

Chapter - 13

Cost Estimate, Benefit Cost Ratio and Financial Aspects

13.0 General:

The Par-Tapi-Narmada link project envisages construction of the following components at DPR stage:

- i) A 808.32 m long composite embankment (concrete face rock fill) cum concrete dam across river Par near village Jheri with FRL 246.00 m and corresponding gross storage capacity 206.03 MCM. The length of concrete face rock fill portion of the dam is 663.32 m and the length of concrete non-overflow section and spill way is 145.00 m. The dam axis is located at Latitude 20°22'25" N and Longitude 73°25'51" E.
- ii) A 1431.85 m long composite embankment (concrete face rock fill) cum concrete dam across river Nar (a tributary of Par river) near village Paikhed with FRL 248.00 m and corresponding gross storage capacity of 229.53 MCM. The length of concrete face rock fill portion of the dam is 1310.85 m and the length of concrete non-overflow section and spill way is 121.00 m. The dam axis is located at Latitude 20°27'42" N and Longitude 73°23'37" E;
- iii) A power house at the toe of Paikhed dam with 3 units each of 3 MW installed capacity.
- iv) A 2781.00 m long composite embankment (concrete face rock fill) cum concrete dam across river Tan (a tributary of Auranga river) near village Chasmandva with FRL 214.00 m and corresponding gross storage capacity of 83.63 MCM. The length of concrete face rock fill portion of the dam is 2703.00 m and the length of concrete non overflow section and spill way is 78.00 m. The dam axis is located at Latitude 20°37'02" N and Longitude 73°22'36" E.
- v) A power house at the toe of Chasmandva dam with 2 units each of 1 MW installed capacity.
- vi) A 1887.00 m long composite embankment (concrete face rock fill) cum concrete dam across river Ambica near village Chikkar with FRL 210.00 m and corresponding gross storage capacity of 141.99 MCM. The length of concrete face rock fill portion of the dam is 1736.00 m

and the length of concrete non overflow section and spill way is 151.00 m. The dam axis is located at Latitude 20°42'00" N and Longitude 73°30'50" E.

- vii) A power house at the toe of Chikkar dam with 2 units each of 1 MW installed capacity.
- viii) A 1170.00 m long composite embankment (concrete face rock fill) cum concrete dam across river Kapri (a tributary of Ambica river) near village Dabdar with FRL 169.00 m and corresponding gross storage capacity 222.38 MCM. The length of concrete face rock fill portion of the dam is 1035.00 m and the length of concrete non overflow section and spill way is 135.00 m. The dam axis is located at Latitude 20°48'58" N and Longitude 73°32'05" E.
- ix) A power house at the toe of Dabdar dam with 2 units each of 1.60 MW installed capacity.
- x) A 1330.00 m long composite embankment (concrete face rock fill) cum concrete dam across river Purna near village Kelwan with FRL 164.00 m and corresponding gross storage capacity of 282.17 MCM. The length of concrete face rock fill portion of the dam is 1141.00 m and the length of concrete non overflow section and spill way is 189.00 m. The main dam is located at Latitude 20°55'30" N and Longitude 73°32'00" E.
- xi) A power house at the toe of Kelwan dam with 2 units each of 1.25 MW installed capacity.
- xii) A power house at the canal fall of feeder pipe line connecting Kelwan dam with main link canal with 2 units each of 1 MW installed capacity.
- xiii) A tunnel of about 12.70 km long with 3.00 m diameter (D shape) and bed slope of 1:875 connecting Jheri reservoir with Paikhed reservoir.
- xiv) A 147.50 m long barrage in the downstream of Paikhed dam with crest level of 136.00 m
- xv) A 128.00 m long barrage in the downstream of Chasmandva dam with crest level of 123.00 m.

- xvi) A 369.043 km long link canal off-taking from Paikhed barrage at FSL 142.50 m.
- xvii) A 100 m long tunnel No.1 at RD 14.650 to 14.750 km; A 350 m long tunnel No.2 at RD 24.000 to 24.350 km; A 200 m long tunnel No.3 at RD 32.350 to 32.550 km; A 50 m long tunnel No.4 at RD 37.750 to 37.800 km; and A 450 m long tunnel No.5 at RD 51.500 to 51.950 km;
- xviii) A 2.859 km feeder pipe line connecting main canal with Chasmandva barrage.
- xix) A 14.342 km pipe line inter connecting Chikkar and Dabdar reservoirs.
- xx) A 12.258 km feeder pipe line connecting main canal with Dabdar dam.
- xxi) A 7.616 km feeder pipe line connecting main canal with Kelwan dam.
- xxii) Cross Drainage / Cross Masonry works including Regulators, Escapes, Road/ Railway bridges (469 No).

