551.577.21 (540.35)

AN EFFECTIVE METHOD TO IMPROVE ACCURACY FOR ISSUING QPF FOR FMO GUWAHATI DURING FLOOD SEASON 2006

1. Issuing of flood warning in terms of 'Quantitative Precipitation Forecast' (QPF) with optimum accuracy had always been seen as a challenge for FMO Guwahati due to complexity in 16 catchments spreading over entire NE – Region. Many authors had studied the role and usefulness of synoptic analogue model for different basins in India. Ray and Sahu (1998) used analogue method for QPF of Sabarmati river basin and Ray and Patel (2000) for Narmada river. Ram and Pangasa (2000) has also used this model for Ghaghara catchment. Similar method has been applied by Lal *et al*., (1989) for river Gomati. A detailed study of rainfall distribution and quantitative estimation of heavy rainfall in Yamuna catchment has been done by Duggal *et al*., (1992). A comparative hydro-meteorological study using isohyetal analysis with associated synoptic situations has been done by Ghosh *et al*., (1982) for Yamuna river. Studies on developing an index for occurrence of flood have been enunciated by eminent scientists like Palmer (1965) in the past. In India Bhalme and Mooley (1980) computed a flood area index using monthly sub-divisional rainfall by adopting Palmer's method. Choudhary and Mashawade (1991) found out variations in floods utilizing statistical techniques for 31 sub-divisions during monsoon season. Sen (1991) suggested a mathematical model for QPF for flood forecasting by using surface as well as upper air observations.

2. Daily rainfall data recorded at the stations under FMO, Guwahati and 131 stations of Central Water Commission (CWC) have been taken as input for this study. For flood season of the year 2006 QPF had been worked out by implementing isohyetal analysis method as recommended in Hydro Meteorological Manual by Abbi (1972) and used as an input along with the identification of prevailing synoptic situations over a particular area of this region. The Area Weighted Average rainfall 'R' is determined by computing the incremental volume between each pair of isohyets, adding these incremental volumes and dividing them by the total area as under.

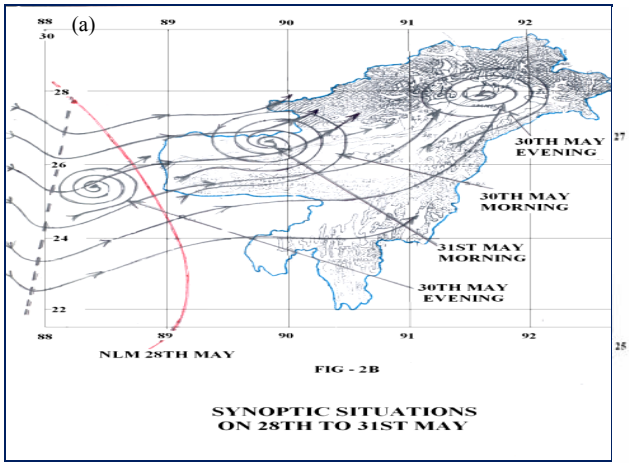
$$R = \frac{\sum_{r=1}^{n} P_r A_r}{\sum_{r=1}^{n} A_r}$$

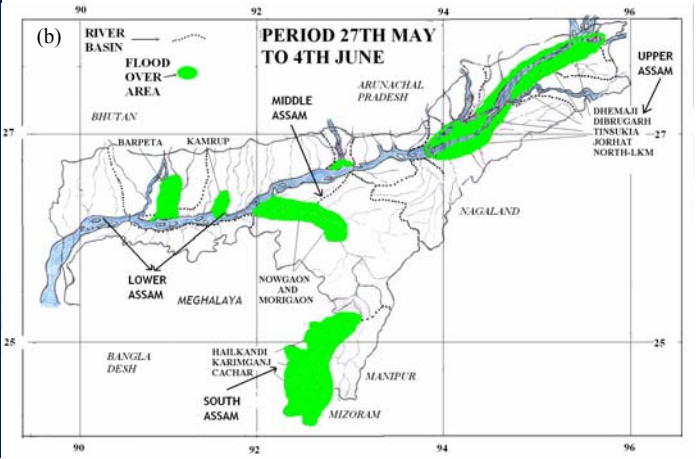
where, r = 1, 2, 3….n and A_1, A_2, A_3……. A_n, are areas as measured by Planimeter and P_1, P_2, P_3 ….. P_n represent average rainfall. The optimum grid size has been applied as 667.7 Sq km for effective method to find out 'Area Weighted Average Rainfall'. In total 1138 number of QPF with an accuracy of 61% were issued during flood season 2006 by FMO Guwahati. Upper Assam, Lower and South Assam contain 16 river catchments areas. Mainly three spells of floods were observed over the region.

