

Executive Summary

1.0 General

The Bedti -Varada link project envisages diversion of 524 MCM through the following two components

- i) Bedti (Pattanadahalla/ Shalamalahalla) - Varada (Link I) for diversion of 302 MCM
- ii) Bedti (Suremane) - Dharma - Varada (Link II) for diversion of 222 MCM

The combined waters from both of the above links will reach Tungabhadra reservoir through Dharma /Varada rivers and will augment irrigation and other uses in Tungabhadra LBC in Raichur district

2.0 The proposal

The Bedti-Varada link project envisages construction of the following components in Uttara Kannada district of Karnataka.

Link I: Bedti - Varada

- (a) Weir of length 145.0m across Pattanadahalla stream located near Siralabail village in Sirsitaluk.
- (b) Approach channel of 0.10 km from foreshore of Pattanadahalla weir to the proposed tunnel entry.
- (c) Tunnel of length 6.5 km.
- (d) Canal of length 0.30 km to join the stream leading to Shalamalahalla stream.

- (e) Weir of length 202.0m across Shalamalahalla stream near Hulgol village in Sirsitaluk to transfer the combined surplus of 302 MCM available at both the weirs.
- (f) Lifting arrangements to facilitate pumping of waters from Shalamalahalla weir.
- (g) Raising main of length 10.15 km taking off from the pump house on the foreshore of the Shalamalahalla pond.
- (h) Tunnel of length 6.7 km taking off from the delivery cistern/chamber.
- (i) Canal of length 1.73 km from tunnel exit to join the stream leading to Varada river.

Link-II: Bedti - Dharma - Varada link

- a) Weir of length 165.0 m across Bedti river near Suremane village in Yellapurtaluk to transfer 222 MCM of surplus waters.
- b) Lifting arrangements in two stages to pump waters from Suremane barrage to Dharma reservoir.
- c) Two stages of raising mains of length 22.30km (10.90km+11.40km) taking off from the pump houses on the foreshore of the Suremane barrage.
- d) Tunnel of length 4.23 km taking off delivery chamber to facilitate further transfer of waters to a stream merging into Dharma river.

3.0 Methodology

The detailed surveys and investigations such as topographical surveys, geological and geotechnical investigations including drilling bore holes on the weir/barrage axes for obtaining rock cores, construction

material investigations including borrow area surveys, socio-economic, ecological and environmental impact assessment studies, seismo-tectonic studies etc. which could not be taken up due to local public hindrance in project area are proposed to be carried out at pre-construction stage. The pre-feasibility report of Bedti - Varadalink project circulated in July 1995 as part of NPP and the PFR of Bedti-Dharma link project circulated in January 2017 as requested by Govt of Karnataka are the main inputs for preparation of the detailed project report.

The topographical details are obtained from toposheets, and Global Mapper generated Digital Elevation Model (DEM); the hydrology and water availability study, 'design aspects', 'irrigation planning', 'cost estimates', economic analysis, construction schedule and manpower and plant planning etc. have been carried out departmentally. The Comprehensive Environmental Impact Assessment (CEIA) study and Socio-economic studies will be taken up by Government of Karnataka after obtaining the necessary approval for ToR of the study from MoEF&CC based on the project specific aspects discussed in the present DPR. The environmental and socio-economic aspects of the link project have therefore been discussed in the DPR based on secondary data.

4.0 Location

The headworks and conveyance are located in Sirsi and Yellapur taluks of Uttara Kannada district in Karnataka whereas the command area is located in the command under Tungabhadra Left Bank Canal (TBLBC) and falls in Manvi, Sirwara, Devadurga and Raichur taluks of Raichur district.

5.0 Climate

The average monthly maximum and minimum rainfall in the project area varies from 1197mm in July to 0mm in February. The mean daily

maximum and minimum temperature recorded is 33.4 °C in November/December and 20.2 °C in February respectively. The monthly mean relative humidity varies between 94% (August) and 55% (December). The maximum and minimum wind velocities observed are 6.0 km/hr in June and 3.9 km/hr in October respectively. The maximum cloud cover of 7.0 octas is observed during July whereas the minimum cloud cover of 0.9 octas is observed during February.

