

Chapter-10

Cost Estimate, Benefit Cost Ratio and Financial Aspects

10.0 General

Damanganga – Pinjal link project consists of the following components:

- i A 851.50 m long composite embankment (concrete faced rock fill) - cum - concrete dam across river Damanganga near village Bhugad.
- ii A Power house at the toe of Bhugad dam with 2 units of 1.0 MW installed capacity each;
- iii A 618.20 m long composite embankment (concrete faced rock fill) - cum - concrete dam at Khargihill across river Vagh (a tributary of Damanganga river) near village Behadpada. A saddle dam of 400 m length and 25.92 m height with FRL 154.52 m is proposed on the left flank of the reservoir.;
- iv A Power house at the toe of Khargihill dam with 2 unit of 1.5 MW installed capacity;
- v A 17.488 km long connecting Bhugad reservoir with Khargihill reservoir.
- vi A 25.224 km long connecting Khargihill reservoir with Pinjal reservoir.

The Pinjal dam and the conveyance system beyond Pinjal dam is being planned by Water Resource Department, Government of Maharashtra and Municipal Corporation of Greater Mumbai (MCGM). As such the cost of Pinjal dam and the conveyance system beyond Pinjal dam has not been considered while working out the total cost of Damanganga – Pinjal link.

The Ministry of Water Resources has issued “Guidelines for preparation of Detailed Project Reports of Irrigation and Multipurpose Projects” in the year 2010. These guidelines have been followed in preparation of estimate of Damanganga – Pinjal link project.

The quantities of various material and works involved in the various components have been worked out based on the engineering drawings. To work out the rates of various items the rate analysis has been carried out using the rates of various materials, manpower etc from schedule of rates for South Gujarat region of Water Resource Department, Government of Gujarat for the year 2012-13. Rates for the items which are not available in the schedule of rates of Gujarat and Maharashtra, the rates for such items have been taken from schedule of rates of WRD, Government of Karnataka for the year 2012-13.

10.1 Classification of Units

The cost estimate of Damanganga-Pinjal Link Project has been broadly grouped into following units:

Unit – I- Head works: Includes the cost of Bhugad dam, Khargihill main and saddle dam, Spillway, energy dissipation works, outlets, intake structures and diversion works etc, and Bhugad – Khargihill tunnel and Khargihill – Pinjal tunnel; and

Unit – II: Canals: The link project envisages transfer of water through tunnels and no canals are proposed. As such no provision under Unit – II is required to be made.

Unit – III- Hydro-electric Installations: Bhugad dam powerhouse and Khargihill dam powerhouse.

Unit – IV: Navigation Works: Navigation is not proposed under this project, as such, no provision is required under this sub head.

The total cost of link project has been worked out as Rs. 274661 lakh at 2012-13 price level, which includes the cost of Implementation of Environmental Management Plan (EMP), Socio-economic Survey and Resettlement & Rehabilitation Plan. The abstract of cost of the project is given in Table – 10.1.

Table: 10.1
Abstract of Cost Estimate of
Damanganga – Pinjal link Project

Sl. No.	Unit	Amount (Lakh)
1	Unit I Head works	271130
2	Unit III Power house	3531
	Total	274661

The head-wise details are described in the following paragraphs:

10.1.1 Unit – I: Head Works

Unit - I includes the cost of the following components/structures of the project:

- i. Bhugad dam including concrete faced rock fill portion, concrete non-over flow section, spillway & energy dissipation arrangements, intake structure of Bhugad dam power House etc;
- ii. Khargihill main dam including concrete faced rock fill portion, concrete non-over flow section with construction sluices, spillway & energy dissipation arrangements, intake structure of Khargihill dam power House, and Khargihill saddle dam etc;
- iii. Bhugad – Khargihill tunnel; and
- iv. Khargihill – Pinjal tunnel.

Total cost of Unit-I: Head Works is estimated to be Rs. 271130 lakh. Details are given in Annexures 10.1 in Volume - II. The sub-head wise details are given below:

10.1.1.1 Direct Charges

The direct charges include the following sub- heads:

I-Works;

II- Establishment;

III- Tools & Plants;
IV- Suspense; and
V- Receipts & recoveries.

