



# DAMODAR BASIN WATER MANAGEMENT SYSTEM - A REVIEW ON CRITICAL ISSUES AND PERFORMANCE

**SATYABRATA BANERJEE**

*Chief Engineer (Civil), Damodar Valley Corporation, Dhanbad, Jharkhand, India*

## ABSTRACT

*Century-long effort of taming the highly destructive turbulent Damodar river during floods and utilizing its huge water resources ultimately resulted the formation of Damodar Valley Corporation (DVC) in the year 1948 just after independence by an act of Parliament. An important national responsibility of taming the river with monitoring and developing this large river basin in an integrated manner for the well-being of the people of the valley was assigned to DVC. This article elaborates briefly about the performance of DVC in last 71 years along with the several criticism of DVC, time to time in operation of its reservoirs. The article explains about the limited resources of DVC due to the non-implementation of the entire scheme, as originally planned along with the haphazard development, major technical, financial & other socio-economical constraints. With a review of the system, the article proposes for taking up various measures such as modernization of operating system, repair & rehabilitation activities, changes in old operational guidelines etc. Measures already taken up by DVC for the betterment of the water management system to achieve the maximum benefits from the existing system in the present & future scenario have also been elaborated in the article.*

**Key words :** Basin Management, Criticism, Constraints, Review, Rehabilitation.

## 1. INTRODUCTION WITH BRIEF HISTORY

Damodar Valley Corporation (DVC), one of the first multipurpose integrated river valley projects of independent India came into existence on 7th July 1948 by an Act of the Central Legislature. The statutory functions of DVC with prime objectives according to the Act XIV (1948) of Parliament assigned were as under:

- (a) Promotion and operation of schemes of flood control;
- (b) Promotion and operation of schemes for irrigation, water supply and drainage;
- (c) Promotion and operation of schemes for generation, transmission and distribution of electrical energy both hydro and thermal; and
- (d) Promotion of afforestation and control of soil erosion;
- (e) Promotion in public health, agriculture, industrial activities and general well-being in the Damodar Valley and its adjacent area of operation.

The Damodar river was a mighty force for the civilization, sustained on its banks for ages. The river Damodar itself has remained as a part of life of the people of the Damodar Valley area covering the States of Bihar and West Bengal. Due to its typical character, errant and often destructive, it became a subject even of myths, fables and rhymes for children. With the passage of time, the river's benevolence was withdrawn from the people as it developed a destructive nature. The proverb 'Sorrow of Bengal' was then attached to its name.

This river had been causing huge damages to public properties and crops in the densely populated Lower Damodar area with its flash floods frequently over the years. A large no of floods, major to medium occurred in regular intervals. Some of the major floods recorded, were in the years 1730, 1823, 1840, 1877, 1913, 1935, 1939, 1943 etc. The flood of 1943, which caused huge damage of properties worth about Rs 8.0 Crore, at that time, inundation of a large area for about 10 weeks attracted the pointed attention of people & administration and the then British Govt. of Bengal- finally set up 'Damodar Flood Enquiry Committee' under the chairmanship of 'Maharaja of Burdwan' with eminent personality like Dr. Meghnad Saha. Committee recommended for the creation of an organization like Damodar Valley Authority (later on-corporation) in line of Tennessee Valley Authority (TVA) of USA. Since then, DVC started functioning as an autonomous body of Govt. of India, with stakeholders as States of Governments of West Bengal & Bihar (now Jharkhand).

For Century-long effort of taming the highly destructive turbulent Damodar river during floods & utilizing its huge water resources, the Planners of Tennessee Valley Authority (TVA), USA, engaged by Govt. of India as Consultant, proposed a scheme of construction of 7 multipurpose dams at Konar, Aiyar, Bokaro, Panchet, Tilaiya, Deolbari & Maithon with a Barrage & canal network system and a diversion dam at Bermo.

