A CASE STUDY OF SEVERE FLOODS IN RIVER BURHI GANDAK

1. Floods of a severe magnitude occurred in river Burhi Gandak in September 1974 and July-August 1975. The river surpassed the highest flood levels at some gauging points. Extensive loss of life and property was reported from some northwestern districts of Bihar in both the years. This note gives a synoptic and hydrometeorological account of the floods.

The river Burhi Gandak has its source region in the western slopes of Someshwar range of hills in Nepal Himalayas. Major part of its catchment (about 12,500 sq. km) lies within India and a small portion in Nepal. The river flows southeast for 610 km in a highly meandering and tortuous course through the districts of Champaran, Muzaffarpur, Darbhanga, and Samastipur to join Ganga opposite the town of Monghyr. During rains it rises very fast and floods a large area of land to a depth of 1 to 1.5 metres.

2. Synoptic features and associated rainfall of September 1974 floods — A low pressure area appeared over west central Burma on 7 September 1974. It moved to north Bay of Bengal and neighbourhood on 8th. Moving further west and north it was located over Bihar Plateau, adjoining Gaugotic West Bengal and northwestern Orissa on 9th (Fig. 1). Associated upper air cyclonic circulation was seen extending up to 5-8 km a.s.l.

The 24-hr rainfall ending at 0830 IST on 9 September are plotted in Fig. 1. A rainbelt delineated with peripheral isohyet of 5 cm can be seen to the northeast of the track of low pressure area from 8th to 9th.

The low pressure area continued moving northwest. It was located over southeast Uttar Pradesh and adjoining northeast Madhya Pradesh on 10th. Cyclonic circulation was now extending only upto 2-1 km a.s.l. with associated trough aloft upto 4-5 km a.s.l. A trough in the westerlies at 500 mb level can be located along 80°E (west of Lucknow). The low was thus positioned in the forward sector of the trough. Concurrently a well marked anticyclonic vortex in the upper troposphere lay over the area extending from east Uttar Pradesh to Assam through Bihar.

With the movement of the low northwestward the rainbelt shifted northwest resulting in the increased intensity of rainfall. Central isohyet of the rainbelt could be observed at a distance of about 250-300 km to the northeast of the track of low from 9th to 10th. Rainbelt was concentrated and oriented along the length of the catchment at 0830 IST of 10 September 1974 (Fig. 2). This feature is peculiar to monsoon depressions of September (Rao 1976).
During subsequent 24-hr the low initially took a slow northerly movement and later recurved northeast. Cyclonic circulation continued extending up to 2.1 km a.s.l. Middle and upper tropospheric features remained practically unchanged.

Rainbelt shifted further northwest and some stations recorded exceptionally heavy falls of the order of 35 cm. Distance of the central isohyet from the mean position of the low from 10th to 11th was about 250 km to the northeast (Fig. 3).

The low pressure persisted over the area till 11th evening. Heavy rainfall continued in some parts of the catchment till 12th.

3. *Synoptic features and associated rainfall of July-August 1975 floods* — Following the movement of a depression from central Bihar to north-east Pakistan, adjoining Punjab and Jammu & Kashmir across Uttar Pradesh and Rajasthan from 18 to 24 July 1975, the axis of seasonal monsoon trough shifted north close to the foothills of Himalayas on 25 July and persisted there till 27th. This resulted in 'Break' monsoon.

A trough in mid tropospheric westerlies over extreme north of the country on 25 July moved eastward to western Tibet on 26 and 27 July. Extending southward into Uttar Pradesh on 27th, it further moved away eastward across eastern Tibet on 28th. This situation was coupled with strengthening of winds in the lower troposphere due to steep pressure gradients prevailing over north India on 26 and 27 July. It is seen from Figs. 4 and 5 that the winds reached 30-40 kt at 900 m a.s.l.

Heavy to very heavy rains occurred along the trough in the submontane belt of Bihar from 26 to 28 July with heavier falls in the north-western part.

The shifting of seasonal monsoon trough to foothills of Himalayas was brought about by northward movement of a Bay depression. The middle latitude westerly trough seems to have played a dominant role in producing heavy rainfall subsequently and holding the trough close to foothills. As can be seen from the rainfall chart of 27 July (Fig. 4), there was a noticeable southward extension of the belt of heavy rainfall, particularly in the catchment of Buri Gandak, and a general increase in rainfall intensity when the trough was moving across
**TABLE 1**

Average (isohyetal) areal rainfall for major rainstorms in Burhi Gandak catchment

<table>
<thead>
<tr>
<th>Period</th>
<th>Max. one-day</th>
<th>Max. two-day</th>
<th>Three day (total)</th>
</tr>
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<tbody>
<tr>
<td>12 Sep 1945</td>
<td>10.8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>21-23 Jul 1949</td>
<td>10.4 (21)</td>
<td>20.1 (21+22)</td>
<td>25.8</td>
</tr>
<tr>
<td>16-17 Sep 1956</td>
<td>8.4 (16)</td>
<td>12.2</td>
<td>—</td>
</tr>
<tr>
<td>30 Jul 1965</td>
<td>14.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>10-11 Sep 1974</td>
<td>11.5 (11)</td>
<td>19.9</td>
<td>—</td>
</tr>
<tr>
<td>26-28 Jul 1975</td>
<td>8.7 (27)</td>
<td>14.5 (26+27)</td>
<td>20.2</td>
</tr>
</tbody>
</table>

western Tibet from 26 to 27 July, its southern end extending into Uttar Pradesh on 27th. As the trough moved further eastward from 27th to 28th, rainfall also stretched eastward (Fig. 5). As soon as the mid-tropospheric trough moved away eastward, the monsoon trough started shifting south.

4. Rainstorm of September 1974 and July 1975 vis-a-vis past major storms — A comparison of the rainfall yields of September 1974 and July 1975 rainstorms was made with a few selected major storms which occurred in the upper catchment.

_Flood Meteorological Office, Patna_  
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**REFERENCE**


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**A CROSSED YAGI AERIAL FOR USE IN A.P.T. RECEPTION**

1. For the reception of APT cloud pictures in the 136-137 MHz band, a circularly polarized antenna with a gain of 10 to 13 db is required for good reception with the receivers being used by the Meteorological Department. At present 8 turn helical antennas having gain of 13 db are being used at Bombay and Pune (Datar 1971). At Delhi, Calcutta and Madras stacked Yagi type of antenna (Dasgupta 1971) are being used. Design of a crossed Yagi aerial for use with an antenna pedestal recently developed by the department is reported here.

2. The antenna specifications were arrived at by taking into consideration the transmission characteristics of polar orbiting satellite (NOAA series) and the sensitivity (1-0 μV close circuit for 26 db S/N ratio) of the APT receiver currently in use by the Meteorological Department. The specifications are:

   1. Frequency : 135-140 MHz
   2. Gain : 10-12 db
   3. Polarization : Circular
   4. Beamwidth : 45° HPBW

3. The satellite transmits linearly polarized radio waves but it is necessary to have circular polarization for the receiving aerial to take into account de-polarization due to Faraday rotation.