Letters to the Editor

SEMI QUANTITATIVE PRECIPITATION FORECASTS FOR GHAGHRA CATCHMENT BY SYNOPTIC ANALOGUE METHOD

1.   The technique of synoptic analogue is the most convenient method from the view of day to day operational forecasting. The dominant factor in forecasting quantitative precipitation amount is the synoptic meteorological situation. Abbi *et al.* (1979) studied the movement of cyclonic storms/depressions/ monsoon trough for a period of 1960-76 with respect to Bhagirathi catchment and prepared analogue maps depicting the associated rainfall distribution Lal *et al.*(1'983) studied different types of synoptic situations and correlated them with their resulting rainstorms over Gomti river catchment in Uttar Pradesh based upon five years data and prepared synoptic analogues for forecast range of real rainfall. In the present paper an attempt has been made for the prediction of quantitative rainfall amounts in Ghaghra catchment by utilising synoptic situations prevailing over Uttar Pradesh and neighbouring areas and rainfall data for the southwest monsoon period from 1991-96 has been used. Results have been checked with monsoon data of 1997.

2.   The river Ghaghra is a valiant river and flows for a total length of about 1800 km and its catchment area is 2,72,500 sq km. The upper half of Ghaghra lies in Nepal and lower half in Uttar Pradesh (India). The Ghaghra is called Karnali (or Manchu) in upper reaches and has its source in the Tibetan glaciers about 60 km southwest of Mansarovar in Tibet. After flowing for about 72 km in southeasterly direction in Tibet it enters the Nepal territory and about another 25 km the river takes a winding course in Nepal Himalayas till it reaches the plains of Nepal after passing through a narrow gorge in Siwalik range of hills. As the river enters the plains of Uttar Pradesh at Bharatpur in the Bahraich district it divides into several channels. The main important tributary of Ghaghra is Sharda (or Chauka) river. After the junction with Sharda at Mathura in the Bahraich district the river is known as Ghaghra and flows in a southeasterly direction. It passes through Bahraich, Ayodhya, Faizabad and Ballia districts of Uttar Pradesh. The river finally joins the river Ganga few kms downstream of Chhapra in Bihar.

3.   Six years rainfall data have been collected from 1991 to 1996 and daily average areal actual rainfall computed for four monsoon months in respect of 16 stations *viz.* Katarniaghat, Nanpara, Mahsi, Bahraich (IMD), Bahraich (Tehsil), Kaiserganj, Elgin Bridge, Tarabganj, Faizabad, Haraiya, Basti (FMO), Basti (IMD), Ayodhya, Akbarpur, Mukhlispur and Turtipar distributed over the catchment areas, as shown in Fig. 1. Synoptic situation based upon 0000 UTC upper air and 0300 UTC surface data in relation to different categories of rainfall ranges have been categorised using Regional Daily Weather Reports and India Daily Weather Reports. The contribution of rainstorms range between 01-10 mm is negligible in changing the river gauge and reflecting the rainfall amounts, so not considered. The higher ranges of rainfall, *viz.*, 11-25 mm, 26-50 mm, 51-100 mm and greater than 100 mm have been considered for matching with different categories of synoptic situations.

3.1.   The total number of 158 rainstorms associated with different types of synoptic situations are shown in Table 1 and are mentioned below.

3.1.1.A low pressure area/upper air cyclonic circulation located :

A - Over Gangetic West Bengal
B - Over Bihar Plains
C - Over southwest Uttar Pradesh
D - Near the catchment
E - Over the catchment

3.1.2. An elongated monsoon Axis :

F - South of the catchment .
G - Passing through the catchment.
H - Close to the foot-hills of Himalayas (break monsoon situation)

4.   The following results are found from Table 1.

4.1. Out of 115 occasions of rainstorms in the range of 11-25 mm, the systems like (A,B,C); (D,E) and (F,G,H) have accounted for 45%, 34% and 21% respectively.

4.1.1. Out of 38 occasions of rainstorms in the range of 26-50 mm, the systems like (A,B,C); (D,E) and (F,G,H) have accounted for 8%, 47% and 45% respectively.
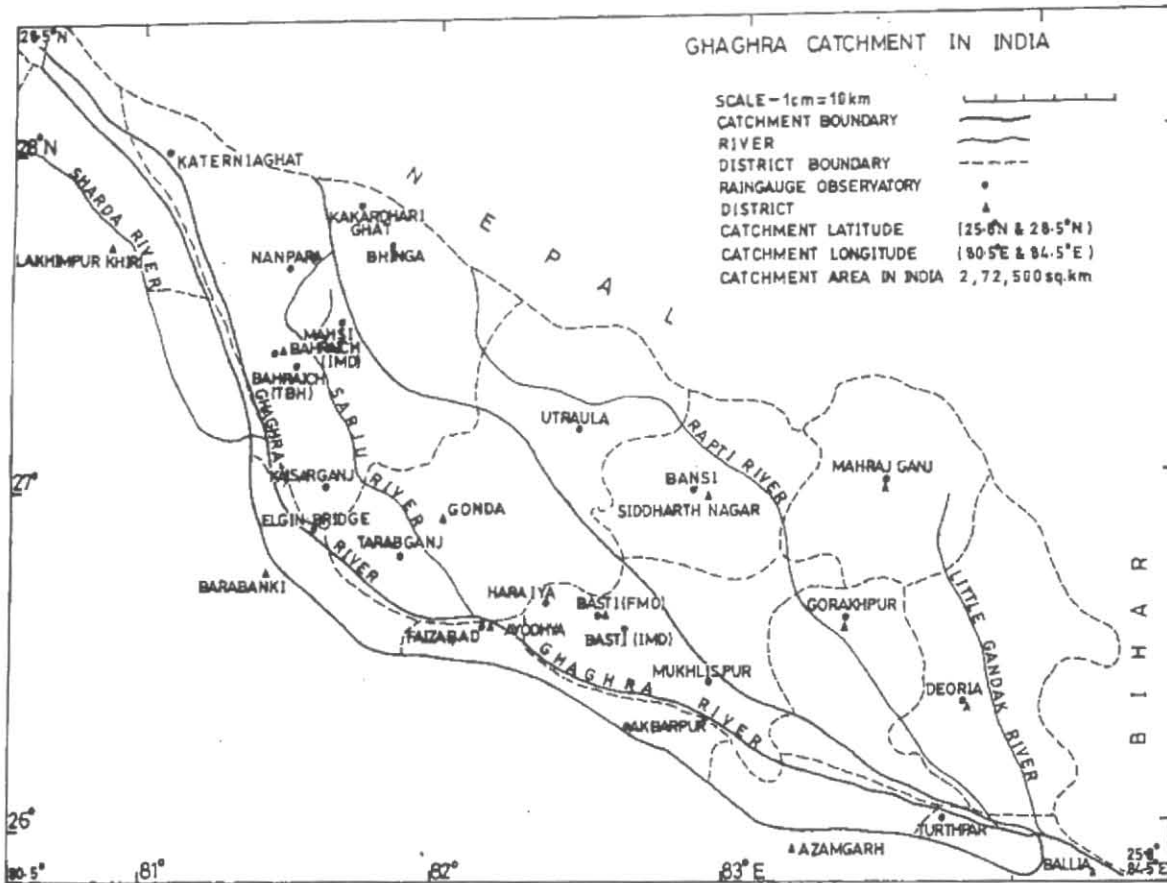
Fig.1. Locator map of river Ghaghra