In the command area, the average monthly maximum and minimum rainfall varies from 156mm in September to 2mm in January. The mean daily maximum and minimum temperature recorded are 40.4 °C in May and 16.6 °C in December respectively. The monthly mean relative humidity varies between 74% (September) and 23% (March). The maximum and minimum wind velocities observed are 14.0 km/hr in July and 7.6 km/hr in December respectively. The maximum cloud cover of 5.8 octas is observed during July whereas the minimum cloud cover of 2.6 octas is observed during January. There is no pan-evaporimeter installed in the project area. The mean monthly average evapo-transpiration computed for Raichur IMD observatory varies from 108.1 mm in December to 234.0 mm in May.

6.0 Topography, Physiography and Geology

Pattanadahalla pond will spread over an area of about 17.88 ha which consists of 12.43 ha of forest land and 5.45 ha of other land. The river bed level at the site is 491.0 m. The pond is bound by thick forest. Shalamalahalla pond will spread over an area of about 88.53 ha which is entirely forest land. The river bed level at the site is 458.0 m. The pond is bound by thick forest all around. Both the weirs are proposed in hilly region. Suremane barrage pond will spread over an area of about 54.38 ha

which is entirely forest land. The river bed level at the site is 419.5 m. The pond is bound by thick forest all around.

The conveyance of is proposed to be aligned through hilly and steep slopes of Western ghats at head works and uniform slope at the tail end. The command area of the link canal, i.e., tail end reach of TBLBC is undulating and of moderate/uniform slope.

The detailed geological, geo-physical and geo-technical studies will be carried out at pre construction stage based on the consensus for western ghat centric environmental consensus. The link project area lies in the seismic zone -II as per the seismic zone map of India, which is considered to be least active.

7.0 Hydrology and water assessment

The water balance at Pattanadahalla, Shalamalahalla weir sites and Suremane barrage site in Bedti basin considering the in-basin needs, committed d/s requirements and environmental needs has been assessed to be surplus to the tune of 181MCM, 276MCM & 294MCM at 75% dependability and 223MCM, 355MCM & 958MCM at 50 % dependability respectively.

Daily simulation is carried out at Pattanadahalla for the monsoon months (June to November) for the period from 1970-71 to 2016-17. It is found that with a daily maximum diversion of 1.75 MCM, it is possible to divert 113.70 MCM annually at 75% dependability. The daily diverted quantity from Pattanadahalla is added to the daily inflows of Shalamalahalla to arrive at the combined daily inflows for daily simulation at

Shalamalahalla. With a daily maximum diversion of 4.75MCM, it is seen that a quantum of 302 MCM (combined surplus from Pattanadahalla and Shalamalahalla) could be diverted annually at 75% dependability through Link -I.

Similarly, daily simulation is carried out at Suremane diversion site for the monsoon months (June to November) for the period from 1970-71 to 2014-15, and it is seen that with a daily maximum diversion of 6MCM, 222MCM can be diverted at 75% dependability annually.

8.0 Designaspects

Link I: Bedti - Varada

The design of various components of the project involves i) weirs on Pattanadahalla and Shalamalahalla streams, ii) pump house at Shalamalahalla weir site, iii) canal of 0.4 km and tunnel of 6.5 km between Pattanadahalla and Shalamalahalla, iv) Lifting arrangements and 10.15 km raising main from Shalamalahalla to lift water, (v) 6.7 km tunnel and 1.73 km canal to further carry the water to the stream. The designs of all these components have been carried out. Design of CD/CM structures will be taken up, if required, at pre-construction stage.

Link II: Bedti - Dharma

The design components involved are i) barrage at Suremane on Bedti river, ii) Lifting arrangements and 22.30 km length of raising main, iii) delivery cistern cum approach of 0.35 km iv) tunnel of length 4.23 km which have been carried out. Design of CD/CM structures will be taken up, if required, at pre-construction stage.

The detailed design features are furnished below.

Pattanadahalla weir: The Pattanadahalla weir is designed for a maximum flood discharge of 824 cumec. Total length of the concrete weir is 145m. Ogee type spillway with a full pond level of 499m is designed. Under sluice of size 1mx1.5m is provided on the left to allow minimum environmental flow with crest level of 491m.