The details are described below:

I-Works

A- Preliminary: Provision under this sub- head has been kept to cover the actual expenditure incurred on various survey & investigation works, collection and procurement of data/ maps /remote sensing data, cost of consultancy works through various expert agencies, Environmental Impact assessment etc for preparation of this Detailed Project Report of Damanganga – Pinjal link project:

- (i) Topographical surveys & investigations;
- (ii) Hydrological & meteorological surveys;
- (iii) Geological & Geotechnical surveys;
- (iv) Construction material survey;
- (v) Borrow area survey;
- (vi) Seismic studies;
- (vii) Morphological studies;
- (viii) Sedimentation studies of reservoirs;
- (ix) Construction of access Roads to facilitate site investigations;
- (x) Procurement of data/maps;
- (xi) Procurement of Remote sensing data;
- (xii) Environmental Impact Assessment study;
- (xiii) Charges for consultancy works for various studies; and
- (xiv) Preparation of Detailed Project Report.

The total expenditure incurred under this sub- head has been worked out to Rs. 613 lakh. However, for detailed survey & investigations for establishing the final locations of different project components at pre construction stage, a lump-sum provision @ of 2% of I-Works has been considered under this sub-head, which works out to Rs. 5114 lakh. The details are given in Annexure 10.1.1 in Volume – V.

B- Land: Under this sub- head the provisions for cost of acquisition of land to be acquired for submergence and for construction of the project components, colonies, offices, stores, stock yards, working area and approach roads etc; compensation for private and forest lands, houses, solatium charges, standing crops and other immovable properties; cost of relocation of communication network; cost of Rehabilitation and Resettlement of PAFs etc. have been considered. The total provision under this minor head has been worked out to Rs. 63265 lakh. The details are given in Annexure - 10.1.2 in volume –V.

C- Works: Under this sub-head the provisions have been made to cover the cost of various components of Bhugad dam and Khargihill dam (both main dam and saddle dam): Concrete faced rock fill dam; non- overflow concrete dam; spillway; energy dissipation arrangements; various outlets and intake for dam toe powerhouse etc and cost of Bhugad – Khargihill and Khargihill tunnels and related components.

The design of various components of the project such as Concrete faced rock fill dam, non- overflow concrete dam, spillway, various outlets and intake for dam toe powerhouse, and tunnels etc. are carried out by various design Directorates of CWC as consultancy work. The quantities and the cost of the various components have been evaluated as per the drawings given by the Central Water Commission, New Delhi. The total provision under this minor head has been worked out to Rs. 147829 lakh. The details are given in Annexure - 10.1.3 in Volume - V.

K- Buildings: Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings and hostel accommodation for various categories of staff and offices, inspection bungalows, circuit houses, workshops, stores, sheds as well as other service buildings like hospitals, schools, police stations, post office & welfare centers etc. Total provision under this sub- head has been worked out to Rs. 12505 lakh. The details under this sub-head are given in Annexures – 10.1.4 in Volume – V.

M- Plantation: Under this sub- head, cost of proposed plantation in the colony areas, parks d/s of Bhugad and Khargihill dams, and along the

approach roads have been considered, which works out to Rs. 26 lakh. The details under this sub-head are given in Annexure – 10.1.5 in Volume – V.

O- Miscellaneous: Under this sub head provisions have been made to cover the cost of the following works:

- i. Capital cost of electrification; water supply, purification and distribution system; sewage disposal; medical equipments; fire fighting equipments; furniture and crockery for inspection bungalows and circuit houses; recreation facilities; initial camp equipments for hospital, primary & secondary schools, community centers etc.
- ii. R & M of above equipments/infrastructural facilities etc and inspection vehicles.
- iii. Provision has also been made for other miscellaneous items such as inaugural/ foundation stone laying ceremony, compensation to work men, visit of VVIPs/ VIPs and other dignitaries, documentation of technical records and project history including photographic records; security arrangements for dam sites, flood lighting, data processing machines etc. Total provision under this sub-head works out to Rs. 4114 lakh. The details are given in Annexure 10.1.6 in Volume – V.

P- Maintenance: Provisions have been made under this sub-head to cover the cost of maintenance of all works during the construction period. A provision of 1 % of the cost of I works less A – Preliminary, B- Land, O – Miscellaneous, M- Plantation, Q – Special T&P, X – Environment & Ecology, and Y – Loss on stock has been made, which works out to Rs. 1626 lakh.

Q- Special Tools & Plants:

The provision under the sub-head Q- special Tools & Plants has been made @ 25% of capital cost of major construction equipment and general purpose equipment. Full capital cost of inspection/ transportation vehicles has been added to the above cost to arrive at the total cost chargeable under this sub-head. The recoveries on account of resale value of Q- special Tools

& Plants is considered @ 75% of the capital cost of the major construction/general purpose equipment chargeable to Q- special Tools & Plants and 20% of the cost of inspection/transport equipment chargeable to Q- special Tools & Plants. The total provision under this sub-head works out to Rs. 8017 lakh. Details of the equipments suggested by CWC, New Delhi and the cost of these equipments chargeable to the project works are given in Annexure – 10.1.7 in Volume - V.