(*i*) The first spell of flood occurred from from 27th May to 4th June. The rainfall distribution was widespread (WS) in all the three sub-divisions Arunachal Pradesh (A.P.), Assam & Meghalaya (A&M) and Nagaland, Manipur, Mizoram & Tripura (NMMT).

During this period, 29 QPF in range (in mm) 1-10, 19 QPF for 11-20, 17 QPF for 21-35 were issued and realized were 21, 10 and 17 respectively. On 27th May a Cycir lay over west Assam and adjoining area of Meghalaya [Figs. 1(a)] extending up to 4.5 km asl. It moved eastwards over west Assam, Meghalaya and adjoining area of Arunachal Pradesh (A. P.) extending up to 1.5 km asl on 28th May and remained there till 30th. In association with seasonal trough on Sea Level Chart, an upper air trough was also running at lower levels over NE Assam and Manipur on 1st and 2nd June. The river Brahmputra was flowing above danger level showing peak as 85.55 metres on 1st June at Nematighat and 105.44 meters on 31st May at Dibrugarh. The Rivers Katakhal and Kapili were above danger level at Matijuri and Kampur respectively [Figs. 1(c-f)] having their peak at 22.27 and 61.42 metres on 1st and 2nd June respectively. River Beki, Jaibharali and Puthimari under catchments 9, 10 and 13 were also above danger level from 1st to 4th June. During this period 16 districts were affected by flood [Fig. 1(b)].

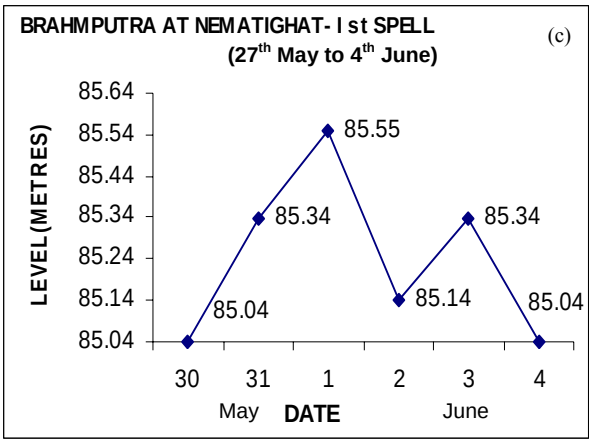
(*ii*) The second spell of floods occurred from 10th to 18th June. During this period 31 QPF for range (in mm) 1-10, 41 QPF for 11-20, 10 QPF for 21-35 and 1 QPF for 36-50 were issued whereas realized within range were 24, 21, 10 and 0 respectively. On 10th June an upper air Cycir lay over west Assam and adjoining areas of Meghalaya extending up to 2.1 km asl with a trough in westerlies running along 90° E / north of 20° N between 3.1 to 5.8 km asl [Fig. 2(a)]. This trough moved eastwards and lay on 12th along 91° E / north of 20° N between 500 to 400 hPa. As a result of it monsoon became very active on 12th June over A. P., Assam & adjoining areas of Meghalaya. On 14th June another trough was seen over Sub Himalayan West Bengal (SHWB) between 0.6 km asl to 3.1 km asl. The seasonal trough on Sea Level Chart was running over West Bengal, Assam, Meghalaya and Nagaland during 15th to 18th June. The river Brahmaputra was flowing above danger level with its peak at 105.54 meters and 86.08 metres at Dibrugarh and Nematighat respectively on 13th June. The river Beki was also