Shalamalahalla weir: The Shalamalahalla weir is designed for a maximum flood discharge of 1567cumec. Total length of the concrete weir is 202m. Ogee type spillway with full pond level of 468 m is designed. Under sluice of size 1mx1.5m is provided on the left to allow minimum environmental flow with crest level at 458 m.

Suremanebarrage:The 165 m long barrage is designed for a maximum flood discharge of 5639 cumec with a full pond level of 426.0 m. 4 no's of under sluices of clear span 8m each with crest level 420.0m and 8 no's of river sluices with clear span of 12 each with crest level of 421.0 m are provided. Radial gates are designed for all the sluice openings.

In Link I, the conveyance system includes 100 m approach channel, tunnel of length of 6.5 km, canal of length 300 m and size 7.1 m X 2.75 m with bed slope of 1:10000 & side slope 1:1.5; and modified horse shoe free flow type tunnel of 4.5 m dia with a bed slope of 1:3000 are provided. Further, 5 nos of delivery mains of each dia 2.75 m; modified horse shoe free flow type tunnel of 6.7 m dia with a bed slope of 1:4000; canal of size 11.0m X 3.75 m with bed slope of 1:10000 & side slope 1:1.5 are

provided. Ten pumps including one no. standby with installed capacity of 12.2 MW each are provided.

In Link II, raising main of 22.3 km in two stages are provided and 6 nos. of delivery mains each dia 2.75 m dia. for a length of 10.90 km in stage-I pumping and 6 nos of delivery mains each of dia 2.75m for a length 11.4 km in stage-II pumping; approach channel of size 9.5 m X 4 m with bed slope of 1:10,000 and side slope 1:1.5; modified horse shoe free flow type tunnel of 7.3 m dia with a bed slope of 1:4000 are provided. In all, 13 with installed capacity of 13.0 MW each for Stage-I pumping and 13 nos. of pumps including one no. of standby with installed capacity of 8.3 MW each for Stage-II pumping are provided.

9.0 Reservoirs

Only two weirs and one barrage are proposed for diversion of surplus waters of Bedti basin to Varada/Dharma for augmentation/stabilization of existing Tungabhadra LBC command. The existing Dharma and Tungabhadra will function as balancing / service reservoirs. The controlling levels and storages of the ponds/ reservoirs are furnished below.

The details of the Dharma and Tungabhadra reservoirs are given below:

Description	Pattana-dahalla	Shalama-lahalla	Sure-mane	Dharma reservoir	Tungabhadra reservoir
FRL (m)	499	468	426	588.57	497.74
Live storage (Mm ³)	0.54	4.32	2.71	22.24	2855.87
Gross storage (Mm ³)				23.24	2855.87
DSL/MDDL (m)				579.73	477.01

10.0 Command area and suggested cropping pattern

The proposed Bedti-Varada(Link -I) and Bedti – Dharma (Link II) provide augmentation to a total 104900 ha in drought prone Manvi, Sirwar, Devdurgaand Raichur taluks of Raichur district of Karnataka state.

The details of link- wise command area to be benefitted under the link project are furnished below:

Command area benefited from the proposed link project

	Link	Annual irrigation (ha)	Utilisation (MCM)
1	Bedti-Varada(Link I)	60300	274
2	Bedti- Dharma (LinkII)	44600	202
	Total	104900	476

The cropping pattern is adopted as per the Tungabhadra LBC command and the same is furnished below.

Cropping pattern in command area

	LinkI		LinkII	
	ha	%	ha	%
Kharif				
Paddy	9045	15	6690	15
Jowar	8442	14	6244	14
Bajra	4221	7	3122	7
Maize	4221	7	3122	7
Cotton	12663	21	9366	21
Fodder	4211	7	3122	7
Groundnut	9045	15	6690	15
Chilies	4221	7	3122	7
Ragi	4221	7	3122	7
Total	60300	100.0	44600	100.0

11.0 Water planning

The proposed diversion of 524 MCM is planned to be utilized for the priority sectors like irrigation, domestic and industrial needs of the command area. The details are furnished below.