R- Communication: Under this sub-head necessary provision has been kept to cover the cost of approach roads to the dam sites, quarry roads, temporary roads in the work area, widening of existing roads in the near vicinity of the project area etc. The total provision under this sub-head works out to Rs. 650 lakh. The details are given in Annexure 10.1.8 in Volume - V.

X- Environment and Ecology: Provisions under this sub head have been made toward the cost of extensive management measures to sustain environment and ecology such as catchment area treatment, compensatory afforestation, soil erosion control and water conservation measures, reservoirs rim treatment/green belt development, land management plan (stabilization of muck disposal sites etc), restoration of quarry sites, tourism development plan, provision for free fuel to laborers, Bio-diversity management plan, restoration and land scapping of project sites, fisheries development plan, ground water management plan, Public Health management, implementation of Environmental monitoring programme (EMP), and Dam break Disaster Management plan etc. The total provision under this sub-head works out to Rs. 12168 lakh. The details are given in Annexure 10.1.9 in Volume – V.

Y. Losses on Stock and Unforeseen Items: Provision under this sub- head has been made @ 0.25% of the cost of I- works less A- preliminary, B- land, O- miscellaneous, M- plantation, P- Maintenance, Q- special Tools & Plants, and X - Environment and ecology. The total provision under this sub-head works out to Rs. 403 lakh.

The total cost of I-works of Head works (Unit – I) worked out to Rs. 255717 lakh.

II-Establishment

Damanganga – Pinjal link project is planned to be completed in a period of 7 years. Provision towards establishment charges has been made @ 8 % of I-Works excluding B- land. The total provision under this sub-head works out to Rs. 15396 lakh.

III-Ordinary Tools & Plant

Provision has been made under this head @ 1% of I-Works towards ordinary Tools & Plants to cover the cost of survey instruments, camp equipment and other small tools & plants. This provision is distinct from the Q- special Tools & Plants. The total provision under this sub-head works out to Rs. 2557 lakh.

IV – Suspense

It is assumed that all the outstanding suspense would be cleared by adjustment to appropriate heads on completion of the project. As such no provision has been kept under this head.

V- Receipt & Recoveries on capital account

Under this head estimated recoveries by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical installation, telephone lines, water supply fittings, and other accessories, miscellaneous receipt like rent charges of buildings are accounted for and provision has been made accordingly. The total provision under this sub-head works out to Rs. 7273 lakh.

10.1.1.2 Indirect Charges

Provisions for abatement of cost of land revenue @ 5% of cost of culturable land and Audit and account charges @ 1% of I-Works have been kept under 'Indirect charges'. The total indirect charges works out to Rs. 4732 lakh.

The total cost of Head works (Unit-I) works out to Rs. 271130 lakh.

10.1.2 Unit – III: Hydroelectric Installation

Damanganga-Pinjal link project envisages construction of two power houses: one each in the downstream of Bhugad dam (2X 1.0 MW) and Khargihill dam (2X1.5 MW).

Provisions for expenditure towards installation of these two power houses, penstocks, switch - yards, tail race channel, various electro-mechanical equipments, transmission lines etc have been made under Unit-III “Hydro electric installation”. Total cost of unit – III for Bhugad and Khargihill powerhouses is estimated to be Rs. 3531 lakh at 2012-13 price level. The details are given at Annexure 10.2 in Volume - II. The sub-head wise details are given below:

10.1.2.1 Direct Charges

I – Works

A- Preliminary: Provision for preliminary surveys & investigations works carried out to arrive at optimum designs for the project components including consultancy charges for Power Potential and E&M studies at DPR stage and design works at pre construction stage has been made at 1% of I-Works Under this sub-head. The total provision under this sub-head works out to Rs. 37 lakh.

B- Land: Provision for acquisition of land for construction of power houses, Penstocks, Switchyards, Tailrace Channel, approach roads etc have been considered in the cost of Head works (Unit – I).

J- Power Plant Civil Works: Under this sub head, provision has been made towards civil engineering structures comprising of intake structure, penstocks, power house complexes and tail race channel etc. The total provision under this sub-head works out to Rs. 1041 lakh. The details are given in Annexures - 10.2.1 in Volume – V.

P- Maintenance: Provisions have been made under this sub-head to cover the cost of maintenance of all works during the construction of power houses. A provision of 1% of the cost of I-works less A-Preliminary, B-Land, and Q- special Tools & Plants has been considered. Total provision under this sub- head has been worked out to Rs. 32 lakh.

