

Chapter –1

Introduction

1.0 General

In the year 1980, the erstwhile Union Ministry of Irrigation and Central Water Commission (CWC), formulated a National Perspective Plan (NPP) for Water Resources Development in the country which comprises two Components: (i) Himalayan Rivers Development component; and (ii) Peninsular Rivers Development component. The National Water Development Agency (NWDA) was set up by the Government of India as an Autonomous Society under the Ministry of Irrigation on 17th July, 1982 to study the feasibility of the proposals of the National Perspective Plan and give concrete shape to these proposals. The NWDA after carrying out the detailed technical studies identified 30 link proposals for preparation of feasibility reports; 14 links under Himalayan Rivers Development component and 16 links under Peninsular River Development component. Bedti-Varada link is one of the 16 link proposals of Peninsular River Development component.

The Pre- Feasibility Report of Bedti-Varda link Project was prepared by NWDA during July 1995 and circulated among the concerned states and members of the Technical Advisory Committee (TAC) of NWDA. As per the PFR, the link envisaged diversion of 242 MCM available in Bedti basin to Tungabhadra sub-basin for stabilising the part command area under Tungabhadra LBC to the extent of 60200 ha.

National water Development Agency had additionally been given mandate to carryout the studies on intra-state river links as proposed by the states in 2006. A no. of intra-state river linking proposals have beenreceived

from different states. Among them, Government of Karnataka has proposed 6 intra state links and suggested that NWDA may study the proposals for establishing their feasibility. One of the intra-state links proposed by Govt. of Karnataka is Bedti - Dharma - Varada.

NWDA has studied the Bedti - Dharma-Varada link for availability of water, utilisation of water. The pre feasibility report of the link project was prepared and circulated in July 2017 among the concerned states and members of the Technical Advisory Committee (TAC) of NWDA. As per the PFR, the link envisages construction of a dam on Bedti river near Suremane, canal/tunnel alignment to divert 551 MCM of surplus waters of Bedti river towards eastern side of Western ghats to a stream leading to Dharma river to irrigate an area of 52900 ha in Hangal, Savanur and Haveri taluks in Haveri district, Shirhatti and Mundaragi taluk in Gadag district and further from Dharma reservoir for augmentation of requirement in the command area of Singatalur LIS for irrigating 25150 ha.

In the present DPR, the Bedti-Varada link originally proposed under National Perspective Plan is named as Link - I and the intra-state link of Bedti - Dharma-Varada link as Link - II and studied accordingly.

1.1 Brief description of the link project.

Bedti-Varada (Link-I) link envisages diversion of 302 MCM of monsoon surplus waters from the proposed Pattanadahalla and Shalamalahalla weirs across Pattanadahalla and Shalamalahalla streams of Bedti river towards eastern side of Western ghats to a stream leading to Varada river which is a tributary of Tungabhadra river to be utilised in the Tungabhadra left bank canal command. Pattanadahalla and Shalamalahalla

weir sites are proposed to be interconnected by a 6.9 km of conveyance system which includes 0.40 km canal and 6.5 km tunnel. Combined surplus water from Shalamalahalla is proposed to be lifted by about 107.5 m (static) from RL 463.0 to 570.50 m through a raising main of 10.15 km. Further, water will be carried through a tunnel of 6.70 km to cross Western ghats followed by an open canal of length 1.73 km to drop on eastern side into the stream leading to Varada river. Thus, total length of conveyance system (Link - I) will be 25.48 km.

Under Link - II, one barrage viz. Suremane is proposed across Bedti river for diversion of 222 MCM of water from Bedti river to Dharma river (a tributary of Varada river) through a 22.30 km long raising main, 0.35 km long DC cum approach and 4.23 km long tunnel. The water from Suremane barrage will be lifted by 185.5 m (120+65.5) in two stages.

