall during the 27 years period. From the study made, the ratio (r) has been found < = 0.5 on 19 and > 0.5 on 8 occasions, Table 2. Hence as per second method, normal/excess rainfall is predicted for 19 years and deficient for 8 years. On five occasions (1966, 1970, 1979, 1981, 1991), when prediction was for normal, deficient rainfall occurred and on three occasions (1969, 1971, 1976) it was excess instead of predicted deficient rainfall.

Comparing the actual and predicted rainfall, it is observed that 14 out of 19 years for normal/excess and 5 out of 8 years for deficient rainfall were predicted correctly. So the percentage of success in forecasting normal/excess and deficient rainfall has been 73.7 and 62.5 respectively (Table 3).

6. *Conclusion* - We find that the percentage of success of long range monsoon rainfall forecast of these methods have been 81.5% and 70% respectively when only two temperature parameters have been used. These results are quite encouraging. Thus these methods suggest some clue for long range monsoon forecast for Gaya in Bihar plains.

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