But due to huge cost involvement, the total scheme was divided into two phases for implementation. Under Phase I, construction of four dams at Maithon, Panchet, Tilaiya and Konar with hydel stations, a Barrage at Durgapur with Canal Systems, Bokaro thermal power station with transmission and distribution system were proposed. Under Phase-II, construction of remaining three dams at Aiyar, Deolbari, Bokaro & a diversion dam at Bermo. After the close scrutiny by the technical experts and the participating State governments, it was decided that the second phase of DVC project shall be considered for implementation only after observing the success and benefits with full utilization of the dams already constructed under first phase. Later on the then Govt. of Bihar constructed Tenughat Dam on river Damodar with the consent of DVC at the upstream of Panchet dam, at the originally planned site of Aiyar dam as envisaged for 2nd phase of construction of DVC Dams.

Operation & Maintenance of Durgapur Barrage along with the Canal system was handed over to Govt. of West Bengal by DVC in 1964 on agency basis. However, the ownership of same still remains with DVC. Drainage system of Lower Damodar area below Durgapur Barrage also comes under the jurisdiction of Govt. of West Bengal.

DVC dams are operated by a Committee named Damodar Valley Reservoir Regulation Committee (DVRRC), headed by Member (River Management), Central Water commission (CWC), New Delhi with members from the States of West Bengal, Jharkhand & DVC in the rank of Chief Engineers. On behalf of DVRRC, Member Secretary, CWC, posted at Maithon issues all the release advises for DVC dams during Monsoon as well as in Non-Monsoon period. DVC acts as an operator of dams on advice of DVRRC and has no direct role to play in release of water from dams.

## 2. DAMODAR RIVER AND BASIN

The Damodar river originates from the Palamu Hills of Chota Nagpur at an elevation of about 2000 ft. (610 m) above mean sea level. It flows in a south-easterly direction, entering the deltaic plains below Ranigunj in Burdwan district of West Bengal. Near Burdwan the river abruptly changes its course to southerly direction and joins the Hoogli river about 48 km below Kolkata. The river is fed by six streams of which the principal tributary Barakar joins it where river Damodar emerges from the Hills to plains. In the plains, the river splits into several channels, known as hanas and ultimately joins the river Roopnarayan & Hoogli. The main channels, which presently carry most of the discharge, are Amta and Mundeswari channels. The total length of the river is about 541 km.

The total catchment area of the river is 22015 sq-km, of which 17818 sq-km is the catchment of the upper Damodar upto its confluence with Barakar river. A fan shaped upper catchment of about 19,555 sq-km upto Durgapur barrage discharges into a narrow shaped long catchment of lower Damodar area of 2460 sq-km. The mean annual rainfall in different catchments of the Damodar Valley are Barakar 126 cm, Damodar 127.2 cm. and lower valley 132.9 cm. The 82% of mean annual rainfall occurs during the four monsoon months from June to September. The rainfall in this area during the monsoon season is mainly due to the passage of depressions and lows over and near the area and the active monsoon conditions due to accentuation of the seasonal trough. The normal track of the monsoon depression from Head Bay towards Orrisa-West Bengal Coast in the west-northwest direction lies to the south of the Damodar Valley area. Heavy to very heavy rainfall occur in the valley due to monsoon depression from Head Bay moving northwest or west-northwest and passing over or near the catchment area and land low developing over Gangetic West Bengal or Bihar Plateau (Refer Figure - 1)

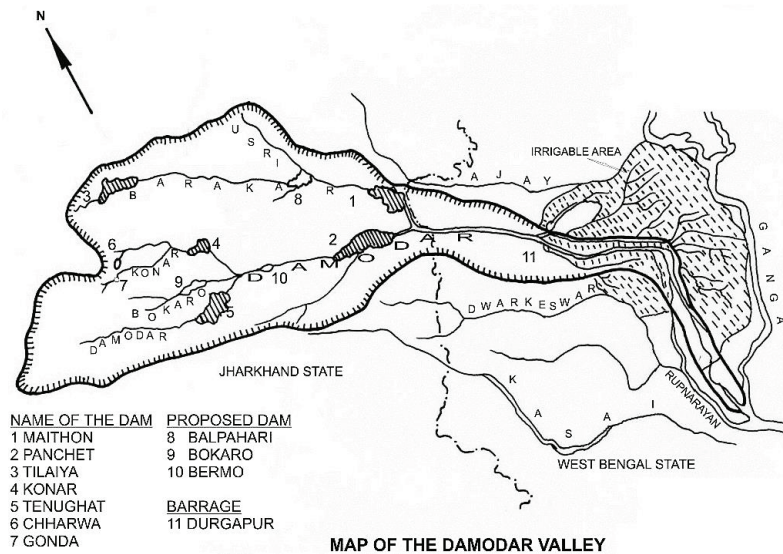


Figure 1 : Map of Damodar Valley.