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 Par-Tapi-Narmada 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 and enhanced to 2014-15 price level by considering 5% escalation per annum to arrive the cost of the project components.

13.1 Classification of Units:

The cost estimate of Par-Tapi-Narmada link project has been broadly grouped into following units.

Unit – I: Head works: Includes the cost of 6 dams viz Jheri, Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan, 2 barrages viz., Paikhed and Chasmandva.

Unit – II: Canals: Includes the cost of main canal, feeder pipe lines, branch canals etc and canal structures and tunnels.

Unit – III: Power House: There are 6 Power houses of which, 5 Power houses at the toes of Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan dams and 1 Power house at the canal fall of Feeder canal connecting Kelwan dam with main link canal.

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

Unit – V: Water Supply: Water supply for domestic and industrial needs are proposed under periphery of the project. Water will be supplied through main canals and various branch canals, whose cost is considered under Unit-II: Canal system. However, water supply network to the local areas will be the responsibility of the local development body / local administration. Hence, no provision towards water supply works at local level has been kept under this head.

Unit–VI: Command Area Development: Includes the cost of command area proposed en-route of the link canal, feeder pipe lines, projects proposed by Government of Gujarat, tribal areas in the vicinity of reservoirs, tribale area in enroute right side of the canal, tribal area on right side of Narmada main canal and target command in the drought prone Saurashtra and Kutch regions, and cost of lifting arrangements consisting of pumps and raising mains and its structures.

The Abstract of cost of the Par-Tapi-Narmada Link project is given below.

Sl. No.	Unit	Amount (Rs. in lakh)
1	I - Head works	474773
2	II – Canals including feeder pipe lines	455710
3	III – Power House	18091
4	IV – Navigation	0.00
5	V – Water supply for domestic and industrial needs	0.00
6	VI – Command area development	72547
	Total	1021121
	Say	10211 crore

Thus, the total cost of the link project works out to be **Rs. 10211 crore** at 2014-15 price level, which includes Environmental Management Plan and Socio-economic Survey and Rehabilitation and Resettlement Plan. The general abstract of the cost of the project is given in Annexure – 13 in Annexure Volume-VI (A). The details under various heads are described in the following paragraphs:

13.1.1 Unit – I: Head Works: Unit - I includes cost of the following components / structures of project.

- i) Jheri dam including concrete faced rock fill portion, concrete non-over flow section, spillway and energy dissipation arrangements.
- ii) Paikhed dam including concrete faced rock fill portion, concrete non-over flow section with construction spillway and energy dissipation arrangements, intake structure of Paikhed dam power house etc.
- iii) Chasmandva dam including concrete faced rock fill portion, concrete non-over flow section with construction spillway and energy dissipation arrangements, intake structure of Chasmandva dam power house etc.

- iv) Chikkar dam including concrete faced rock fill portion, concrete non-over flow section with construction spillway and energy dissipation arrangements, intake structure of Chikkar dam power house etc.
- v) Dabdar dam including concrete faced rock fill portion, concrete non-over flow section with construction spillway and energy dissipation arrangements, intake structure of Dabdar dam power house etc.
- vi) Kelwan dam including concrete faced rock fill portion, concrete non-over flow section with construction spillway and energy dissipation arrangements, intake structure of Kelwan dam power house etc.
- vii) Two barrages with main concrete structure, guide bunds, gates etc.

Total Cost of Unit-I: Head Works is estimated to be Rs.474773 lakh. Details are given in Annexure 13.1 of Volume-VI(A) and Volume –II. The sub-head wise details are given below.

13.1.1.1 Direct Charges

The direct charges include the following sub- heads.

- I- Works,
- II- Establishment,
- III- Tools and Plant,
- IV- Suspense and
- V- Receipts and recoveries.

The details are described below:

I-Works

A- Preliminary:

Rs.8726 lakh

Provision under this sub- head has been kept to cover the actual expenditure incurred on various survey and 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 Par-Tapi-Narmada link project consists of:

- i) Topographical surveys and investigations,

- ii) Hydrological and meteorological surveys,
- iii) Geological and 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.

However, for detailed survey and 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. The details are given at Annexure 13.1.1 in Appendix Volume-VI (A).

B- Land:

Rs.54545 lakh

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 Project Affected Families etc have been considered. The details are given at Annexure 13.1.2 in Appendix Volume-VI(A).

C- Works:

Rs.304488 lakh

Under this sub-head the provisions have been made to cover the cost of various components of Jheri, Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan dams, concrete faced rock fill dam, non- overflow concrete dam, spillway, energy dissipation arrangements, various outlets and intake for dam toe powerhouses etc, two barrages with main concrete structures, guide bunds, gates etc.