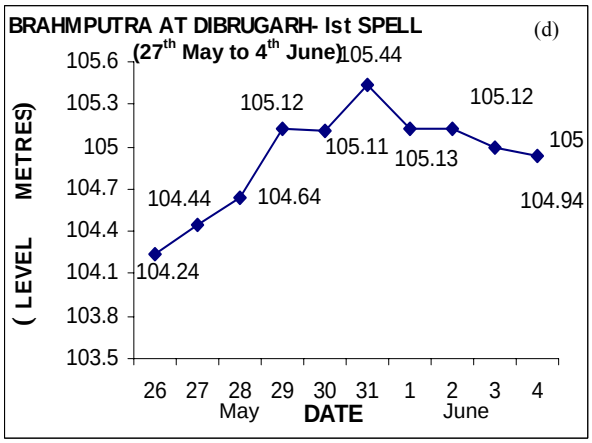


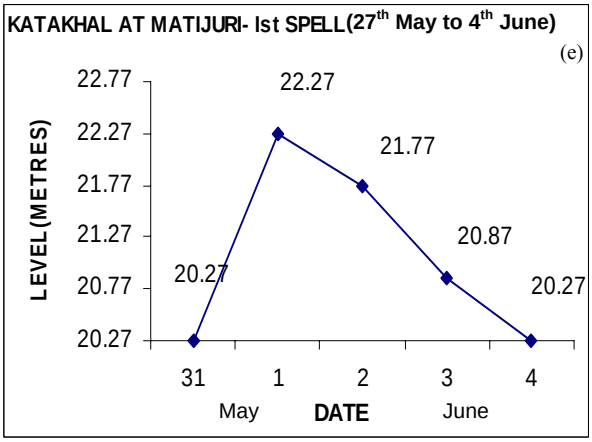


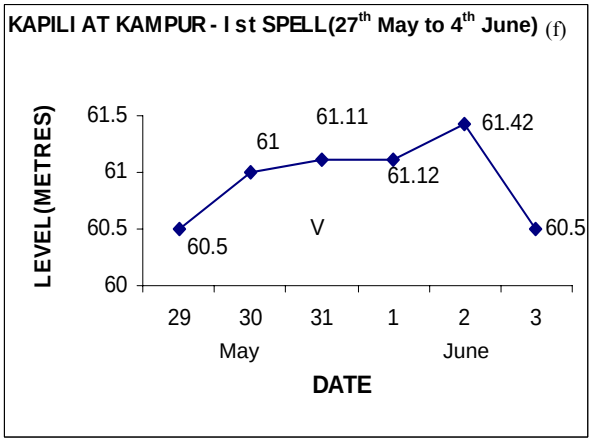
Figs. 1(a). Synoptic system during 1st spell of floods

Fig. 1(b). Areas affected by the first spell of floods









Figs. 1(c-f). Levels (metres) of different rivers at different locations during 1st spell of floods from 27th May to 4th June 2006

