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An analysis of September 1958 rainstorm over Damodar Valley area

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ABSTRACT. The rainstrom of September 1958 affecting the Damodar Valley has been studied by means of isohyetal charts and depth/area diagrams and the results compared with the previous flood producing storms.

1. Introduction

Newspaper reports mentioned about the occurrence of heavy rainfall over the Gangetic West Bengal and Chota Nagpur during 14 to 18 September 1958. These reports also added that unprecedented flood occurred in the river Damodar as a result of this heavy precipitation. A relevant report in this connection appearing as a news-item in the progress report for the month of September 1958 of the Damodar Valley Corporation is reproduced below—

> "There was unprecedented flood in the Damodar and Barakar on the 15 and 16 September 1958. The flood was greater than that recorded in the last 67 years. The maximum observed peak flows at Panchet and Maithon were 430,000 and 170,000 cusecs respectively. But for the dam, the maximum observed peak flows at Durgapur in the lower valley would have been of the order of 665,000 cusecs. The four reservoirs at Maithon, Panchet, Tilaiya and Konar controlled the flood and reduced the flow at Durgapur Barrage to 205,000 cusecs which is much less than the bankfull capacity (250,000 cusecs) of Damodar river downstream of Durgapur. Had there been no dams, flood would have caused calamities and damages on a scale larger than anything known in recent history".

In view of the unprecedented nature of the flood, an attempt has been made to analyse and compare the rainstorm of September 1958 with the major flood producing storms of the previous years.

2. Synoptic situation

A low pressure wave from the east moved across the Chittagong-Arakan coast and entered into the north Bay of Bengal where conditions became unsettled on 12 September 1958. The unsettled conditions concentrated into a depression on the following morning and it was centred near Lat. 20½°N and Long. 89½°E *i.e.*, about 240 km (150 miles) southeast of Calcutta. The depression deepend, moved northwestward and crossed the West Bengal coast near Contai (Long. 88°E) during early morning of 14th. At 0830 IST of the same day it was over Gangetic West Bengal with its centre about 75 km (46 miles) westsouthwest of Calcutta. Moving northwest it weakened into a depression and was centred about 80 km (50 miles) northeast of Hazaribagh on 15th morning. The depression recurved northeastwards and was close to Bhagalpur on 16th. Continuing in the same direction it broke against the Darjeeling Himalayas on 17 September 1958. The track of the depression is shown in Fig. 1. In association with this depression widespread rain occurred

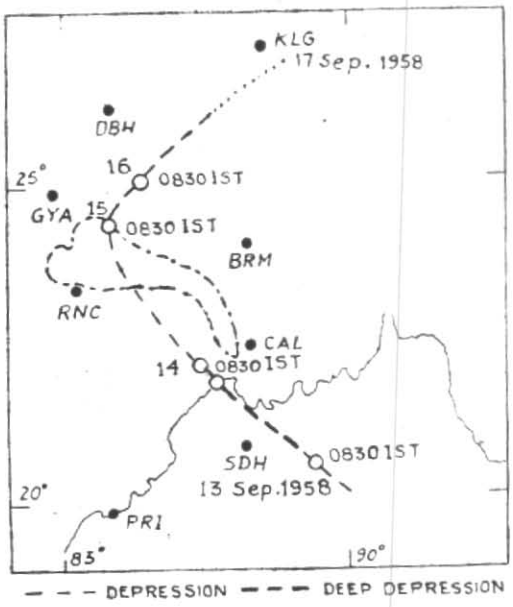

Fig. 1. Track of the depression

over Gangetic West Bengal and Chota Nagpur during 14th to 16th. Locally heavy to very heavy falls, however, occurred in the Damodar catchment during the last two days of the spell.

3. Storm isohyetals and depth area curves

On a large scale map of the Damodar Valley catchment (1″=16 miles) the rainfall recorded at the India Meteorological Department observatories, Damodar Valley observatories and State raingauge stations were plotted for each day 14th, 15th and 16th and isohyetals drawn (Figs. 2, 3 and 4). Total isohyetals for the two-day and three-day periods (*viz.*, 14th and 15th, 15th and 16th, and 14th, 15th and 16th) were also drawn and are shown in Figs. 5, 6 and 7. The basin area of the catchment above Raniganj is 7200 sq. miles and for each isohyetal map, the area above Raniganj was planimetered and the corresponding depth/area data for one day, two-day and three-day periods obtained. The average depth of rainfall over an area between two isohyetal lines is taken to be the average of the two surrounding isohyetals. The depth/area curves for different periods were also drawn (Figs. 8 to 10). From these curves the average depth of rainfall that occurred in a given time over different areas of the catchment were also read off and shown in Table 1.