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 powerhouses and tunnels etc are carried out by various design Directorates, Central Water Commission 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 details are given at Annexure 13.1.3 in Appendix Volume-VI(A).

K- Buildings:

Rs.28111 lakh

Provision has been made under this sub-head for construction of temporary and permanent buildings for both residential and 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 and welfare centers etc. The details under this sub-head are given at Annexure 13.1.4 in Appendix Volume – VI(A).

M- Plantation:

Rs.50 lakh

Under this sub- head, cost of proposed plantation in the colony areas, parks downstream of Jheri, Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan dams and along the approach roads have been considered. The details under this sub-head are given at Annexure 13.1.5 in Appendix Volume – VI (A).

O- Miscellaneous:

Rs.8797 lakh

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 and fire fighting equipments, furniture and crockery for inspection bungalows and circuit houses, recreation facilities, initial camp equipments for hospital, primary and secondary schools, community centers etc.
- ii) Running and Maintenance 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. The details are given at Annexure 13.1.6 in Appendix Volume-VI(A).

P- Maintenance:

Rs.3367 lakh

i) 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 TandP, X – Environment and Ecology, and Y – Loss on stock has been made. The details are given at Annexure 13.1.7 in Appendix Volume-VI(A).

Q- Special Tools and Plant:

Rs. Nil

No provision has been made under this head as the cost of special Tools and Plant will be borne by the contractors.

R- Communication:

Rs.693 lakh

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 details are given at Annexure 13.1.8 in Appendix Volume-VI(A).

X- Environment and Ecology:

Rs.26700 lakh

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 labourers, 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 and Dam Break Disaster Management Plan etc. The details are given at Annexure 13.1.9 in Appendix Volume – VI(A).

Y. Losses on Stock and Unforeseen Items: Rs.833 lakh

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 and Plant and X - Environment and ecology.

The total cost of I –works of Unit – I (Head works) works out to **Rs. 436310 lakh.**

II-Establishment: Rs.30541 lakh

The Par-Tapi-Narmada 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.

III-Ordinary Tools and Plant: Rs.4363 lakh

Provision has been made under this head @ 1% of I-Works towards ordinary Tools and Plant to cover the cost of survey instruments, camp equipment and other small tools and plant. This provision is distinct from the Q- special Tools and Plant.

IV – Suspense: Rs. Nil

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 and Recoveries: Rs. (-) 2627 lakh

Under this head estimated recoveries by way of resale or transfer of temporary buildings, 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.

13.1.1.2 B - Indirect Charges: Rs.6186 lakh

Provision for abatement of land revenue and Audit and Account charges are covered under 'Indirect Charges' at the following rates:

- Abatement of land revenue – 5% of cost of land
- Audit and Account charges – 1% of I-Works

Total cost of Head works (Unit-I) works out to **Rs. 474773 lakh.**

13.1.2 Unit – II: Canal system

Unit – II Canal system covers the cost of the following components along with their appurtenants works

- A tunnel of about 12.70 km long with 3.00 m diameter (D shape) connecting Jheri reservoir with Paikhed reservoir.
- A 369.043 km long canal off taking from Paikhed barrage.
- A 2.859 km feeder pipe line connecting main canal with Chasmandva dam
- A 14.342 km pipe line inter connecting Chikkar and Dabdar reservoirs.
- A 12.258 km feeder pipe line connecting main canal with Dabdar dam
- A 7.616 km feeder pipe line connecting main canal with Kelwan dam
- Total 5 no. of tunnels of total length 1.15 km along the link alignment.
- 469 No. of CD structures

The total cost of Unit – II: Canal system is estimated to be Rs. 455710 lakh at 2014-15 price level. Details are appended in Annexure 13.2 of Volume-VI(A) and Volume –II. The sub-head wise details are discussed in the following paragraphs.

13.1.2.1 Direct charges

I-Works

A- Preliminary:**Rs.8222 lakh**

Provision under this sub- head has been kept to cover the actual expenditure incurred on various survey and investigation works mentioned below for preparation of Detailed Project Report of this project.

- i) Topographical surveys and investigations,
- ii) Geological and Geotechnical surveys,
- iii) Construction material survey,
- iv) Vehicle charges for inspecting officers for site investigations,
- v) Survey and Camp equipments,
- vi) Charges for consultation for various studies,
- vii) Actual expenditure on Establishment and
- viii) Preparation of Detailed Project Report.

However, for detailed survey and 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.