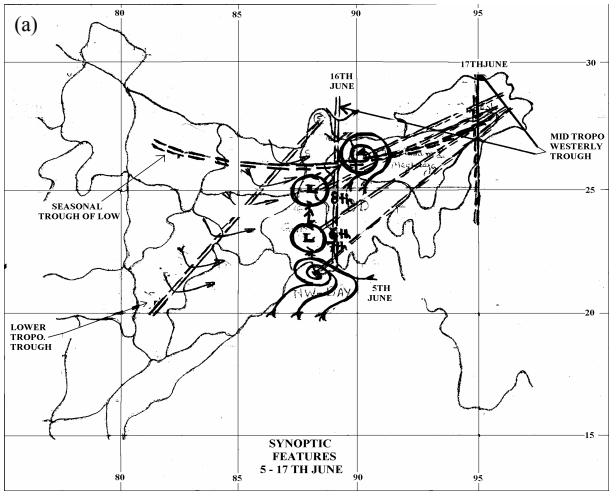


Fig. 2 (a). Synoptic systems during second spell of floods

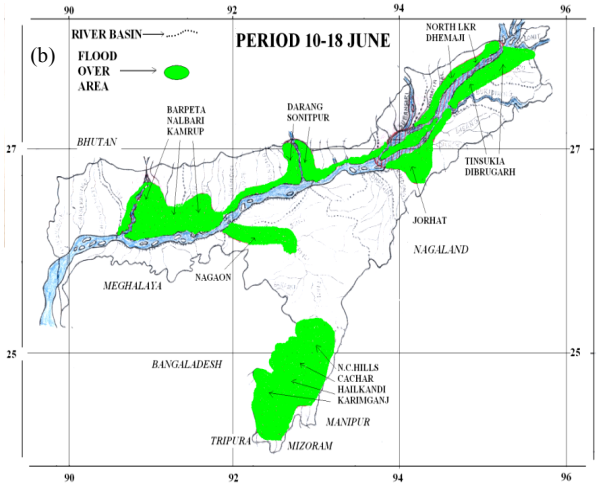
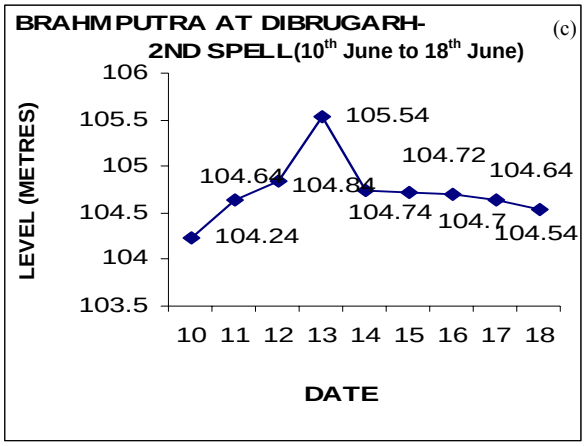
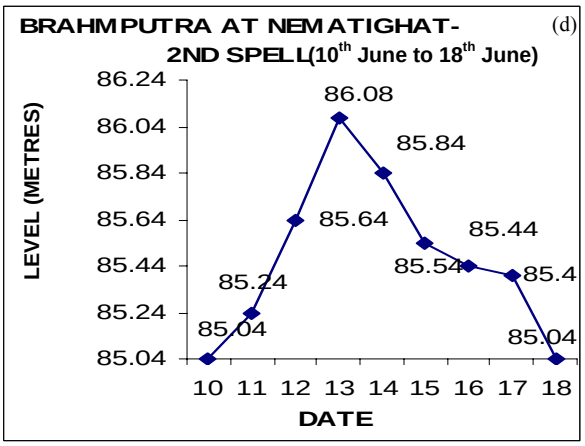
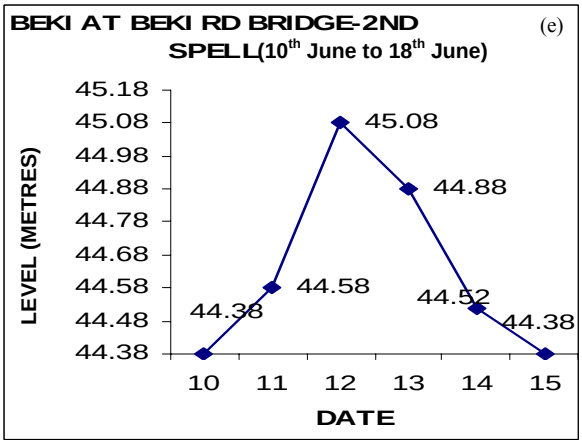
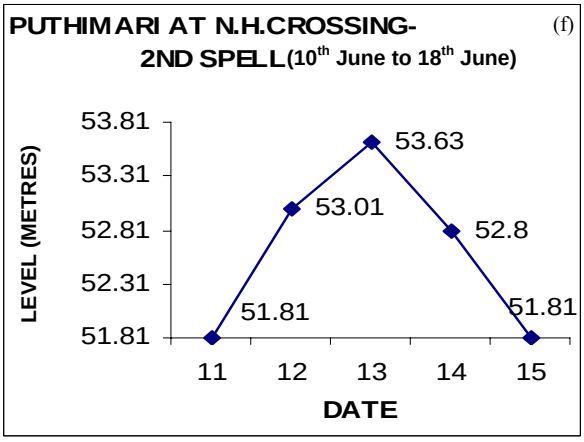