1.1.1 Aim and justification of the project

Karnataka receives highest rainfall in coastal area i.e., Western side of Western ghats. The west flowing rivers originating in Western ghats carry abundant discharges during monsoon months. Due to steep slope and short length of the rivers, the topography of the region does not permit utilisation of entire waters within these basins. Whereas on eastern side of the Western ghats, the state receives scanty rainfall as it falls in rain shadow area and is chronically drought affected. Hence, the available monsoon surplus waters of Bedti basin are proposed to be diverted to eastern side of Western ghats at Pattanadahalla, Shalamalahalla and Suremane diversion sites.

1.2 Location of project area

The link project and its components (head works and conveyance system) lie in Sirsi and Yellapur taluks of Uttara Kannada district of Karnataka. Pattanadahalla&Shalamalahalla weir sites and the conveyance system of Link - I are located in Sirsi taluka of Uttara Kannada district. Suremane barrage site and the conveyance system of Link - II are located in Yellapur&Sirsi talukas of Uttara Kannada district. The detailed locations of the weirs are given below in **Table 1.1**.

Table 1.1

Sl. No	Name of the weir	Location		Latitude	Longitude
		Taluka	District		
1	Pattanadahalla	Sirsi	Uttara Kannada	14°40' 15" N	74°41' 18" E
2	Shalamalahalla	Sirsi	Uttara Kannada	14°42' 26" N	74°48' 31" E
3	Suremane	Yellapur	Uttara Kannada	14°52' 53" N	74°47' 13" E

1.3 Communication facilities

The entire project area of Bedti-Varada link is easily approachable through national/ state highways, major district roads and village roads. All the villages/towns in the vicinity of the project area are 100% electrified and are well connected by communication network. International airport of Bengaluru city is the nearest airport located at a distance of about 300 km from the project area. The nearest domestic airport is located at Hubli which is at about 120 km from Link-I area and 70 km from Link-II area.

Konkan railway connecting Mangaluru to Goa and another broad-gauge line connecting Bengaluru and Mumbai pass nearby. Haveri and Hubli are the nearest railway stations to the link project, connecting Bengaluru/Mumbai.

National highways NH 48 connecting Bengaluru to Mumbai, NH 66 connecting Mangaluru to Mumbai and NH 52 connecting Ankola to Hubli pass through and nearby the project area. The state highway SH 93 and SH 69 connecting Sirsi to Yellapur and Sirsi to Hubli are passing through the project area. The project area is approachable with other major district roads also.

The seaport of Gangavali is situated at the mouth of Gangavali (Bedti) river. However, Karwar sea port located at about 50 km from Link-I and 100 km from Link-II project area is the nearest sea port.

1.4 General climatic conditions of the state and project area

Karnataka state has tropical monsoon climate characterised by hot and moist summers and cool and dry winters. There is diversity in the climate of the state with the influence of geographical location, oceans, physical features, vegetation and monsoon winds. Hence, the annual temperature and distribution of rain are not the same all over the state. During summer season, high temperature is often registered in March; it is very hot, dry and sultry. After March, the temperature rises uniformly all over the state and reaches the maximum during April and May. Raichur district has recorded a temperature of 45.6°C and it is the hottest place in Karnataka state. The hot winds of the plains blow during April and May with an average velocity of 3.0 to 6.0 km/hour. The state experiences rains known as 'Cherry Blossoms' or the 'Mango showers'. During winter season, temperature, humidity and rainfall are low. The average temperature is

between 25°C and 27°C. January is the month which records the lowest temperature. The minimum temperature recorded in Belagavi is 6.70°C. During winters, the days are bright and warm and the sun is not too hot.

Karnataka gets all its rains from the south-west monsoon between June to September and north - east monsoon between October to December. The average annual rainfall in Karnataka ranges between 1248 to 3456 mm. The Malenadu and coastal plains receive heavy rainfall while the eastern maidans (plains) receive low rainfall. Often, droughts and floods occur due to uneven and uncertain rainfall. The broad variation in weather and rainfall among the three major geographical regions of the state is furnished in **Table1.2**.