B- Land:**Rs.50695 lakh**

Under this sub-head the provisions for cost of acquisition of land to be acquired for canals and canal structures etc., compensation for property and standing crops, solatium charges, diversion of communication systems and other immovable properties, rent for use of land prior to acquisition, economic rehabilitation measures etc., have been considered. The details are appended in Annexure 13.2.1 in Appendix Volume-VI(A).

C-Works:**Rs.13408 lakh**

Under this sub-head provisions for Tunnels, Tunnel Intake structures, Tunnel outfall structures considered. The cost of tunnels worked out based on Design drawings of tunnels given by Central Water Commission, New Delhi. The details are given in Annexure 13.2.2 in Appendix Volume-VI(A).

D-Regulator:**Rs.7478 lakh**

Under this sub-head, provision for cross regulator at appropriate locations where branch canals take off from main canal, desilting chamber

at begging of canal has been made. Provision for Head regulator for branch canal has also been made. The cost of regulators is arrived from cost curve of regulators. The details are appended in Annexure 13.2.3 in Appendix Volume-VI(A).

E-Falls: Rs.78 lakh

There is no canal drop in the main canal. However, canal drops at Kelwan feeders have been provided to cope up with the topography and to join at suitable level of main canal. The cost of canal drop on Kelwan feeder have been estimated from the cost curves of canal falls. The details are given in Annexure 13.2.4 in Appendix Volume-VI(A).

F-Cross drainage works: Rs.29152 lakh

The cross drainage works proposed across the main canals are aqueducts, syphon aqueducts, canal syphons to facilitate the crossing of river / streams. The costs of the structures have been estimated from the cost curves. Details are appended in Annexure 13.2.5 in Appendix Volume-VI(A).

G-Bridges: Rs.1597 lakh

A number of bridges (major and minor) are required to be constructed in the Par-Tapi-Narmada link canal of the project to facilitate crossing of various roads. Necessary provision has been made towards construction of these bridges. The estimates are prepared based on the cost curves. Details are appended in Annexure 13.2.6 in Volume-VI(A).

H-Escapes: Rs.227 lakh

Under this sub-head provision has been made for canal escapes at suitable locations where drainage facilities exist to take care of the discharges in the eventuality of canal breaches. The details are appended in Annexure 13.2.7 in Volume-VI(A).

K- Buildings: Rs.18541 lakh

Provision has been made under this sub-head for construction of temporary and permanent buildings for both residential and non-residential buildings for various categories of staff, offices, inspection bungalow,

stores, club cum welfare hall, laboratory and research station etc. Rates have been adopted for these buildings based on the plinth area and prevailing market rates. Details under this sub-head are given in Annexure 13.2.8 in Volume-VI(A).

L- Earthwork and Lining: Rs.162842 lakh

The earthwork quantities involved in cutting based on the type of soils are separately worked out. The quantity of earthwork required for embankment from borrow areas are separately worked out. The detailed estimates are prepared considering the cross sections taken at 50 m interval along the canals and detailed drawings supplied by Central Water Commission, New Delhi at various sections. Lining is provided for bed and side slopes in the entire length of canals as per the drawings. Details under this sub-head are appended in Annexure 13.2.9 in Volume-VI(A).

M- Plantation: Rs.215 lakh

Under this sub-head, cost of plantation in the colony areas and along the main canals and branch canals on both sides has been provided. Details are given in Annexure 13.2.10 in Volume-VI(A).

O- Miscellaneous: Rs.1017 lakh

Under this sub-head provision has been made to cover the cost of the following works:

- Capital cost of electrification, water supply purification and distribution arrangements, sewage disposal, fire fighting equipment, telephones, wireless sets, equipment for quality control and field labs, initial equipment and other accessories for hospitals etc.
- RandM of above equipments / infrastructural facilities etc.
- RandM of inspection vehicles, inspection bungalow etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, flood lighting, model exhibits etc. Details are given in Annexure 13.2.11 in Volume-VI(A).

P- Maintenance: Rs.2840 lakh

Under this sub-head provision has been made to cover the cost of maintenance of all works during the construction of canals. A provision of 1% cost of I-Works less A-Preliminary, B-Land, M-Plantation, O-Miscellaneous, Q-Special Tools and Plant, X-Environment and Ecology and Y-Loss on stock has been made. Details are appended in Annexure 13.2.12 in Volume-VI(A).

Q- Special Tools and Plant: Nil

No provision has been made under this head as the cost of special Tools and Plant will be borne by the contractors.

R- Communication: Rs.1279 lakh

Under this sub-head, provision for construction of temporary roads and remodelling of existing roads for approach to canal and regulatory system, quarry sites and other working areas has been kept. Details are given in Annexure 13.2.13 in Volume-VI(A).