### 3. PERFORMANCE OF DVC

#### 3.1 Flood Control

Even with the reduced flood storage capacities (about 36% of originally planned), DVC has managed to moderate a large number of floods in post dam era to a great extent as elaborated in Table-1.

**Table 1 :** Moderation of Some Major Floods by DVC

Period	Combined Peak Inflow	Combined Peak Outflow	Flood Moderation
	cusec	cusec	cusec
Oct 1959	6,23,000	2,88,000	3,35,000
Oct 1961	5,16,000	1,60,000	3,56,000
Oct. 1973	5,88,000	1,75,000	4,13,000
Sept 1978	7,74,000	1,63,000	6,11,000
Sept 1995	6,19,000	2,50,000	3,69,000

As one of the remarkable achievements, DVC reduced the flood intensity of 1978 flood from a peak inflow of 7.74 lakh cusec to an outflow of 1.63 lakh cusec only. Please note that if this flood of 1978 was allowed to pass without any moderation from DVC dams, it would have generated a flood peak of 11,80,000 cusec at Durgapur Barrage, which is more than the total design flood of DVC system i.e. 10,00,000 cusec as envisaged in the original plan and a total devastation with huge loss of properties, inundation with washing away of major cities like Burdwan, other small towns & villages, GT road, railway lines etc. in lower Damodar area could not be avoided.

#### 3.2 Irrigation

After the commissioning of the DVC project, the farmers in the command area are now in a position to cultivate 3 crops in a year, which could not be imagined in the pre-DVC arena. On an average water supplied by DVC annually for Kharif, Rabi (Winter crop) & non-committed Boro (Summer crop) irrigation are 1150 MCM, 86 MCM & 300 MCM respectively. Only kharif Irrigation in Lower Damodar area has been extended from 89000 hectares in pre dam period to now about 3,34,000 hectares against a target of 3,93,000 hectares.

#### 3.3 Water Supply for Municipalities & Industries

A dependable supply of water & electricity by DVC in a highly rich coal belt area attracted many industries to grow in the valley area. Currently DVC supplies about 620 MCM of water annually, to about 141 various industrial & municipal agencies within the valley, which includes, Durgapur Steel Plant, Durgapur Projects Ltd., Thermal power plants of DVC, Jharia Water Board, PHED, Govt. of West Bengal & Govt. of Jharkhand, Dhanbad, Asansol, Raniganj & Durgapur Municipalities, Railways, Collieries & various other industries in the area.

#### 3.4 Power Generation

When the second phase of DVC dams and hydel power plants could not come up, DVC had to switch over to a large scale thermal power generation to earn revenue to fulfil all its prime objectives of national importance. With the growth of the heavy industrial activities in the region, the power demand increased abnormally in the valley area. Railways, Steel plants at Jamshedpur, Durgapur, Bokaro, IISCO, TISCO, Sindri Cements & Fertilisers, Coal Industries etc. all placed their demands to DVC for power time to time and DVC had to continuously augment its capacity to meet up the power demands of the region. This also helped DVC to grow as a financially sound organization, when it could not get any direct financial assistance from any stakeholder except the initial capital investments of Central & participating State governments.

Emphasis on power aspect gained more momentum in last ten years and on the instruction of the Ministry of Power, Govt. of India, DVC enhanced its thermal power generation capacity to 7090 MW during 11th & 12th Five Year Plans. Beside this the hydel power generation capacity is 147.2 MW. As a result, DVC now stands as one of the major Power Generating Units of the eastern region of the country.