Table1.2
Climate & rainfall in various geographical regions of Karnataka

Sl.No	Geographical	Temperature°C		Humidity	Rainfall
		Max	Min		
1.	The coastal strip	29-31	22-25	88%-96%	Moderate to high
2.	Northern interior	26-31	19-24	80%-96%	Moderate to high
3.	Southern interior	23-31	18-21	82% -100%	----

Source: Govt.of India, IMD, Meteorological Centre, Bengaluru.

The proposed weir/barrage sites viz. Pattanadahalla, Shalamalahalla & Suremane lie in Uttara Kannada district which has a tropical climate. It has a well-defined rainy season of about five months between June to

November mostly from south west monsoon and to some extent from north-east monsoon. The climate remains hot and humid. The winds are predominantly south westerly during the summer monsoon and north easterly during the winter monsoon. The climate year may broadly be classified into four seasons. The dry season is from January to February with clear and bright weather. It is followed by hot weather from March to May. During this season, thunderstorms are common in the month of May. The monsoon season is from June to September. The presence of Western ghats in Uttara Kannada district causes orographic precipitation. The link project area falls under hilly agro climatic zone. Mean annual rainfall in the district is 2718 mm.

The target command under the Tungabhadra left bank canal lies in Raichur district of Karnataka State. The climatic condition of the region can be termed as mild to severe, with mild winters and hot summers. December is the coldest month with mean daily minimum of 16.6⁰C, while May is the hottest month with mean daily maximum temperature of 40.4⁰C. The day temperature in May often touches 45.0⁰C. The south-west monsoon (June-September) brings 67% and northeast monsoon contributes 24% of annual rainfall in the district. The climatological parameters in the command area of the link project based on the data of Raichur IMD observatory are tabulated in **Table-1.3**.

Table-1.3
Climatological parameters in the command area of the link project

Sl.No.	Parameter	Max.	Min.
1	Air Mean Temperature (°C)	40.4	16.6
2	Relative Humidity(%)	74.0	23.0
3	Wind Speed (km/hr)	14.0	7.6
4	Cloud Cover (Octas)	5.8	2.8

5	Normal Monthly Rainfall (mm)	156.0	2.0
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Source: Climatological tables of India, IMD

1.5 Topography, physiography and geology of the area

1.5.1 Topography/physiography

The major part of Uttara Kannada district is covered by hilly areas belonging to Sahyadri hill ranges, except for the narrow coastal strip on western side and plain table and areas on eastern side. The land mass of the district is situated between the elevations of 0 to 800 m above MSL. The link project is lying in the hilly areas with elevation range from 400m to 650m from above MSL. The district has a coast line of 122 km.

The link project area in Uttara Kannada district is covered by reserved forest, dense forest, evergreen forest, isolated hills, undulating plains, broad flat terrains interspersed with isolated ridges and small hills and hillocks with bushes at some places.

The region of command area in Raichur district is undulating with black soil strips, cut by numerous nalas and characterise region of Dharwar schists. The region is rocky terrain on one side and acres of dry land on other side.

1.5.2 Geology

The main geographic feature of project area in Uttara Kannada district is Western ghats or Sahyadri range which runs from north to south. The area covers Western ghats moist deciduous forest. The Bedti river

plunges 180m in two leaps at Magod falls. Shivganga falls are where the river Sonda (Shalmali) drops by 74m.

Geologically, the area is underlain by the Peninsular gneissic complex of Archeans & meta volcano- sedimentary sequence of Dharwar super group & younger, intrusive at granites. All these lithounits have been intruded by basic & acid dykes. Laterites occur overlying the schist & granites and alluvium along the rivers & lagoons of the coast. Alluvium occurs along the river banks in few to 14 m thickness, holds the bank storage & occurs as narrow strip along sea coast and creeks occur upto a depth of 50m. During sub-recent to recent age, these rocks have undergone laterisation resulting in a cover of laterite varying thickness. Alluvial deposits of limited thickness occur along the major drainage course of Bedti river. The basic dykes (gabbro & dolerite) are common intrusive, especially in the eastern & southern sectors of area.