Q- Special Tools & Plants: No separate equipments for construction of Bhugad and Khargihill powerhouse complex have been provided as equipments deployed for concrete dams shall be utilized for construction of power houses also. As such no provision under this sub-head has been made.

S- Power Plant & Electromechanical Works: The provisions under this sub-head have been made towards the cost of power plant equipments, switch yard, transmission lines and other items connected with the installation at both the power houses. The E&M studies/ designs of both the power houses have been carried out through THDC Ltd Rishikesh. Provisions made under this sub-head for various components are based on the E&M studies carried out by THDC ltd. The total provision under this sub-head works out to Rs. 2092 lakh. The details under this sub-head are given in Annexure 10.2.2 in Volume – V.

Y. Losses on Stock and Unforeseen Items: Provision under this sub- head has been made @ 0.25% of the cost of I- works less A- preliminary, B- land, P- Maintenance, Q- special Tools & Plants. The total provision under this sub-head works out to Rs. 8 lakh.

The total cost of I –works of Unit – III (Hydro- electric Installation) works out to Rs. 3210 lakh.

II-Establishment

The two power houses proposed under Damanganga – Pinjal link project are planned to be completed in a period of 15 months. Provision towards establishment charges has been made @ 8 % of I-Works excluding B- land. The total provision under this sub-head works out to Rs. 257 lakh.

III- Ordinary Tools & Plant

Provision has been made under this head @ 1% of I-Works towards ordinary Tools & Plants to cover the cost of survey instruments, camp equipment and other small tools & plants. This provision is distinct from the Q- special Tools & Plants. The total provision under this sub-head works out to Rs. 32 lakh.

IV – Suspense

It is assumed that all the outstanding suspense would be cleared by adjustment to appropriate heads on completion of construction of the power houses. As such no provision has been kept under this head.

V- Receipt & Recoveries on capital account

No provision for special T&P has been kept under the sub-head Q-Special T&P. Also the provision for K- Buildings has been considered in the cost of Head works. As such there will be no recoveries on the account of resale of special T&P and also buildings.

10.1.2.2 Indirect Charges

The provision of B- land and abatement of cost of land revenue has been considered in cost of Head works (Unit – I). Provision for audit & account charges @ 1% of I-Works has been kept under ‘Indirect charges’. The total indirect charges works out to be Rs. 32 lakh.

The total cost of Hydro - electric Installation (Unit-III) works out to Rs. 3531 lakh

10.2 Revenues

10.2.1 Yearly Programme of Development w.r.t. Date of Starting of Construction of the Project

The link Project is scheduled to be completed in 7 years. Yearly programme of construction schedule of the project has been discussed in

detail in Chapter-7 “Construction Programme, Manpower and Plant Planning”.

10.2.2 Sources of Revenue

Damanganga – Pinjal link has been planned to augment the domestic water supply to the Mumbai city. Also, two power houses: one each in the down-stream of Bhugad and Khargihill dams are proposed to generate the hydropower. As such, sale of water for domestic use and sale of hydropower will be the main source of revenue generation from Damanganga – Pinjal link project.

10.2.2.1 Revenue from Domestic Water Supply

Damanganga – Pinjal link project has been planned for augmentation of domestic water supply to Mumbai city and the diverted water will be distributed by MCGM through existing water supply network. The revenue from this water will be collected by MCGM as per the rates fixed by them from time to time.

Project will provide 579 Mm^3 (1586 MLD) waters annually at 100 % dependability with constant rate of discharge. It is assumed that 90 % of the diverted Damanganga waters will be augmented to the cooperative societies and other domestic premises and remaining 10 % water will be supplied to the commercial establishments. The Municipal Corporation of Greater Mumbai has notified the water rates for domestic and non-domestic purposes for the year 2013 duly approved by the Municipal Commissioner vide no. MGC/F/923 dated 5th Jun 2013 (Annexure – 6.1 in Volume -II). Considering these rates the revenue that is likely to be collected from 1586 MLD (579 Mm^3) of Damanganga waters have been worked out to Rs. 725. 328 Crores annually (Annexure – 6.2 in Volume -II). Considering the increase in the water charges @ 8% annually the annual revenue has been projected up to the year 2050 and is furnished in Annexure – 6.3 in Volume -II.

10.2.2.2 Auction of Ferry Service, Inundated Land Lease, Auction for Fruit Bearing Trees along Canals, Lease of Land for Shops in Colony Area, Navigational Permits

Damanganga – Pinjal link does not envisages construction of canals and navigation facilities are also not proposed. The land for shops provided in project colony areas may be leased.