Fig. 2 (b). Areas affected by the second spell of floods

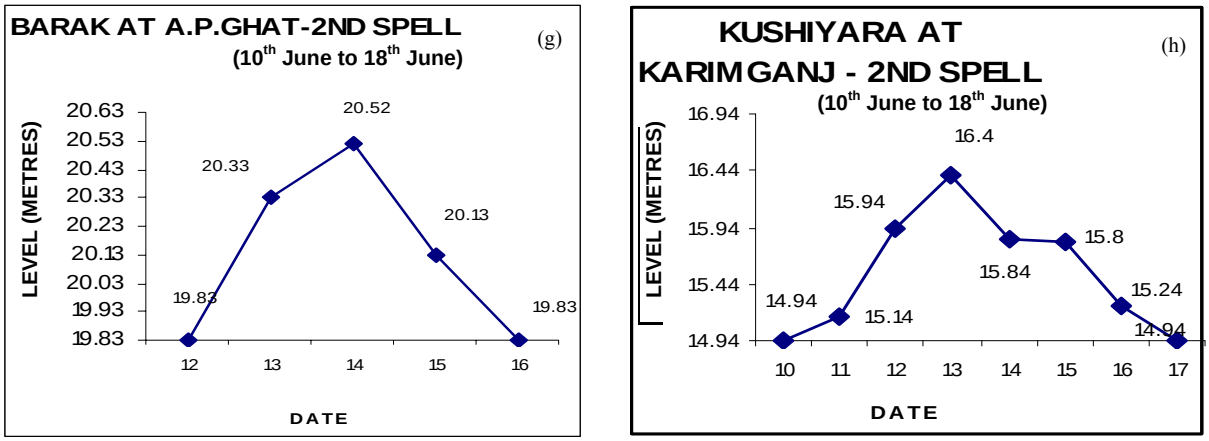








Figs. 2 (c-f). Levels (meters) of different rivers at different locations during second spell of floods from 10th to 18th June 2006



Figs. 2 (g&h). Levels (meters) of different rivers at different locations during second spell of floods from 10th to 18th June 2006

flowing above danger level with their peaks at 45.08 meters at Beki road bridge on 12th June. The River Barak attained its peak at 20.52 metres at AP Ghat and River Kushiyara attained its peak at 16.4 metres at Karimganj on 14th June respectively. The river Puthimari was flowing above danger level with its peak at 53.63 metres on 13th June at NH crrosing [Fig. 2(c-f)]. The Districts Barpeta, Nalbari and Kamrup which lay under river catchments numbers 9, 10, 13 and the districts North Lakhimpur, Dhemaji, Tinsukia, Dibrugarh and Jorhat which lay under river catchments numbers 1 to 6 were under grip of flood [Fig. 2(b)].

(*iii*) During the third spell from 16th to 28th July intermittent heavy rainfall occurred over upper and lower Assam. Rainfall distribution was Scattered (SCT) to Fairly Widespread (FWD) on most of the days. On 102 occasions QPF were issued for range 1-10 and 28 for 11-20 but realized were 77 and 5 respectively. An east-west trough in lower troposheric level was running from east UP to NE-Assam and adjoining areas of A.P. from 19th to 21st July. A cycir lay over A.P and adjoining Assam extending upto 0.9 km asl with a trough aloft upto 2.1 km asl on 22nd July which became unimportant on 23rd July. On 24th a cycir lay over SHWB and adjoining Assam extending upto 1.5 km asl which moved over NE-Assam on 25th and 26th July extending upto 2.1 km asl and then became less marked later on 27th. River Brahmputra was flowing above danger level with its peak 105.14 metres on 26th at Dibrugarh. River Dikhow at Sibsagar was flowing above danger level attaining two peak 93.12 and 93.5 metres on 19th and 23rd respectively. The river Desang at Naglamuraghat rose from 94.46 to 94.93 metres on 20th July. Dhanasiri at Numaligarh was also flowing above danger level with its peak at 78.25 metres on 26th July [Fig. 3(c-g)]. Dibrugarh, Sibsagar, Jorhat and Golaghat district of Upper Assam and Barpeta districts of Lower Assam were affected by flood during the period [Fig. 3(b)].