The target command area of the link project in Raichur district lies at about 450m above MSL. Granites, gneisses and Dharwar schists are the main rock formations in the region of Raichur district. They are grouped as hard rock as they do not have any primary porosity

1.6 Population

a) Affected

The submergence is confined to river portion at all the proposed weirs and barrages and land acquisition is limited to canal/tunnel/raising mains. The conveyance is mostly through dense forest and to some extent through other lands. The villages and project affected families whose lands are likely to be acquired shall be identified during CEIA study of the link project.

b) Benefitted

The monsoon surplus waters of Bedti river carried through the link project are proposed to be utilised to provide an annual irrigation of 104900ha in the Tungabhadra left bank canal command in the drought prone Raichur district of Karnataka state. A population of 268722 in the Manvi, Sirwar, Devdurga & Raichur taluks of Raichur district under TBLBC will get the envisaged irrigation benefits from the link project as detailed below in **Table-1.4**.

Table-1.4
Benefitted population from the link project

Sl. No.	S.C.	S.T.	Other Caste	Total
1	55858	51140	161724	268722

The population is predominantly rural as per 2011 census. Scheduled caste and Scheduled tribes comprise 21% and 19% of the benefitted population respectively.

c) Occupation

Out of 268722 of human population likely to be benefitted from the link project, about 34175 (12.72%) persons depend mainly on agriculture while 53433 (19.88%) persons are working as agricultural labourers and 181114 (67.40%) persons are involved as household workers and other workers. Due to augmentation of existing irrigation, the agricultural and allied activities get impetus and people involved in agricultural related activities get benefitted due to increased economic activities. Occupational details of population in the project command area are given below in **Table-1.5**.

Table-1.5
Occupational details of population in the command area under the link

Agriculture (Cultivators)	34175 (12.72%)
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Agriculture labour	53433 (19.88%)
Household & other workers	181114 (67.4%)
Total	268722

Source: District Census Handbooks, 2011.

1.7 Natural resources

1.7.1 Water resources

Bedti basin

The revised water balance study of Bedtibasin and upto Suremane diversion site (TS No. 97) prepared by NWDA, revealed that the estimated 75% and 50% dependable annual gross yields of the Bedti basin have been assessed to be 5877 MCM and 7614 MCM respectively. Out of the geographical area of 390200 ha, the maximum culturable area of the Bedti basin is 125559ha (32.18%). The annual irrigation from all the existing major, medium and minor projects is about 75335ha with the annual water utilization of about 425 MCM. **Table 1.6** furnishes the information on water resources scenario in various basins/ sub-basins/diversion sites pertaining to the project area.

Table 1.6

Water resources scenario in basins/sub-basins

Sl. No:	River basin/sub-basin	Basin/Sub-basin/ Weir/ Dam	Categorization for planning on the basis of availability of natural water
1	Bedti	Basin as a whole	Surplus
		Upto Pattanadahalla	Surplus
		Upto Shalamalahalla	Surplus
		Upto Suremane	Surplus

2	Tungabhadra	Basin as a whole	Surplus
		Upto Tungabhadra dam site	Deficit

Source: Water balance study reports of NWDA.

Bedti basin upto Pattanadahalla and Shalamalahalla weir sites

The catchment area of Bedti river upto Pattanadahalla weir site and Shalamalahalla weir site are 52.80 Sq.km and 169.42 Sq.km respectively. The revised water balance study of Bedti Basin upto Pattanadahalla and Shalamalahalla weir sites (TS No. 133) revealed that the 75% and 50% dependable annual net yields have been assessed to be 184 MCM & 226 MCM and 286 MCM & 365 MCM respectively. The maximum culturable area in the catchment upto Pattanadahalla is 896 ha (16.97%) while that upto Shalamalahalla is 2877 ha (16.98%). The ultimate annual irrigation by 2050 AD from surface water in the catchment upto Pattanadahalla is about 538 ha and that upto Shalamalahalla is 1726 ha with annual water utilization of about 2.8 MCM and 8.7 MCM respectively.