Sl. No	Irrigation (MCM)	Domestic (MCM)	Industrial (MCM)	Transmission losses	Total (MCM)
Link I	274	8	14	6	302
Link II	202	6	10	4	222
Total	476	14	24	10	524

12.0 Power

There is single stage pumping in Link I and two stage pumping in Link II. The details of lifting arrangements are furnished below.

Link / Component	Static head (m)	Installed capacity (MW)	Power requirement (MU)
Link I: Shalamalahalla to Varada	107.50	122	137.90
Link II: Suremane to Dharma	185.50	276.90	181.30
Total		399	319

13.0 Direct benefits

The direct benefits include irrigation of 104900ha of CCA under Tungabhadra LBC, the domestic and industrial needs in the command area. The details are furnished below.

Name of link	Irrigation (ha)		Domestic		Industrial (MCM)
	Annual irrigation	Utilisation (MCM)	Population (Nos)	Utilisation (MCM)	
Link I	60300	274	227238	8	14
Link II	44600	202	168134	6	10
Total	104900	476	395372	14	24

14.0 Other indirect benefits

Though not explicitly quantified as part of the present DPR, many other tangible and intangible benefits like development of agro based industries, food processing units, employment generation during construction period and thereafter, development of infrastructure, tourism, improvement of water table, quality of ground water etc. will accrue from the implementation of the link project. In all likelihood, the living standards and socio-economic status of the people of the region is set to be improved.

15.0 Tourism

Creation of ponds will make the environment more pleasant which will help develop tourism and water sports facilities such as boating, fishing etc. The tourist / picnic spots are proposed to be developed on the periphery of Pattanadahalla & Shalamalahallaweirs and Suremane barrage.

16.0 Construction equipment and manpower planning

The link project is proposed to be constructed in 5 years and the construction equipment and man-power planning has been made accordingly.

17.0 Environmental and ecological aspects

The water resources projects when built increase the water availability leading to various developmental activities and prosperity in the area, but some adverse impacts on the environment are also likely. To identify the possible environmental impacts, both positive and adverse due to the proposed Bedti-Varada link project and to suggest measures to mitigate or ameliorate the anticipated adverse impacts on the environment, the Comprehensive Environmental Impact Assessment Study of Bedti-Varada link project has to be carried out. The Water Resources Department, Govt. of Karnataka submitted the draft Terms of Reference (ToR) to MoEF&CC, Govt. of India for approval for conducting CEIA study. Since the MoEF&CC desired the State Government to finalize the technical aspects of the project at DPR level to ascertain the project specific ToRs, Govt. of Karnataka requested NWDA for preparation of DPR of Bedti-Varada link project in order to take up CEIA study with approved ToR of MoEF&CC. Accordingly, the preparation of the DPR is taken up and once the CEIA study is completed, the findings and recommendations would be suitably incorporated in the DPR of the project at a later stage.

18.0 Socio-economic aspects and R&R

The submergence under weirs/barrage is confined to the river banks. No habitations or people will be affected. Thus, no major adverse impacts are anticipated due to the link project from socio-economic point of view. The forest land of 243 ha and 50 ha of otherland will have to be acquired for implementation of the Bedti-Varada link project. Out of this, 132 ha of forest land and 30 ha of other land will be required for Link-I while 111 ha of forest land and 20 ha of other land is needed for Link-II.

No wild life sanctuaries or national parks are located in the project area. However, EAC of MoEF&CC during scoping observed that ‘Shalamala riparian ecosystem conservation reserve’ is part of the proposed Shalamalahalla reservoir and Bedti conservation. On the other hand, the link will provide irrigation to about 104900 ha of drought prone area in Raichur district under TBLBC. This will improve the social status of farmers/cultivators etc. Socio-economic conditions of the people living in the command area as well as in the vicinity of the project will improve in general.

19.0 Cost estimate

The estimated cost of the Bedti-Varada link project is Rs.2817.62 crore, out of which the cost of Link-I component will be Rs. 946.26 crore while that of Link-II component will be Rs. 1871.36 crore. The details are furnished below.