U- Distributaries and Minors:

V- Water Courses and Field Channels: Rs.89854 lakh

Under this sub-head, provision has been made for providing branch canals, distributaries and minors and courses and field channels considering a cost of Rs.38701/- per ha for the culturable command area of Canal. The details are appended in Annexure 13.2.14 in Volume-VI(A) and 13.10.4 in Volume VI (B)

W- Drainage: Rs.5060 lakh

Under this sub-head, provision has been made at the rate of Rs. 6665/- per ha for total command area for field drainage. Details are given in Annexure 13.2.15 in Volume-VI(A).

X- Environment and Ecology: Rs.17761 lakh

Provisions under this sub-head have been made towards the cost of extensive management measures to sustain environment and ecology such as land management plan (stabilisation of muck disposal management), measures to arrest transportation of silt across basin, provision for free fuel

to department engaged labour, Public Health Management, Environmental Monitoring Programme (EMP). The details are given in Annexure 13.2.16 in Volume-VI(A).

Y- Losses on Stock and Unforeseen: Rs.824 lakh

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I-Works excluding sub-heads A-Preliminary, B-Land, O- Miscellaneous, M-Plantation, P-maintenance and X-Environment and Ecology.

The total cost of I –works of Unit – II (Canals) works out to Rs. 411090 lakh.

II- Establishment: Rs.36040 lakh

Provision has been made as per norms @ 10% of I-Works excluding B-Land towards establishment and pensionary charges.

III-Ordinary Tools and Plant: Rs.4111 lakh

Provision has been made under this head for ordinary Tools and Plant @ 1% of I-Works. This provision is distinct from the Q-Special Tools and Plant and is meant to cover the cost of survey instruments, camp equipment and other small Tools and Plant.

IV-Suspense: Rs. Nil

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 and Recoveries: (-)Rs.1017.00 lakh

Under this head, estimated recovery by way of resale or transfer of temporary buildings, special Tools and Plant and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly

13.1.2.2 B - Indirect Charges: Rs.5486 lakh

Provision for abatement of land revenue and Audit and Account charges are covered under ‘Indirect Charges’ at the following rates:

- Abatement of land revenue – 5% of cost of land
- Audit and Account charges – 1% of I-Works

Total cost of Canals (Unit-II) works out to **Rs. 455710 lakh.**

13.1.3 Unit – III: Hydroelectric Installation

Par-Tapi-Narmada link project envisages construction of 6 power houses out of which, 5 power schemes at the toe of Paikhed, Chasmandva, Chikkar Dabdar and Kelwan dams and the other one at the drop of feeder pipe line canal originating from Kelwan reservoir to Main canal. The total installed capacity for power generation from all the power schemes is 21 MW.

Provision for expenditure towards installation of these 6 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 above powerhouses is estimated to be **Rs. 18091 lakh** at 2014-15 price level. The details are given at Annexure 13.3 of Volume-VI(A) and Volume –II. The sub-head wise details are given hereunder.

13.1.3.1 Direct Charges

I – Works

A-Preliminary:

Rs.329 lakh

Provision for preliminary surveys and investigations works carried out to arrive at optimum designs for the project components including consultancy charges for Power Potential and Environmental and Management studies at Detailed Project Report stage and design works at pre construction stage has been made at 2% of I-Works Under this sub-head.

B-Land:

Rs.0.00 lakh

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:**Rs.8086 lakh**

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 details are given in Annexure 13.3.1 in Volume-VI(A).

P-Maintenance:**Rs.161 lakh**

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 and Plant O-Miscellaneous and Y- Loss on stock has been considered. The details are given in Annexure 13.3.2 in Volume VI (A)

Q-Special Tools and Plant:**Rs. Nil**

No provision has been made under this head as the cost of special Tools and Plant will be borne by the contractors.

S-Power Plant and Electro Mechanical Works:**Rs.7831 lakh**

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 the power houses. The Electro-mechanical studies / designs of the power houses have been carried out through Tehri Hydro Development Corporation (India) Limited, Rishikesh. Provisions made under this sub-head for various components are based on the Electro Mechanical studies carried out by Tehri Hydro Development Corporation (India) Limited, Rishikesh. The details under this sub-head are given in Annexure 13.3.3 in Volume-VI(A).

Y. Losses on Stock and Unforeseen Items:**Rs.40 lakh**

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 and Plant, O-Miscellaneous and X- Environment and Ecology

The total cost of I –works of Unit – III (Hydro- electric Installation) works out to **Rs. 16447 lakh.**

II-Establishment: Rs.1316 lakh

Provision towards establishment charges has been made @ 8% of I-Works excluding B- land.