10.2.2.3 Revenue from Hydro-power

Two power houses are proposed to generate the hydropower. The Power Potential studies of both the power houses have been carried out through THDC India Ltd. The total installed capacity of the proposed power houses is 5 MW (Bhugad dam power house 2X1 MW and Khargihill dam power house – 2X1.5 MW Installed Capacity). As per these studies 25.29 MU energy would be generated annually at 90% dependability. This hydro power is charged @ Rs. 2.72 per Kwh as prevailing rates in the area. The revenue from sale of hydro power generation will be Rs. 688 lakh annually.

10.2.2.4 Navigation

Navigation facilities are not envisaged in Damanganga – Pinjal link project.

10.2.2.5 Other sources (Pisciculture, Tourism, etc)

Due to formation of Bhugad and Khargihill reservoirs the natural fish production will increase. Tourism activities will also increase in the project area due to formation of water bodies. The benefits from these activities have not been quantified as such, the likely benefits have not been considered in the benefit-cost analysis of the project.

10.2.3 Concession in Water Rates (Irrigation), Cargo and Passenger Rates, etc

The project has been planned as domestic water supply project, as such, no benefits on account of providing irrigation is envisaged.

10.2.4 Administrative Charges for Supply of Water and Collection of Revenues etc

The diverted water will be distributed by MCGM as augmentation to the present water supply through existing water supply network and the revenue will be collected by the Municipal Corporation of Greater Mumbai (MCGM) through their existing system / staff. Hence, no provision has been made.

10.2.5 If the Area to be Irrigated is Prone to Scarcity, the Expenditure Normally Incurred to Redress the Scarcity

Damanganga – Pinjal link project has been planned for augmentation of domestic water supply to Mumbai city.

10.2.6 Year in Which the Revenue Would Start Accruing from Various Sources Counting from the First Year of Construction

The construction of project is scheduled to be completed in 7 years. The revenue from Water supply for domestic use in Mumbai is expected from the next year after completion of project (8th year). The revenue from hydro power generation is expected on completion of construction of head works, power houses and related structures.

10.2.7 Total Income from Various Sources

The total revenue from various sources will be Rs. **73221 lakh**. The details are furnished in Table 10.2:

Table 10.2

Revenue Generation from Damanganga – Pinjal link Project

Source of Revenue	Revenue (Rs. in lakh)
Domestic water	72533
Hydro power	688
Total	73221

10.2.8 Details of Staff Proposed for Collection of Revenues and its Basis

The revenue will be collected by the Municipal Corporation of Greater Mumbai (MCGM) through their existing system / staff. Hence, no provision has been made.

10.2.9 Net Revenue Expected from Different Components of Project

The total net annual income/benefit from various sources is estimated to be Rs. 73221 lakh.

10.3 Benefit– Cost Ratio and Internal Rate of Return

10.3.1 Allocation of Cost

The project has been planned as domestic water supply project to augment domestic water supply of Mumbai city. The hydropower generation is from the committed down stream releases only and incidental. As such, the total cost of head works (Unit – I) has been allocated to domestic water supply only.

10.3.2 Estimate of Annual Cost

The details of annual cost of the project are given below:

Sl. No.	Description	Annual Cost (Rs. in lakh)
A	Annual Cost of Damanganga – Pinjal Link	
1	Interest @ 10% on Capital cost of the project including cost of land development	27466
2	Depreciation of the project @ 1% cost of the project for 100 years of life (Domestic water supply component)	2711
3	Depreciation of the project @ 1.20% cost of the power component for 75 years of life	42
4	Annual O&M charges for power houses @ 5% cost of E&M works of power houses	105
5	Maintenance of head works @ 1% of the cost of head works	2711
	Sub Total	33035

B	Apportioned annual cost of conveyance system beyond Pinjal dam upto Pogaon (Mumbai)	4580
	Total annual cost	37615

10.3.3 Benefit Cost Ratio

The net annual benefits from various components of the project work out to Rs. 73221 lakh. The annual costs work out to Rs. 37615 lakh. The Benefit-Cost Ratio of the project works out to 1.95.

10.3.4 Internal Rate of Return (IRR)

The project has been planned to be completed in a period of 7 years including pre construction year. The phasing of the expenditure has been planned accordingly. The details of yearly expenditure chargeable to link project have been given in Annexure 7.8 in Volume - II. Considering life of the project as 100 years, the IRR of the Damanganga-Pinjal link project has been computed as 16.29 %. Detailed calculation is placed at Annexure – 10.3 in Volume – II.