#### 3.5 Soil Conservation, Social Integration and other activities

In addition to the above major activities, DVC has also given much attention to the conservation of soil & maintaining the ecological balance of the region and for this purpose a separate department has been functioning, since the inception of DVC project in 1948. Various watershed management activities like afforestation, construction of check dams, soil surveys, terraced cultivation etc. have been taken up on sub-catchment basis as per the standard guidelines.

Further DVC is involved in various developmental activities in the surrounding villages of its major project, to improve the quality of life of the inhabitants. Some of the major activities performed by DVC in this line are construction or renovation of School buildings, roads, culverts or bridges, construction of community centres, street lighting, water supply, health care centres or dispensaries, arranging NGOs to impart various training programs to villagers for health

care, cottage industries, farming etc. Many other activities related to recreation, fisheries, tourism etc. have also been encouraged by DVC.

#### **4. CRITICISM OF DVC, ISSUES**

DVC is generally criticized for some issues, which are highlighted as below.

##### **4.1 Man Made Flood by DVC**

DVC is often criticized for creating man made floods in the lower reaches of Damodar in the districts of West Bengal. It is not correct, as severe constraints of DVC system are never reviewed and taken into account during such criticism. Some major constraints in this regard are as under:

###### **4.1.1 Inadequate Storage capacity in DVC Reservoirs**

In the original plan of DVC, it was envisaged that Damodar Catchment has the ability to generate a max. peak flood of 28317 cumec (10 lakh cusec). To moderate this flood peak to a safe channel capacity of Lower Damodar area, considered as 7079 cumec (2.5 lakh cusec), a total flood storage of 3596 MCM in 7 (seven) storage dams was to be developed. But under first phase, only 4 nos Dams at Tilaiya, Maithon, Konar & Panchet with a barrage at Durgapur with a canal system of length 2500 Km was completed by the year 1959. It was decided that after reviewing the performance of 1st phase of DVC dams, construction of remaining 3 dams will be taken up. Under the first phase of DVC project commissioned in 1959, a total flood storage of 1863 MCM could be developed with the construction of 4 dams. Within the flood storage of major dams of DVC, Maithon & Panchet Dams, land could not be acquired upto the max. water levels of these dams, resulting a further reduction of flood storage capacity to 1291 MCM (Land could not be acquired at Maithon for 5 ft. and at Panchet for 10 ft. in flood cushion). So in fact only 36% of flood storage with respect to original plan was made available in DVC system for moderation of floods, which was grossly inadequate considering the flood generation capacity of Damodar catchment. So in fact where high to very high magnitude floods are concerned, DVC is dangerously situated like a volcano with a grossly inadequate flood storage system.

###### **4.1.2 Drastic Reduction in Lower Damodar Channel Capacity to Carry Flood Discharge**

Due to the reduction in occurrence of frequent floods and the reduction in magnitude of floods in Lower Damodar area after the commissioning of DVC dams, various human activities in the flood prone area of Lower Damodar increased to a great extent. People have become confident to start various activities in the area such as cultivation, fish farming, even encroachment of the area for habitation, construction of houses etc. Practically, there were no control over these human activities over the years.

Damodar river bifurcates into 11 nos different channels below Surekalna & Beguahana below Durgapur Barrage. Presently, only the Channels named Amta and Mundeswari carry most of the discharges during floods. All other channels have been totally defunct and silted up. Amta channel is capable of discharging max upto 25,000 cusec into Hoogli river and Mundeswari Channel is capable of discharging max upto 1,00,000 cusec into Roopnarayan river. So the maximum capacity of discharging flood water by lower Damodar channels are only 1,25,000 cusec (3539 cumec) and that too under favourable conditions with no heavy rainfall in lower Damodar area and no tidal effect.

So above specified human activities and siltation of various channels have resulted a drastic reduction in the lower Damodar channel capacity to about 50% below Durgapur Barrage with respect to original capacity envisaged as 2.5 lakh cusec.