III- Ordinary Tools and Plant: Rs.164 lakh

Provision has been made under this head @ 1% of I-Works towards ordinary Tools and Plant to cover the cost of survey instruments, camp equipment and other small tools and plant. This provision is distinct from the Q- special Tools and Plant.

IV – Suspense: Rs. Nil

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 and Recoveries: Rs. Nil

No provision for special Tools and Plant has been kept under the sub-head. 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 Tools and Plant and also buildings.

13.1.3.2 Indirect Charges: Rs.164 lakh

Provision for abatement of land revenue and Audit and Account charges are covered under ‘Indirect Charges’ at the following rates:

- Abatement of land revenue – 5% of cost of land
- Audit and Account charges – 1% of I-Works

Total cost of Hydro - electric Installation (Unit-III) works out to **Rs. 18091 lakh.**

13.1.4 Unit–IV: Navigation

Navigation is not proposed under this project and hence, no provision is required under this sub-head.

13.1.5 Unit–V: Water Supply Works

Water supplies for domestic and industrial needs are proposed under periphery of the project. Water will be supplied through main canals and various branch canals, whose cost is considered under Unit-II: Canal system. However, water supply network to the local areas will be the responsibility of the local development body / local administration. Hence, no provision towards water supply works at local level has been kept under this head.

13.1.6 Unit–VI: Command Area Development:

Provision for expenditure towards command is development including lifting arrangement consisting of pumps and raising mains and its structure have been made under Unit-IV command area development. The total cost of command area development is estimated to be Rs. 72547 lakh. The details are given at Annexure 13.4 of Volume-VI (A). The sub-head wise details are given below.

13.1.6.1 Direct charges

I-Works

‘A’ Preliminaries

The total probable expenditure involved under this minor head is taken as 2% of the cost of I-Works. This works out to Rs. 1331 lakh. The provision covers the probable expenditure on investigations to be conducted during execution, surveys, design studies, field tests, etc.

‘B’ Land

Provision made under this sub-head covers the cost of land acquisition for raising mains, pump houses, sumps and delivery cisterns etc. This works out to Rs. 2184 lakh. The details are furnished in Annexure 13.4.1 in Volume VI (A)

‘C’ Civil Works

Provision made under this sub-head covers the cost of intake structure, pump houses, sump wells, raising mains, Delivery cisterns and supporting structures for raising mains etc. This works out to Rs. 52427 lakh. The details are furnished in Annexure 13.4.2 in Volume VI (A)

‘L’ Earth Work

The total culturable command area covered under par-Tapi-Narmada link project is 232175 ha. This area is covered by enroute command (61190 ha) feeder pipeline command (1270 ha), project proposed by Government of Gujarat (45561 ha), tribal area in enroute right side of canal (36620 ha) tribal area in vicinity of reservoir (12514 ha), tribal area on right side of Narmada main canal (34342 ha) and target command area (42368 ha) in Saurashtra and Kutch region in lieu of part command area of existing Miyagaon Branch Canal of Narmada canal system of Sardar Sarovar Project to be taken over by the link canal. The total 24470 ha of command area considered for land levelling and shaping to facilitate irrigation and also to prevent soil loss due to erosion in undulating area. This works out to Rs 2090 lakh. Details are given in Annexure 13.4.3 in Volume VI (A)

‘M’ Plantation

The total probable expenditure involved under this minor head is taken as 0.5% of the cost of I-Works. This works out to Rs. 333 lakh.

‘O’ Miscellaneous

The total probable expenditure involved are towards miscellaneous works related to lifting arrangements i.e., Pumps, raising mains and its supporting structures etc., under this minor head is taken as 4% of the cost of I-Works. This works out to Rs. 2662 lakhs.

‘P’ Maintenance

A provision of Rs. 578 lakh is made under this minor head for the maintenance of all works during construction period at 1% of I-works less preliminaries, land, plantation, miscellaneous special tools and plants, loss on stocks charges.

‘R’ Communications

The total probable expenditure involved under this minor head I kept as 499.00 lakh which is 0.75% of the cost of I-Works.

‘S’ Power Plant and Electrical Mechanical Systems.

The provision made under this minor head towards cost of pumps works out to Rs. 4308.00 lakh. The details are furnished at Annexure 13.4.4 in Volume VI (A)

‘Y’ Losses on Stock and Unforeseen

A provision of Rs. 149 lakh at 0.25% of I-works less Preliminaries, land, Miscellaneous, Plantation and Special T and P is made under this minor head in the estimate.

II. Establishment

An amount of Rs. 5150 lakh is made under this sub-head for establishment including leave and pension charges at 8% on I-works less B-Land.