TABLE 1

Date	Area (Sq. miles)	Rainfall (inches)
15–16 Sep 1958	500	11·65
	1000	10·75
	2000	9·43
	3000	8·60
	4000	7·98
	5000	7·44
	6000	7·00
	7000	6·90
14–15 Sep 1958	500	12·55
	1000	11·75
	2000	10·50
	3000	9·65
	4000	8·85
	5000	8·20
	6000	7·70
	7000	7·40

4. Storm period

Though rainfall had occurred over the catchment during 14th, 15th and 16th, it is doubtful whether it should be called a three-day storm in view of the fact that the average rainfall over the basin area of the catchment on the first day was less than 1″ (0·7″). The average rainfall on the subsequent two days 15th and 16th was 3·50″ and 3·33″ respectively. With the formation and movement of the depression there was fresh incursion of moist air over Gangetic West Bengal and

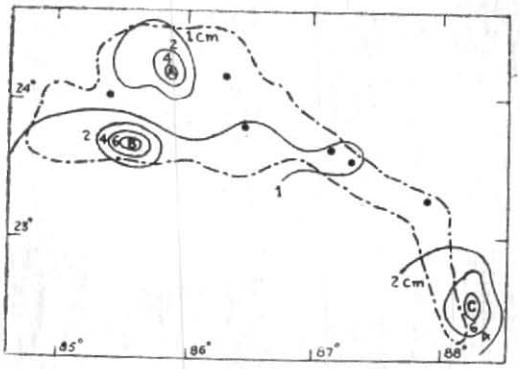

Fig. 2. Isohyetals (cm) on 14 September 1958

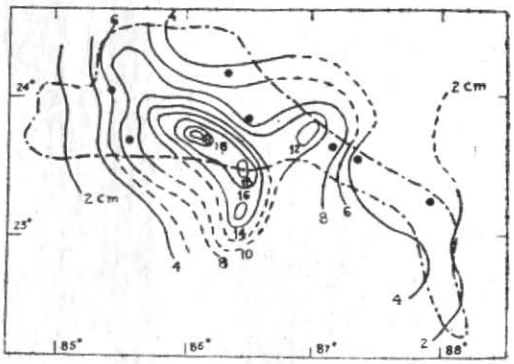

Fig. 3. Isohyetals (cm) on 15 September 1958

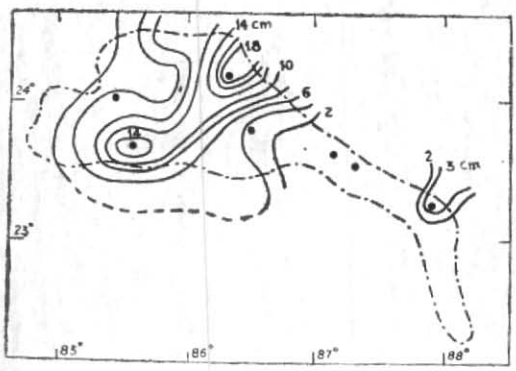

Fig. 4. Isohyetals (cm) on 16 September 1958

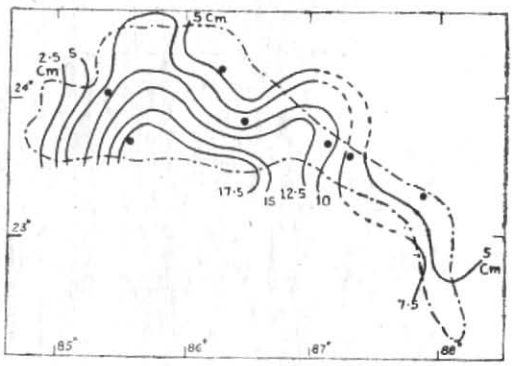

Fig. 5. Two-day Isohyetals (cm) on 14 and 15 September 1958

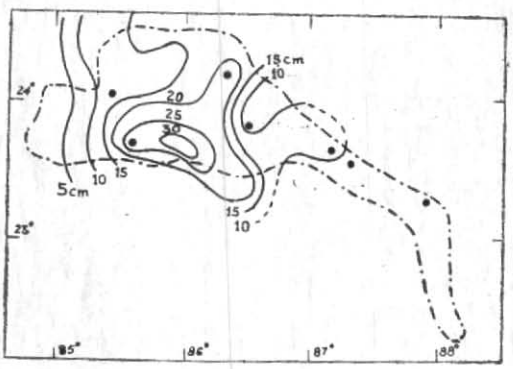

Fig. 6. Two-day Isohyetals (cm) on 15 and 16 September 1958

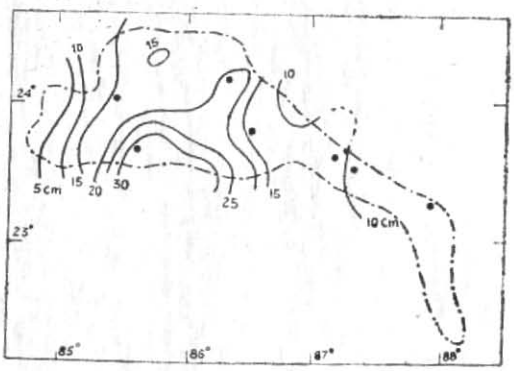

Fig. 7. Three-day Isohyetals (cm) on 14, 15 and 16 September 1958