4. During these three main spells of floods over the region the number of QPF issued for all 16 catchments for different ranges of rainfall and the realized during three spells is shown in Table 1. On 162 occasions QPF had been issued for range 1-10 and realized was 122 thus indicating 75.3% accuracy. The majority of QPF issued were for catchments number 6-10 in this range. This range may not be the main cause for flood situations but continuous occurrence of rainfall in the ranges 11-20 and 21-35 in between had led to flood situation. QPF for range 11-20 was issued on 88 occasions and realized was 36, indicating accuracy of 41%. There were 27 QPF issued and 27 realised for the range 21-35 mm with 100% accuracy. Combined accuracy for these three main spells is 66.5%. Overall accuracy for the flood season 2006 was 61% which is a significant achievement as compared to last 10 years average accuracy of 34% which may be due to application of this method.

5. During all three spells 27th May to 4th June, 10th to 18th June and 16th to 28th July for total 31 days Upper, Lower and South Assam areas were in grip of floods. Most of the rivers in these areas were flowing above danger levels under favourable synoptic situations in association with scattered to broken clouds embedded with moderate to intense convection resulting into heavy to very heavy downpour. Third spell was a weaker spell as compared to other two spells. The 'Area Weighted Average' with a grid size of 667.7 sq km was observed to be optimum for effective method of issuing QPF. However more attention is needed to enhance the accuracy for higher ranges in view of normal or excess