Bedti basin up to Suremane diversion site

The catchment of the Bedti river up to Suremane barrage site is 2078 Sq.km which is 53.26% of the total catchment of the Bedti basin. The estimated surface water balance at 75% and 50% dependability are 298 MCM and 962 MCM respectively. The ultimate annual irrigation by 2050 AD from surface water is estimated to be 60156 ha which is 60% of the culturable area of 100260 ha in the catchment with an annual utilisation of 334 MCM.

Tungabhadra sub-basin and upto Tungabhadra dam

The catchment area of Tungabhadra sub-basin is 47827 Sq.km out of which 38790 Sq.km area lies in Karnataka, 7481 Sq.km lies in Andhra Pradesh and 1556 Sq.km lies in Telangana. The water balance study report of the Tungabhadra sub-basin (TS No. 65) revealed that the surface water balance at 75% and 50% dependabilities are 866 MCM and 2597 MCM respectively. Out of the geographical area of 4782700 ha, the maximum culturable area of the sub-basin is 3271891 ha. The ultimate annual irrigation by 2050 AD from surface water is estimated to be 981564 ha which is 30% of the culturable area of the catchment with an annual utilisation of 10156 MCM.

The catchment area of Tungabhadra sub-basin up to Tungabhadra dam site is 28179 Sq.km which entirely lies in Karnataka. The estimated surface water balance at 75% and 50% dependabilities are (-) 712 MCM and 742 MCM respectively. The maximum culturable command area is 1760152 ha i.e., 62.46% of the basin area. The ultimate annual irrigation by 2050 AD from surface water is estimated to be 445089 ha which is 25.29% of the culturable area of the catchment with an annual utilisation of 4540 MCM.

1.7.2 Land resources

The target command area under the link project falls in Raichur district. Total geographical area of the district is about 844200 ha while the reporting area for land use statistics is 835843 ha. Out of this, 757008 ha is culturable area which is about 90.58 percent of the reporting area. The net area sown is about 602979 ha which accounts for 79.7 percent of the culturable area. The land use statistics of the district for the year 2018-19 are given in **Chapter 8: Irrigation Planning and CAD.**

1.7.3 Agriculture

The main food crops grown in the target command area are rice, wheat, sorghum (jowar), bajra, maize, ragi and sugarcane. The main cash crops of the region are cotton, groundnut and chillies. Scanty and unreliable rainfall resulting in frequent droughts and famines in the area has limited the progress of agriculture.

1.7.4 Mineral wealth

The project area lies in Uttara Kannada and Raichur districts of Karnataka. Uttara Kannada district is quite rich in mineral wealth. Iron and manganese are the major items while limestone, bauxite, quartz, silica, lime shells and sand are the other important minerals. The iron ore occurs mainly in the western half of the district in the taluks of Ankola, Honavar and Yellapur. The Dharwar rocks of the Raichur district are fairly rich in economic minerals. This mineral wealth includes gold, silver, copper, iron, galena, quartz, mica, feldspar, ochre, ilmenite, soapstone and granite. Raichur is the second district in the state, next to Kolar, in producing gold.

1.7.5 Industry

Traditionally, Uttara Kannada is known for sandal wood carving and cane work. The industries of district may be classified into 4 categories, 1) Agro-based 2) Marinebased 3) Forest-based and 4) Mineral based. There are numerous Rice mills and Khandasari manufacturing units all over the district. There are a few fruit processing factories and coir industrial units. The marine based industries are concentrated in the coastal zone and consist of boat building, production of fish oil and fish manure, ice plant and

freezing plants. Forest industries include the numerous saw mills, the plywood factory, veneers manufacturing unit and the paper mill. Ferromanganese and silicon-manganese unit as well as the caustic soda factory are the major mineral based industries.