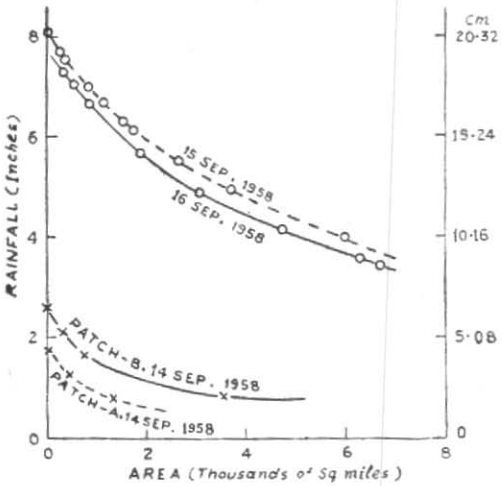

Fig. 8

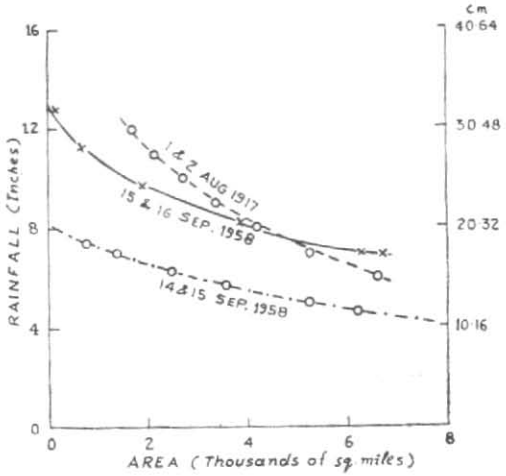

Fig. 9. Two-day rainfall

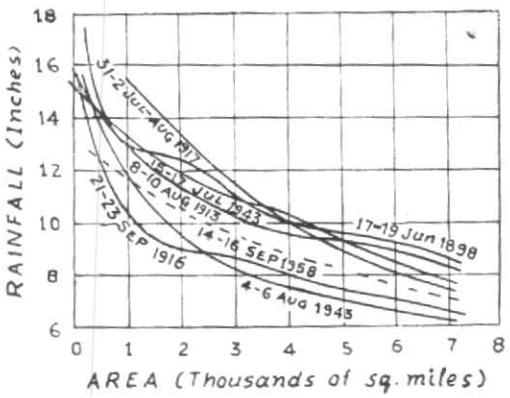

Fig. 10

Chota Nagpur and the rainfall commenced over the Damodar Valley area on 14th after a comparatively dry spell of about 2-3 days. On 14th, rainfall was mainly over the western portion of the catchment and was in general light to moderate in intensity except at Ramgarh where a very localised rainfall of 71 mm (2·79″) was recorded. That the rainfall at Ramgarh was extremely localised can be judged by the amounts recorded at the neighbouring stations—Bokaro, Gola and Hazaribagh, which were 1, 2 and 7 mm respectively. In view of the above, it may be said that though the rainfall on 14th was in association with the depression, it may not be taken as a part of the storm rainfall because of the comparatively low average *viz.*, 0·7″ in 24 hours. The rainfall on 14th may therefore be taken as a prelude to the storm rainfall on 15th and 16th. Moreover, as the catchment was comparatively dry on the preceding few days, the rainfall on 14th must have got easy and quick flow along the river and the amount might not have contributed significantly to the peak flow and discharge on the next two days.