Abstract of cost of the Bedti-Varadalink project

Sl. No	Item	Estimated cost (Rs. in lakh)		
		Link-I	Link-II	Total
1.	Unit-I Head works	4894	10206	15100
2.	Unit-II Conveyance system	55972	100183	156155
3.	Unit-III Lifting arrangements	33760	76747	110507
	Total cost of the project	94626	187136	281762

The annual cost of the project including cost of maintenance of head works, depreciation, interest on capital cost etc. for the link project is Rs.451.87 crore. While the annual cost in respect of Link-I is Rs. 161.48 crore and the same in respect of Link-II is Rs.290.40 crore. The details are presented below.

Annual cost of the project

Sl.no	Component	Annual cost (Rs lakh)		
		Link I	Link II	Total
1	Interest on capital @ 10 % (Estimated total cost of the project including cost of land development)	9463	18714	28176
2	Depreciation of the project	946	1871	2818
3	Depreciation of the pumping system @ 8.33% (12 years)	2812	6393	9205
4	Power charges at Rs 1.80 per unit for total of 181.30 MU	1973	1291	3263
5	Maintenance of head works @ 1 %	49	102	151
6	Annual operation and maintenance charges at Rs. 1500/- per ha for 104900 ha (CCA)	905	669	1574
	Total annual cost (1 to 6)	16148	29040	45187

20.0 Sources of revenue

The benefits from the proposed Bedti - Varada link project include revenue from agriculture produce, irrigation service fee, domestic and industrial water supply, pisciculture and animal husbandry. These are the direct benefits which are regular and expected net benefits due to implementation of the link project. The details are furnished below.

Annual benefits from the link system

Sl No	Component	Annual benefits (Rs lakh)		
		Link I	Link II	Total
1	Irrigation	48364	35772	84136
2	M&I	15736	11248	26984
4	Irrigation cess	995	736	1731
5	Pisciculture	6356	4623	10979
6	Animal husbandry	708	545	1253
		72159	52923	125083

21.0 BenefitCost Ratio (BCR) and Internal Rate of Return (IRR)

The benefit - cost ratio (BCR) of the Bedti - Varada link project is worked out considering the annual cost of the link project and the annual likely benefits from the link project at 2020-21 price level. The economic parameters of various alternatives are furnished below.

Economic parameters of the link system

Name of the link project	BCR	IRR
Link I	4.47	38.65
Link II	1.82	18.85
Project as a whole	2.77	26.45

22.0 Other aspects

The DPR has been prepared considering most of the relevant aspects. The other aspects which are not in the scope of the present DPR, are discussed in the **Chapter 15: Other aspects**.

23.0 Statutory clearances

The detailed project report (DPR) along with the necessary CEIA studies, needs the following clearances by Govt. of India and the respective agencies.

Clearances required for the project

Sl.No.	Clearance	Agency
(i)	Techno-economic	Central Water Commission, TAC of Ministry of Jal Shakti.
(ii)	Forest Clearance	Ministry of Environment, Forest and Climate Change (MoEF&CC)
(iii)	Environmental clearance	Ministry of Environment, Forest and Climate Change (MoEF&CC)
(iv)	R & R Plan of Tribal population	Ministry of Tribal Affairs (MoTA)

After obtaining the above clearances, the Detailed Project Report will be submitted to the Ministry of Jal Shakti/NITI Aayog for investment clearance.

24.0 Fitment of the scheme in overall development of the region

The state of Karnataka being on the rain shadow part of western ghats, has several clusters of drought areas. However, the state is blessed with abundant rainfall in west flowing river catchments like Bedti. Utilisation of the surplus of west flowing Bedti in east flowing Krishna basin and its sub basins will be very much essential to balance the water resources availability in the state. The Bedti - Varada link project to transfer 524 MCM of water from Bedti to Tungabhadra, a tributary of river Krishna will meet the frequent shortages in the drought prone Raichur district.

25.0 Public cooperation and participation

The project will provide impetus to all-round development of the region and reduce the socio-economic imbalance by enhancing agricultural production and employment opportunities. Hence, co-operation and wholehearted participation is anticipated from the beneficiary areas. The link project has an added advantage of not having any major R&R problems as the submergence is confined to river banks due to construction of only weirs and barrage (instead of dams). The farmers will favour the project because of the assured water supply and other allied benefits that accrue from it.