###### **4.1.3 Tidal Effect, Sedimentation of Channels & Outfalls at Roopnarayan & Hoogli Rivers**

Further under adverse conditions, like Tidal affect at the outfalls of river Roopnarayan & Hoogli, synchronizing with heavy rainfall in Lower Damodar area due to cyclonic circulations, even a small magnitude of flood release of even 2831 cumec (1.0 lakh cusec) or less from DVC dams, inundates some of the low lying areas like blocks Khanakul, Udainarayanpur-1 & 2, Arambag, Amta, Pursura of Hoogli & Howrah districts of West Bengal. Further heavy siltation of rivers Roopnarayan and Hoogli at the outfall points of Damodar channels also create problem in the quick discharge of flood water through Damodar channels.

###### **4.1.4 Tenughat Dam**

After the construction of 1st phase of DVC dam, the then Govt. of Bihar constructed Tenughat dam on Damodar river with the permission of DVC. This dam was envisaged as one of the 2nd phase of DVC dams in original plan. The dam was completed and commissioned in 1980, but it could not be developed to its full potential, as land could not be acquired for flood storage. The dam is being utilized only for the purpose of supplying Municipal & Industrial water. Further this dam is operated by the Govt. of Jharkhand (earlier Govt. of Bihar) and could not be included in the unified operation of DVC reservoirs. Sudden releases from this dam during Monsoon often distorts the flood operation of Panchet Dam in lower reaches as well as the total combined flood operation as a whole. However, as per the recent agreement in DVRRRC, this dam is to be included in the unified operation of DVC system shortly.



#### **4.1.5 Uncontrolled Catchment below Maithon & Panchet dams:**

Control of DVC exists only upto the main storage dams at Maithon on Barakar river and Panchet at Damodar river. Barakar is the main tributary of river Damodar which meets Damodar just about 4.0 Km downstream of Maithon Dam. Below these dams, DVC constructed a barrage at Durgapur as diversion structure for supplying water to left & right bank irrigation canals and it has no role to play during floods. So below these dams of DVC, there exists an uncontrolled catchment of 2995 sq-km including the catchment of Khudia river upto Durgapur barrage and further 2460 sq-km below Durgapur barrage to outfall at Roopnarayan river. This catchment with no control structure in plane land can itself produce a flood intensity of about 2,00,000 cusec (5663 cumec), under heavy rainfall during cyclonic circulations centered in lower Damodar area, as observed in Sept.1978 flood. DVC has no control over this catchment of 2995 sq-km.

#### **4.1.6 Conclusion on Man Made Flood:**

DVC dams are operated very systematically & scientifically as per Damodar Valley Reservoir Regulation (DVRR) Manual by DVRRRC, an expert Committee as stated above. Release of water in Monsoon during heavy rainfall & cyclonic circulations can never be stopped from DVC dams, as the safe release of 2,50,000 cusec was considered even in the original plan of DVC with a complete system of 7 dams. Whereas as stated above, presently available storage in 4 DVC dams is only 36% of originally planned full flood storage. On the other hand, due to drastic reduction of lower Damodar Channel capacity, a small release from DVC dams even in the tune of 75,000 to 80,000 cusec sometimes inundates some low lying area due to very poor drainage condition of lower Damodar area and during that period unnecessary pressure is created on DVC for the absorption of entire flood inflow in reservoirs.

Releases from dams are natural phenomenon, as no dam can absorb the entire inflow of a severe flood, generated due to heavy rainfall during monsoon. So, releases from DVC dams during monsoon period can never be completely stopped or restricted. However, if the Lower Damodar channel capacity is increased to 2.0 lakh to 2.5 lakh cusec through a comprehensive drainage scheme by Govt. of West Bengal, issue of frequent inundation of low lying area of Lower Damodar due to floods of low to medium magnitude will be completely resolved. On the other hand, it is also true that in the absence of DVC dams, the situation of lower Damodar area could have been much more difficult & worst during flood periods.

So far “Man Made Floods” are concerned, drastic reduction of lower Damodar channel capacity due to various uncontrolled human activities in the flood zones of lower Damodar area including direct encroachment etc. and non-completion of DVC water system as per original plan, as stated above may be considered as reasons for “Man Made Floods” on these accounts and not on account of the present system of DVC.