Two-day storm—It may be seen from the depth/area curves of 15 and 16 September 1958 (Fig. 8) that the rainfall on the first day of the storm *i.e.*, 15 September, was a little higher than that on the 16th. The total rainfall for the two-day period over the basin area of the catchment was 6·83″. Pramanik and Rao (1953) recorded frequency of occurrence of two-day period of heavy rainfall (exceeding 6″) as follows—

Rainfall (cents)	Number of occasions (observed)
601-650	1
651-700	0
701-750	4

It may be seen that during the sixty-year period ending 1950 there were only five occasions when the two-day rainfall exceeded 6″. Hence the rainstorm of September 1958, when the two-day rainfall was 6·83″, may be taken as one of the major storms which have affected the Damodar Valley area. When compared with the depth/area figures for two days as given in the table prepared by Pramanik and Rao, it is found that the two-day rainfall on 1 and 2 August 1917 of the three-day storm (31 July—2 August 1917) can be well compared with the rainfall of 15 and 16 September 1958. The depth/area curve of 1 and 2 August 1917 has been superimposed on Fig. 9 and it may be seen that in area less than 4800 sq. miles the depth of rainfall in the present case was less, while over larger areas (greater than 4800 sq. miles) the September 1958 rainfall was more than that of 1 and 2 August 1917. During the storm period of September 1958 the highest rate of fall of rain per day over the basin area was 3·50″ and this works out to be 677,600 cusecs (1″ of daily rainfall over 7200 sq. miles of the catchment above Raniganj is equivalent to 193,600 cusecs). As the discharge rate was maintained at 200,000 cusecs approximately during the two days, the quantity of water held back in the four reservoirs comes to about $(6·83-2·00)\times 384,000$ =1854,720 acre feet. Without the reservoirs the volume of water that would have caused floods in the country side might have been of the order of 1·85 million acre feet. From the records of previous floods as prepared by Satakopan (1949), this value of discharge was exceeded on four occasions during the last 68 years (1891—1958), *viz.*, June 1898, August 1913, August 1935 and July 1943.

It may be mentioned in this connection that as reliable discharge data in respect of the Damodar Valley area are not available, it has not been possible to work out the true rainfall-run off relationship. In view of the above and considering the fact that rainfall during 1958 flood occurred towards the end of the monsoon season, it has been assumed in this paper that almost all the rainfall on 15 and 16 September 1958 has contributed to the run off and the flood estimated at 1·85 million acre feet.

Three-day storm—If, however, the storm is taken to be one of three-day duration *i.e.*, 14th to 16th, the total rainfall occuring over the basin area, as calculated from the depth/area curve of 14–16 September 1958 in Fig. 10 is of the order of 7·4″ and the figures quoted by Pramanik and Rao (1953) indicate that there were nine occasions during 1891—1950 when the three-day rainfall over the catchment exceeded 7″. Hence even assuming it to be a three-day storm, it may be seen that such occurrences are also not very frequent.

The depth/area curves in respect of the previous three-day storms as prepared by Pramanik and Rao are also shown in Fig. 10 to facilitate comparison of the respective depth/area values. It may be seen that during the period of 60 years (1891—1950) there were four rainstorms (curves of 1898, 1913, 1917 and 1943) when the rainfall distribution over the basin area of the catchment was higher than that of September 1958. During the intervening period 1951-57, there was however no major rainstorm except one in 1956 when the basin area of the catchment received comparatively less rainfall.

5. Conclusion

From the above analysis, it may be seen that the four reservoirs at Maithon, Panchet, Tilaiya and Konar apparently controlled a flood which would have been of the order of 1·85 million acre feet. Though the volume of water flooding the Damodar Valley was larger than 1·85 million acre feet on a few occasions in the past, yet it cannot be denied that the economic loss, that the 1958 flood would have brought in its wake, must have been of an enormous magnitude as a new prosperous valley has already sprung up around the erstwhile erratic Damodar.

REFERENCES

Pramanik, S. K. and Rao, K. N. 1953 *Mem. India met. Dep.*, **29**, Pt. 6.

Satakopan, V. 1949 *Ibid.*, **27**, Pt. 6.