



INDIA: FLOOD MANAGEMENT - DAMODAR RIVER BASIN

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Abstract. Information is provided about the approach and experience in flood management in the Damodar river basin of India. This is achieved through a scheme for the integrated operation of a number of reservoirs on that river and on its tributaries for the purpose of irrigation, hydropower generation and flood protection. Of particular interest is the recent change in policy towards a multi-disciplinary approach for the planning and management of water resources in general, and the recognition in particular of the need for increased emphasis on non-structural measures for the management of floods, to be achieved through a shift of strategy towards efficient management of flood plains, flood proofing and forecasting, and flood insurance. This is complemented with information on the main functions of the "Damodar Valley Reservoir Regulation Committee (DVRRC)"; and the description of the flood forecasting network for the Damodar river basin. The study also contains some practices/lessons with potential to be transferred/applied to other regions.

1. Location

The National Commission on Floods (1980) assessed the flood prone area in India as 40 million ha (12% of the total area). Out of the total area liable to floods, about 80% (32 million ha) could be provided with reasonable protection, and about half of this surface has so far been provided with a reasonable protection through various means of flood management measures.

One of these areas is the Damodar River basin. It is entirely situated in the two states of Jharkhand and West Bengal of India. The catchment area is about 22,000 km², of which about 19,000 km² are in uplands and 3,000 km² of very fertile irrigated plains. The Damodar is a shallow, wide, seasonal and flashy river. The entire left bank area includes important industrial towns and coal mines, as well as vital means of communications. The destructions it causes have earned the Damodar the name of "the river of sorrow", since it can produce much distress and losses in both states.

The total population of the area affected from Damodar floods may presently be around 8.9 million.

2. Nature of floods

The catchment area of the Damodar river experiences seasonal rains due to the South-West Monsoon every year and depending upon the intensity of the storms, floods occur. During the monsoon season, the rainfall in the area is mainly due to either the passage of depressions over and near the area or active monsoon conditions. The normal track of the monsoon depression from Bay of Bengal towards the West Bengal lies to the south of the Damodar valley.

A heavy storm preceded by another storm normally causes flooding in the West Bengal area, mainly due to silting process having going on for immemorial times. Thus, the cross-section of the lower Damodar in the delta area has become considerably shallower, thus reducing its drainage capacity.

The maximum flood in the Damodar River recorded in the pre-dam period was in August 1913 with a peak flow of 18,406 m³/s (before the implementation of the Damodar Valley Scheme - see below). The all-time high combined inflow to the dam system observed in the valley occurred in

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September 1978 with a peak flow of 21,900 m³/s; needless to say that without these dams which comprise the above scheme the whole area would have been devastated.

3. Flood and water management measures

The challenge of taming the Damodar seems to have engaged attention for some considerable time already since the early 18th Century, when embankments were built for flood protection purposes. In 1863, the Government of India investigated the possibility of flood control by means of reservoirs in the upper reaches of the river. The scheme was not accepted on the grounds that the financial investment was disproportionate to the benefits envisaged. Subsequently, a number of disastrous floods since 1900 revived continuous deliberations on the issue, but it was the disaster caused by a flood in 1943 which led to the preparation of a project, primarily for the control of floods and secondly for the development of water resources for various other uses, e.g. power, irrigation, navigation, and water supply for industrial and municipal uses. This project was approved in 1947, to be implemented through the *Damodar Valley Corporation* (DVC), which came into existence in 1948.

The multiple objective of the scheme is achieved mainly through a set of reservoirs at five sites on Damodar and its tributaries. It was implemented in two phases (four dams constructed during 1953 to 1959 and one in 1978). Besides flood protection, the whole system was expected to provide committed annual irrigation of 364,000 ha besides water for industrial and domestic uses.

The main dams comprising the Damodar Valley Scheme have served their purpose of moderating the flood flows, showing that a tangible reduction to the extent of 53 to 80% has been achieved in the high flood years. However, as indicated before the reduced channel of the lower Damodar in cases is not capable of carrying the regulated discharge.

In the absence of frequent floods of higher intensities as a result of the above scheme, the lower Damodar valley gained great value and importance due to a false sense of security and there has been extensive encroachment into the flood plains. The Government of West Bengal realised the importance of the productive value of the flood plains of Damodar, given the density of population and high level of investment on flood plains; in addition, that such protection can only be imparted at great expenses and at the cost of denying the productive use of flood prone land. While there are losses in the high flood years, the flood plains are utilised gainfully by the people living in the area during the low flood years. The approach, therefore, has been to "bear the losses" at the time of flood disaster while enjoying the benefits of the land during the rest of the time.