In this regard, this is also to warn that people of the Lower Damodar area are really fortunate enough that a flood of very high magnitude similar to that occurred in the year 1913 have not occurred in the valley over the last 60 years of its operation, especially in the late monsoon period when the reservoirs levels are high at the top conservation levels. Under such situation, it will be practically impossible to avoid a total catastrophe with devastation of entire Lower Damodar area of Burdwan, Hoogli & Howrah districts of West Bengal, if a flood of high to very high magnitude, generated by a severe cyclone enters into DVC reservoirs. A serious thought in this regard is utmost necessary instead of criticism like Man Made flood etc.

#### **4.2 Release of Flood Without Intimation**

DVC is often criticized that prior intimation is not given before the release of flood water, which is absolutely incorrect.

As stated above, DVC dams are operated very systematically & scientifically as per “Damodar Valley Reservoir Regulation (DVRR) Manual” by DVRRRC, an expert Committee. As per DVRR Manual, before releasing flood water from DVC dams, flood warnings are issued well in advance (6 hours before) and all the data are communicated through electronic system to all concerned departments, district authorities and agencies. DVC website continuously show the extent of release of water from dams (with different colours such as red, orange, yellow, green for different intensity of releases from dams) and also show the time of reaching of flood water at different places such as Durgapur, Sadarghat, Surekalna, Champadanga & Amta, in the lower Damodar area. In general, after the release of water from DVC dams, it takes about 48 to 72 hours in reaching the low lying lower Damodar area depending on the magnitude of discharge. All data such as rainfall, run-off, release advises of Member Secretary, DVRRRC and actual magnitude of release with time etc. are communicated continuously on real time basis to Govt. of West Bengal Authorities well in advance and same are displayed digitally round the clock in their offices at Kolkata. It has never happened that water has been released from DVC dams without any prior intimation to Govt. of West Bengal authorities, as Chief Engineer, I&WD, Govt. of West Bengal is also a member of DVRRRC.

#### **4.3 Dredging of DVC Reservoirs**

DVC is often criticized for taking no action towards dredging of reservoirs for improvement of flood moderation. Observations of DVC in this regard are as under:

Sedimentation of reservoir is a natural phenomenon. DVC is monitoring the sedimentation of reservoirs on regular basis through sedimentation survey over the years. DVC dams were designed for a life of 75 years by considering full of dead storage of dams with sediment. However, in the operation of last 60 years, it is observed that total flood storage capacity reduced in two main DVC dams, Maithon & Panchet is in the tune of 14% only. Dead storage capacity and live storage capacity have reduced to 55% & 33% respectively over the years. An initiative was taken by DVC towards de-siltation of Panchet dam. DVC explored that the total cost of de-siltation of Maithon & Panchet reservoir come in the tune of Rs. 50,000 Crore as on date as a whole. Out of which, about Rs. 11,815 Crore only will be required for the de-siltation of flood storage area of both the dams, Maithon & Panchet and such expenditure will be of recurring nature and will have a negligible effect in moderation of flood, if the above issues of huge shortcomings in the DVC water management system are not addressed properly. While referred the issue of dredging to Central Water Commission (CWC), it was intimated to DVC that de-siltation of reservoirs of size like Maithon & Panchet is not techno-commercially viable, based on the reply of Minister of Water Resources, Govt. of India in Lok Sabha on 15.12.2011, against a Unstarred question no 3462 as:

Quote

*“The de-siltation of reservoir is not techno-economically viable as it is associated with the problems of disposal of excavated earth and high cost of repeated desiltation”*

Unquote

It may kindly be noted that DVC set up a Soil Conservation Department at Hazaribag, since its inception in 1948 and a lot of water shed management programs in the upper catchment of Damodar have been taken up by this department over the years. Under the activities, construction of about 17,000 rain water harvesting structures (check dams etc.) coupled with some drainage line treatment measures, land levelling programme etc. have been undertaken by DVC to create an additional storage capacity of 21,933 hectare-meter under minor irrigation schemes in an area of about 64,748 hectares, mostly in the upper catchment in the state of Jharkhand. These activities have not only helped in water harvesting, ground water recharge, irrigation etc. but also drastically reduced the sediment entry into the main reservoirs. As an example, only 55% of dead storage of DVC dams have been filled up in last 60 years, whereas as per design 100% dead storage is to be filled up in 75 years i.e. life of reservoirs. So in that respect, life of DVC reservoirs have been extended upto 110 years from design life of 75 years.