III. Tools and Plants (Ordinary)

A sum of Rs. 666 lakh is made under this sub-head to cover the cost of survey instrument, camp equipment, office furniture and equipment and other small tools at 1% of the cost of I-Works.

IV Receipts and Recoveries

An amount of Rs. 532 lakh is expected to be recovered by way of sale of special TandP at 75% of the provision under Q-Special Tools and Plants, resale/transfer of accessories under capital cost of O-Miscellaneous @ 20%.

Indirect Charges

(a) Abatement of Land Revenue

A provision Rs. 36 lakh at 5% of the land cost is provided towards abatement of land revenue due to land acquisition for raising mains.

(b) Audit and Account Charges

A provision of Rs. 666 is made under this minor head at 1% of the cost of I-Works cover the establishment charges of the Accounts staff.

13.2 Revenues

13.2.1 Yearly Programme of Development with respect to the Date of Starting of Construction of the Project

The link project is scheduled to be completed in 7 years. Yearly programme of construction of the project has been discussed in detail in Chapter - 10 “Construction Programme, Manpower Deployment and Plant Planning”. This programme has been planned by CMO Directorate, Central Water Commission, New Delhi.

13.2.2 Sources of Revenue

The Par-Tapi-Narmada link project has been planned to provide irrigation in the new areas in its en-route Irrigation, projects proposed by Government of Gujarat, tribal area in the vicinity of reservoirs, tribal area in enroute right side of the canal, tribal area on right side of Narmada main canal and drought prone Saurashtra and Kutch regions by substitution (in lieu of taken over part command areas of existing Miyagam Branch Canal of Narmada Canal Systems of Sardar Sarovar Project). Also, the project envisages power generation and domestic water supply to the villages in the periphery of the proposed reservoirs and also along the canal. Accordingly, following would be the source of revenue from the link project.

- Irrigation water charges
- Irrigation cess
- Sale of water for domestic water supply and
- Sale of hydro power

Other than the above, fisheries development in the proposed reservoirs can also be one of the major sources of revenue on account of this project.

13.2.2.1 Water Rates – Irrigation Cess

Water rates: A large infrastructural network such as this project being created for making water available in the proposed command areas for irrigation and drinking purposes besides power generation, needs to be self sustainable. Therefore, appropriate water pricing is quite necessary, so that cost of operation and management of project could be recovered from the beneficiaries of the project upto some extent. Water rates may be different from irrigation and non-irrigation use. Water rates for irrigation use can be applied on the basis of per unit area irrigated. On the other hand, for drinking water supply, rates may be applied on the basis of per unit volume of water supplied, while power can be charged per unit basis.

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

Vacant lands on either side of canals may be leased for plantation of fruit bearing trees. Similarly, in project colony areas, land for shops may also be leased.

13.2.2.3 Revenue from Hydro-power

There are 6 power houses proposed to generate the hydropower. The Power Potential Studies of 6 power houses have been carried out through Tehri Hydro Development Corporation (India) Ltd, Rishikesh. The total installed capacity of the proposed power houses is 21 MW and annual energy generation will be 102 Million Units. The revenue from sale of hydro power generation will be Rs. 6120 lakh annually.

13.2.2.4 Revenue from Water Supply

The annual local domestic and industrial demands considered through @ 10.0 MCM each of the proposed reservoirs. The total water supply is 76 MCM. The revenue from sale of water will be Rs. 8987 lakh annually.

13.2.2.5 Navigation

Navigation facilities are not envisaged in Par-Tapi-Narmada link project.

13.2.2.6 Other Sources (Pisciculture, Tourism etc.)

Due to formation of Jheri, Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan réservoirs, the naturel Fish production will increase. The revenue from sale of fish will be Rs. 303 lakh annually.

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.

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

As the water rates (Irrigation) prescribed by the States are highly subsidized, there appears to be no rationale for further concession of these rates in the project commands.

13.2.4 Administrative Charges for Supply of Water and Collection of Revenues etc.

Suitable provision has been made for running and maintenance of the canals, which include administrative charges for supply of water.

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

The main aim of the Par-Tapi-Narmada link project is to provide irrigation in the draught prone areas of Saurashtra and Kutch regions and along the areas in en-route of the link canal which needed assured water supply.

13.2.6 Year in which Revenue Would Start Accruing from Various Sources Counting from First Year of Construction

The construction of project is scheduled to be completed in 7 years. The irrigation development in all the commands is also expected to be completed by then. Revenue from irrigation is expected to start accruing in full from beginning of 8th year i.e after completion of the project. Power benefits from Power Houses also start accruing from beginning of 8th year

13.2.7 Total Income from Various Sources

The total revenue from various sources will be Rs. 126586.70 lakh. The details are furnished in Table 13.2.