4. Institutions responsible for flood management

The integrated operation of all structures is done by the *Damodar Valley Reservoir Regulation Committee* (DVRRC) headed by *Member (River Management)*, *Central Water Commission* (CWC), with representatives each from DVC and the states of Jharkhand and West Bengal.

The overall objectives of DVC are the promotion and operation of schemes for irrigation and drainage; water supply; generation, transmission and distribution of electrical energy (both hydropower and thermal); flood control; navigation; forestation and soil erosion; etc.

The main functions of DVRRC are to discuss and lay down the principles for smooth and effective regulation of the reservoirs, including improvement in the carrying capacity of the Lower Damodar Channel, creation of additional storage in the DVC system and conflict resolution. The Committee directs the storage into, and releases from the DVC reservoirs on a day-to-day basis, as well as the distribution of stored water to DVC and the Government of West Bengal for power generation, irrigation and industrial/domestic uses.

The DVRRC is assisted by the CWC, which maintains a flood forecasting network system and provides inflow forecasts. The network for the Damodar River Basin comprises five stations for



which level and inflow forecasts are issued. For the lower Damodar stage/discharge and data from three reference stations and information of two reservoirs are used for the formulation of forecasts. In addition, a mathematical model was developed and adopted for use in the Damodar Basin in 1986.

A reservoir manual prepared by CWC is utilised for integrated regulation of the reservoirs for flood management and other purposes.

Conflicts amongst the states and DVC, as well as between the interests of flood control, irrigation and power sectors are resolved by the DVRRC by holding a number of annual meetings. The stakeholders/users are involved only indirectly, since the composition of DVRRC includes solely the government departments' representatives, who get the brief from the public representatives (Members of Parliament and local politicians) and attend the meetings of the DVRRC.

In the event of extreme flood events and eventual disaster, the affected states and the central governments initiate action for relocating the people, cattle and limited moveable properties to safe areas and providing them with relief items. The District Magistrates from the state administration coordinate all concerned agencies. The Crisis Management Group under the Ministry of Home coordinates at central level and monitors the disaster situation and recommends central relief funds to the state governments.

5. National policies

As of 1947 the general policy adopted by the state governments of India was that the flood plains were to be utilised gainfully by the people living in these areas during the low flood years. This emerged from the necessity to safeguard the interests of already densely populated flood plains and the difficulty envisaged in the uprooting and resettlement of the flood plain occupants who were living off the flood plains; furthermore, that it was considered more beneficial to accept occasional flood losses against large benefits accruing out of the use of flood plains.

As a result of one of the highest flood events (1978) in India, the *National Commission on Floods* in 1980 put forth 207 recommendations as a comprehensive measure of flood management in the country. These included, amongst others, a dynamic and flexible approach to the problem of floods, as part of a comprehensive approach for the utilisation of land and water resources. Furthermore, that measures to modify the susceptibility of life and property to flood damage should have priority.

In 1999, equally important were the recommendations by the *National Commission for Integrated Water Resources Development and Management Plan* regarding flood management, through a shift of strategy towards efficient management of flood plains, flood proofing and forecasting, and flood insurance. Furthermore, that the network of flood forecasting and warning be extended to remaining flood prone areas.

Finally, the *National Water Policy* of India, formulated in 1987 and then revised in 2002, lays down policies with regard to water resources development and management, to be achieved through an integrated and multi-disciplinary approach to the planning, formulation, clearance and implementation of projects, including catchment area treatment, environmental and ecological aspects, the rehabilitation of affected people and area development. As regards flood protection, while physical works like embankment and dykes will continue to be necessary, increased emphasis should be laid on non-structural measures for minimisation of losses and to reduce the recurring expenditure on flood relief.



6. Main lessons learned

- The main dams comprising the Damodar Valley Scheme have served their purpose of moderating the flood flows. However, the lower Damodar channel is not capable of carrying the regulated discharge. The need is therefore underlined for an immediate solution of the problem of drainage congestion of lower reaches, in order to derive the maximum benefits of flood moderation. This also highlights the need for integrated flood management with coordinated development and management of water, land and related resources in the basin/sub-basin.
- From the policy changes it has been recognized that structural measures alone should not be the strategy for tackling the problem of floods, but rather a mix of structural and non-structural measures, with the latter to be the backbone of the programme for flood management.
- The DVC is acting as a River Basin Organisation and is successfully implementing the concept of integrated water resources management, through the development of irrigation, power generation, flood control and water supply facilities, while applying environmental protection measures in an integrated manner. The DVC is self-sufficient and self-sustaining. Models like DVC might be replicated and appropriate River Basin Organisations could be established for the integrated planning, development and management of other river basins, taking into account the needs of different uses of water with a multi-disciplinary approach.