4.1.2.   Out of 5 occasions of rainstorms in the range of 51-100 mm and above, there was the occurrence of systems (D,E) and G only. The systems have accounted for 60% and 40% respectively.

4.2. The rainstorms of different categories during the monsoon months June, July, August and September of 1997 were tested by synoptic analogue method. There were total 28 occasions of rainstorms which are shown in Table 2 and are mentioned below.

4.2.1 Out of 18 occasions in 11-25 mm, the systems like (A,B,C) and (D,E) have accounted for 44% and 33% respectively when the realised rainfall was within the forecast range (11-25). This shows that the percentage of occasions matches well with the analogue in the range 11-25 mm.

4.2.2. Out of seven cases of rainstorms in the range of 26-50 mm, the systems like (D,E) accounted for 43% which is slightly less than analogue value of 47%.

4.2.3. Out of three occasions of rainstorms in the range of 51-100 mm and above the systems (D,E) and (G,H) accounted for 67% and 33% respectively which are approximately matching with the analogue values.

4.3 Though the test results are approximately matching with the analogue, it was observed that from 8 to 11 July the same synoptic situation has given different rainfall because the area coverage of the catchment by the system was increasing daily. Also on 10 and 11 August it was observed that the synoptic situation (H) has given different amount of rainfall because the shifting of the monsoon axis towards the foot-hills of Himalayas. Dates on which the analogue did not fit well were 17 July, 21

TABLE 1

Synoptic situations and the rainstorms of total monsoon period affecting Ghaghra catchment during 1991-96 monsoon season/months

Average areal rainfall range (mm)	Associated synoptic situation (type)	Total number of rainstorms occurring
11-25	A	3
	B	23
	C	26
	D	15
	E	24
	F	15
	G	7
	H	2
26-50	A	1
	B	1
	C	1
	D	9
	E	9
	F	2
	G	14
	H	1
51-100 or above	D	1
	E	2
	G	2
Total		158

TABLE 2

Testing of synoptic analogues of Q.P.F. for Ghaghra catchment for 1997 monsoon season

S. No.	Date (1997)	Actual average areal rainfall (mm)	Associated synoptic situations categorised (type)	Q.P.F. range as per the analogue (mm)
1.	18 June	13	B	11-25
2.	19 June	14	B	11-25
3.	24 June	16	B	11-25
4.	8 July	19	E	11-25
5.	9 July	43	E	26-50
6.	10 July	70	E	51-100
7.	11 July	71	E	51-100
8.	12 July	25	D	26-50
9.	13 July	18	D	11-25
10.	14 July	21	D	11-25
11.	17 July	13	D	26-50
12.	21 July	19	E	26-50
13.	30 July	13	D	11-25
14.	2 August	17	D	11-25
15.	3 August	11	D	11-25
16.	6 August	16	B	11-25
17.	10 August	27	H	11-25
18.	11 August	78	H	51-100
19.	18 August	14	F	11-25
20.	19 August	19	F	11-25
21.	31 August	11	B	11-25
22.	2 September	27	D	26-50
23.	5 September	12	B	11-25
24.	6 September	28	E	26-50
25.	7 September	16	F	11-25
26.	12 September	20	D	26-50
27.	13 September	18	B	11-25
28.	21 September	12	B	11-25

July and 12 September when the estimation of precipitation forecast was a degree higher and on 10 August a degree lower than the realised average areal rainfall respectively.

5.   The above study concludes that the synoptic systems which are far away from the river catchment generally produce rainfall in lower range of 11-25 mm. The systems like low pressure area/upper air cyclonic circulation located over the catchment area and neighbourhood, located near or moving towards the catchment area and neighbourhood and active monsoon trough over the catchment area with a tendency to move

towards foot-hills of Himalayas produce rainfall generally in the higher ranges. Thus on the basis of this study the synoptic analogue technique is fairly accurate in issuing quantitative precipitation forecasts by the forecaster in 24 hrs advance for Ghaghra catchment.

References

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