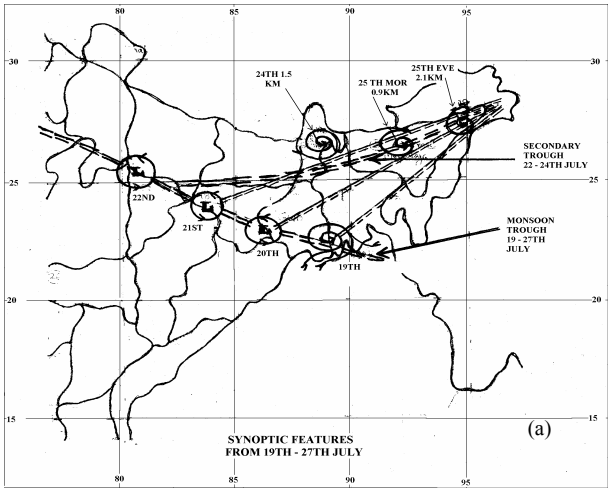


Fig. 3(a). Symptic systems during third spell of floods

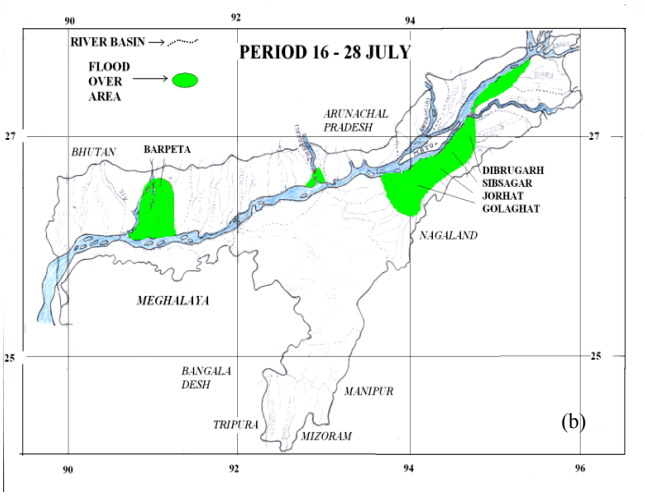
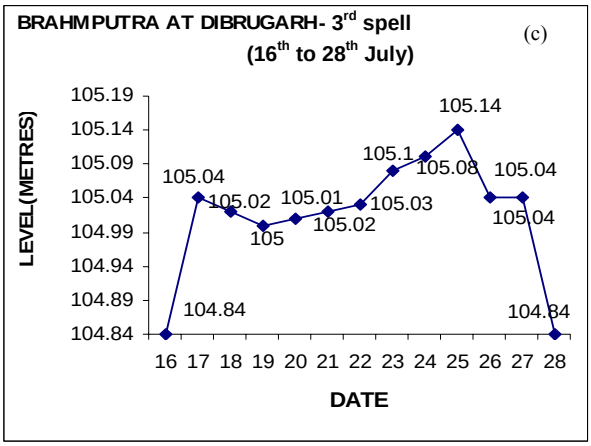
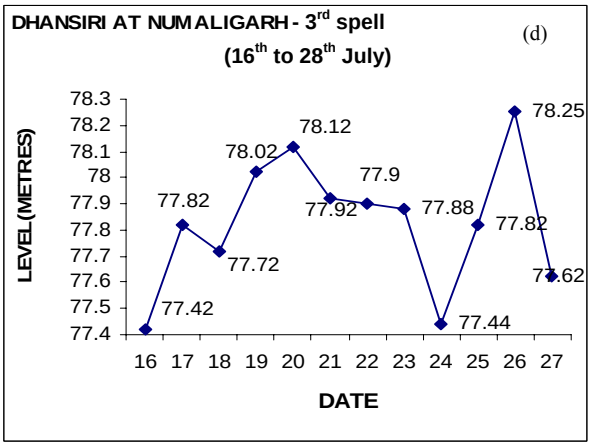
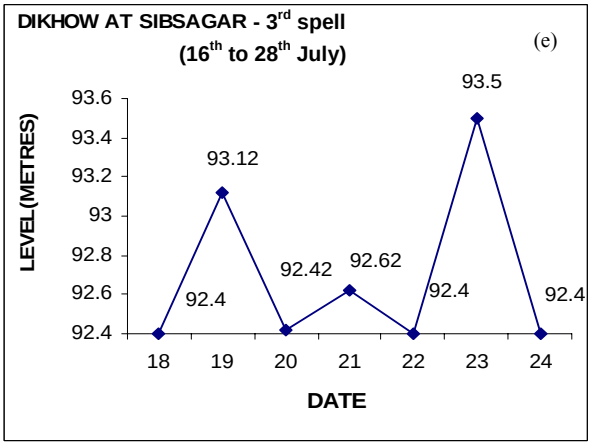
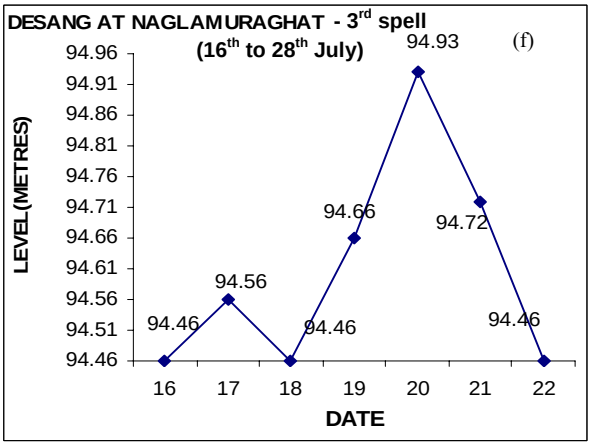


Fig. 3(b). Areas affected by the third spell of floods









Figs. 3(c-f). Levels (meters) of different rivers at different locations during third spell of floods from 16th to 18th July 2006

TABLE 1

Comparison of realized rainfall and QPF issued

Range (mm)	Spell I of flood		Spell II of flood		Spell III of flood		Total		Accuracy (%)
	QPF Issued	Realised	QPF Issued	Realised	QPF Issued	Realised	QPF issued in range	Realised in range	
1-10	29	21	31	24	102	77	162	122	75.3
11-20	19	10	41	21	28	5	88	36	41
21-35	17	17	10	10	0	0	27	27	100
36-50	0	0	1	0	0	0	1	0	0
Total	65	48	83	55	130	82	278	185	66.5

monsoon over the region. It is suggested to identify more number of synoptic systems causing severe flood over the particular areas to enhance accuracy for higher ranges.

The increase in accuracy of Q.P.F from 34% (mean of last 10 years) to 61% had been achieved during flood monitoring period from 15th May to 15th October 2006 by using Area Weighted Average Rainfall method for issuing QPF and giving due weighage to suitable synoptic conditions.

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