In view of above, criticism of DVC towards not taking up the dredging of reservoirs is not at all justified.

## **5. OTHER CONSTRAINTS OF DVC**

### **5.1 Haphazard Development & Conflict on Acts**

As per the DVC Act XIV of 1948, section-17, construction of any dam or any other works of extraction of water from the system is prohibited without the consent of DVC. But several such structures & dams have been constructed over the years in the upper reaches without the consent of DVC. Such activities not only affect the yield into the DVC reservoirs, but also create serious problem during monsoon. Similarly, several such irregular & unauthorized drawl of water from DVC system by various agencies, through construction of small weirs/structures in the upper reaches without the consent of DVC, mining & various other activities on the rivers & submergence areas over the years have also been noticed by DVC and reported to the concerned authorities. Similarly conflicts between the DVC act & State Acts such as State Irrigation Act etc. often create problem for DVC in levying revenue for bulk supply of raw water for irrigation, industrial and domestic purposes. An “Interstate agreement” was signed between the Govt. of West Bengal and Govt. of Bihar in July 1978 for sharing of DVC water between the states, which has not been implemented till now. But only one aspect of sharing of water of Konar & Tilaiya reservoirs by Govt. of Jharkhand is raised, without considering the other aspects of Agreement, such as land acquisition in Maithon, Panchet dams upto maximum water levels etc.

### **5.2 Financial Status of DVC**

The total capital investment for construction of 1st phase of DVC was from Central Govt., and State Govts. of West Bengal & Bihar (now Jharkhand) upto 1968-69 was Rs. 214.72 Cr (Rs. 56.08 Cr-Govt. of India, Rs 109.27 Cr.- Govt. West Bengal, Rs.49.37 Cr.-Govt. of Bihar). Thereafter no direct capital was provided by any of the participating Governments as per the provision of Section-30 of the DVC Act for the projects undertaken by DVC later on. However, DVC developed itself as a profit making organization before the 10th plan period with a recorded profit of about Rs. 1000 Cr in a financial year. But under the capacity expansion of 5000 MW thermal power projects during 11th & 12th Plan period, through a huge market borrowing from the financial institutions, DVC has been under tremendous financial crisis with debt burden and in fact not in a position to take up any major activities without the financial assistance of its stakeholder participating governments. Due to various reasons of delay in acquisition of land, law & order issues etc. the new plants could not be commissioned in time, which created a huge IDC (Interest during construction) burden on DVC. With the result DVC is incurring continuous loss for last 5 years and it has obviously a great impact on taking up any major activities towards improvement, rehabilitation, repair, operation & maintenance in Water Resources Sector to fulfil its very important mandates.

Further DVC is dealt simply as a power generating unit either during assessment of its performance or during imposition of regulations on power tariff etc., without considering the major important mandates or functions of DVC as per DVC Act towards reservoir operation for flood control, supplying water for irrigation, municipalities, industries, various welfare activities etc., where there is no other major source of income for DVC except through generation of power.

## **6. STEPS FOR IMPROVEMENT IN WATER MANAGEMENT SYSTEM AND ACTION TAKEN BY DVC:**

An overall review and study of basin management system by taking into account all the constraints of DVC, some of the steps to be taken or already taken by DVC for the improvement of Water Management system are elaborated briefly as under:

- (a) Land acquisition upto Maximum water levels in Maithon & Panchet reservoirs to utilize the total flood storage already developed under 1st phase of constructions of DVC dams. No significant steps have been taken in this regard till now.
- (b) Improvement in the drainage condition of lower Damodar area with structural & non-structural measures. Structural measures such as de-siltation of channels, interconnection of channels, construction of embankments etc. and & non-structural measures such as flood plain zoning, flood proofing measures, rehabilitation measures, appropriate flood fighting steps, disaster preparedness and response planning etc. Govt. of West Bengal has already taken up a comprehensive scheme towards improvement of drainage condition of lower Damodar area.
- (c) Augmentation in the storage of DVC water system for better flood moderation and fulfilling the future demands of water in the valley area. DVC has already proposed the construction of Balpahari dam, one of the second phase of DVC dams as originally planned. A DPR was prepared by DVC in 2012 through CWC. This project has been found techno-economically viable. As per DPR, the reservoir under Balpahari project will has a live storage of 715.61 MCM and 414.81 MCM water will be available towards M&I uses. The estimated life of the project is 70 years. Irrigation in 35,478 Ha of land and supply of municipal & industrial water to a population of 2,61,644 in the State of Jharkhand have been envisaged through this project. This will also enhance the life of Maithon reservoir by another 50 years, which fulfils 70% of downstream requirement in West Bengal during non-monsoon period. But the consents of stakeholders are yet to be obtained. Further all the technical, financial and administrative issues for taking up the project by DVC are also to be decided.
- (d) Land acquisition upto Maximum water level in Tenughat dam to utilize its huge flood storage capacity is utmost necessary along with its inclusion in the unified operation of DVC reservoirs through DVRRC. Repair, renovation & rehabilitation of this dam is also necessary.
- (e) Modernization of real time data collection system, flood forecasting system and decision making system for an efficient operation of integrated water system of DVC is very much necessary. However most of such activities have already been taken up by DVC, through World Bank funded, National Hydrology Project (NHP) of Govt. of India. The aim of the projects under NHP is to strengthen the hydrological information system with a view to develop web based flood forecasting system, river basin management, Real Time Data Acquisition System (RTDAS) and Real Time Decision Support System (RTDSS).
- (f) Rehabilitation, repair & improvement of all dams of DVC with respect to electro-mechanical parts such as crest gates, intake gates, gantry crane, undersluice gates etc. are necessary for efficient operation. In this regard DVC has taken up all these activities of rehabilitation works of Maithon, Panchet & Konar dams under World Bank funded, Dam Rehabilitation & Improvement Project (DRIP) of Govt. of India. All the activities are in progress and will be completed by June 2020. Beside these activities, Operation & Maintenance manuals and Emergency action plan (EAP) for each dams are also being prepared and will be published finally.
- (g) Rationalization of use of water for Irrigation, Municipalities & Industries is also the need of the hour. Allocation of water for different uses must be reviewed in the present and future scenario of demands. Allocation of water to new industries should be done judiciously with a proper assessment of availability of water in the system for present & future uses. Loss of water in unlined irrigation canals through seepage and misuse must be reduced to increase the availability of water for future demands of irrigation & industries. Review of current irrigation patterns and crop rotation are necessary. Actual demand with respect to allocation of water in industries & municipalities should be reviewed on regular basis and advised for recycling of water for various uses.

## **7. CONCLUSIONS**

Prior to the developmental activities undertaken by the DVC, the river Damodar used to be known as 'River of Sorrow' due to its devastating floods, which inundated a large part of West Bengal almost every year. With the start of operation of DVC dams in 1959, not only the intensity of floods came down drastically, but a large area within its command in the districts of Burdwan, Hoogli of West Bengal became highly fertile and now popularly known as the 'Granary of India'(Rice Bowl of India). Socio-economical changes are quite visible in the entire valley area.

Unnecessary criticism of DVC without considering the actual facts & figures will not fetch any positive result in future. Instead of that much attentions should be given towards resolving the issues of acquisition of land for full utilisation of reservoirs, improvement of drainage condition of lower Damodar area, completion of whole system of DVC as originally planned, financial support to DVC etc. If some sincere efforts are given towards removing the shortcomings of the system, enormous benefits may be drawn from this year-old water management system of DVC. To achieve the national objective of well-being of the people of valley area, DVC desperately needs a full support administratively, technologically & financially from each of its stakeholders to make the system more dynamic and effective for the overall benefit of the people of the valley and Nation.

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