Table 13.2

Revenue Generation from Par-Tapi-Narmada Link Project

Source of Revenue from	Revenue (Rs. in lakh)
Agricultural produce (see para no.9.11.5.1(ii) i chapter 9)	111176.70
Sale of Power	6120.00
Domestic water supply	8987.00
Fisheries	303.00
Tourism	0.00
Total	126586.70

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

The revenue will be collected by the District / Tehsil administration through their existing system / staff. Hence, no provision has been made.

13.2.9 Net Revenue Expected from Different Components of Project

The total net amount of income / benefit from various sources is estimated to be **Rs. 126586.70 lakh.**

13.2.10 Productivity of Project in Terms of Percentage Financial Returns

The details of productivity in the command area at pre and post project scenarios are as follows:

Details of Productivity in the Command Area

Unit: Qtl

Crop	En-route Canal		Government of Gujrat projects		Feeder Pipe line		Tribal area enrout Right side of Canal and Vicinity of Reservoirs and right side of NMC		Target command in Saurashtra	
	Pre-project	Post-project	Pre-project	Post-project	Pre-project	Post-project	Pre-project	Post-project	Pre-project	Post-project
Kharif	1268276	909805	964297	691828	15588	19358	100321	107397	51177	54784
Rabi	156650	687699	119117	522977	1993	14633	502737	2773992	256460	1415064
Two seasonal	0	0	0	0	0	0	167467	0	85424	0
Hot weather	0	195027	0	148266	0	3910	74730	398640	38130	203360
Perennial	209001	1942560	158913	1475800	0	41300	0	49840	0	25420
Total	1633927	3734091	1242327	2838871	17581	79201	845255	3329869	431191	1698628
Net increase in produce	2100164 (128.53%)		1596544 (128.51%)		61620 (350.49%)		2484614 (293.95%)		1267437 (293.94%)	
Total increase	7510379									

13.3 Benefit–Cost Ratio and Internal Rate of Return

13.3.1 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 Par-Tapi-Narmada link project	
1	Interest @ 10% on Capital cost of the project including cost of land development	102112.10
2	Depreciation of the project @ 1% cost of the project for 100 years of life (Irrigation component)	9304.83
3	Depreciation of the project @ 1.20% cost of the power component for 75 years of life	217.09
4	Annual OandM charges @ Rs. 600/- per ha of CCA	1393.05
5	Annual OandM charges for power houses @ 5% cost of EandM works of power houses	391.55
6	Maintenance of head works @ 1% of the cost of head works	4747.73
7	Depreciation of pumping system and raising mains a) Pump and Equipment at 8.33% on 4308 b) Raising mains at 3.33% on 47353 c) Civil Works of Pumping station at 1% of Rs.5074	358.86 1576.85 50.74
8	Power Charges at Rs.1.80 per unit for 122.88MU	2211.84
	Total annual cost	122364.64

13.3.2 Benefit-Cost Ratio

As described in the above paras, the net annual benefits from various components of the project work out to Rs. 126586.70 lakh and the annual costs works out to Rs. 122364.64 lakh. Thus, the Benefit-Cost Ratio of the project works out to 1.035. Details are given in Annexure 13.5 of Volume –II.(Annexure)

13.3.3 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 13.6 of Volume-II. Considering life of the project as 100 years, the Internal Rate of Return of Par-Tapi-Narmada link project has been computed as 10.172%. Details are given in Annexure 13.6 of Volume –II.(Annexure)

13.3.4 Benefit-Cost Ratio for Flood Control Component of Projects

No cushion in the reservoir storage is provided exclusively for flood control. Hence, no Benefit-Cost Ratio for flood control component of the project is worked out.

13.3.5 Benefits other than those considered in the Benefit-Cost Ratio and Internal Rate of Return

Benefits from Irrigation, power, water supply and fisheries have been considered for assessing the Benefit-Cost ratio. The project will go a long way by enhancing the socio-economic status of the people of that area. It would provide the impetus to industrialization and overall economic development of the region. In addition to above benefits, lot of employment will be generated during construction period which will enhance the socio economic conditions of the people living in the nearby area. So many new secondary and tertiary economic activities will be generated in that region due to coming up of this project, which will lead to overall development of that area.

In addition to this, following recreational facilities will be available on completion of the project.

- Parks/gardens in downstream of dams.
- Children parks in the township.
- Tourist spot with boating facilities.
- Guest house, inspection bungalow and dormitory accommodation.

These facilities will ensure tourism development in the area. The water-fall located just downstream of the dam site may further enhances the tourism potential.