Raichur district is known for its richness in oil seeds and so there is ample scope for setting up vegetable oil industry in the district. Extraction of oils from groundnut, cotton seed, castor, gingelly and safflower is undertaken in the district. Besides these, there are few mills engaged in spinning and cotton ginning in the district. The reinforced cement concrete pipes manufactured by Messrs Indian Hume Pipe Company Ltd, is another venture in the field of industrial sector in the district. Apart from these few large-scale industries, the district is famous for its village and cotton industries like handloom weaving, leather working, salt making, carpentry, pottery and hand embroidery.

1.7.6 Tourism

The Mahabaleshwar temple is located in Gokarna, 32 km away from Kumta taluk, a sacred pilgrimage site in the Uttara Kannada district of Karnataka. One of the seven Mukti Sthalas of Karnataka, Gokarna is also known for its idyllic beaches and serene landscape. Raichur fort is another tourist attraction. Besides, there are a no. of visiting places locally in the project area.

1.8 Land use and socio-economic aspects

1.8.1 Cropping pattern

The cropping pattern in Raichur district is dominated by semi dry crops in both kharif and rabi seasons. These constitute to 73% of the cropped area, while cotton and paddy occupy 12% and 9% respectively.

1.8.2 Socio-economic aspects

The diverted water is proposed to be utilised in Manvi, Sirwar, Devdurga and Raichur taluks of the Raichur district under Tungabhadra left bank canal command to augment irrigation in 104900 ha annually. The Raichur district is one of the most drought affected and backward districts of the state. The district comes under Kalyana Karnataka Region which is backward region and is given special status under article 371 J by Parliament of India. Based on the available statistics for the four taluks in the project command area, certain socio-economic aspects are furnished below in **Table 1.7**.

Table-1.7

Socio-economic aspects in the command area of the link project

Sl.	Aspect	Manvi (including Sirwara)	Devadurga	Raichur
1	Area (Sq.km)	1809	1504	1546
2	Population	370670	280606	498637
3	Rural	324205	251677	247476
4	Urban	46465	28929	251161
5	% of Urban	12.54	10.31	50.37
6	Population density / Sq.km	205	187	323
7	literate	173380	116048	279078
8	Scheduled caste	78056	60478	104849
9	Scheduled tribe	89190	96535	63178

10	Total workers	183551	139095	218491
11	Cultivators	49360	48184	39173
12	Agriculture labourers	98965	67448	68080
13	Workers in household industries	3182	2138	5216
14	Other workers	32044	21325	106022

Source: District Census of Handbooks,2011.

Maximum of land holdings in the command area (Manvi, Devadurga and Raichur taluks as per 2015-16 census) i.e., 40% belongs to marginal category owning less than 1 ha, and the income from agriculture is very less.

1.8.3 Drought prone areas

Due to both spatial and temporal variation in rainfall, hydro-meteorological disasters like droughts and floods occur simultaneously in the different regions of the Karnataka state. Droughts are more common than the other disasters in the state thus affecting rain-fed agriculture production system. The State also has huge arid and semi-arid land and is highly vulnerable to drought. Raichur district where the command area lies is one of the most drought prone districts in the state.

1.8.4 Ground water

The target command area under the link project lies in Manvi, Sirwara, Devadurga and Raichur taluks of Raichur district. The Sirwara taluk was carved out of Manvi taluk in 2017. The ground water availability and existing draft in the taluks pertaining to the command area is given **Table1.8.**

Table 1.8
Groundwater availability and existing draft in
the target command area

Unit: ham

Taluk	Net Annual GW availability	Existing draft for irrigation	Provision for D&I use	Balance available for irr. development	Existing stage of GW development
Devdurga	7133	2170	667	4296	38%
Manvi*	34285	5861	996	27428	19%
Raichur	7465	4838	717	1910	70%

* including Sirwara taluk

Source: Ground water information booklet, CGWB-2013 for Raichur district.

1.8.5 Water quality

The ground water quality monitoring in the project area has been done by the CGWB under Hydrology Project by constructing several ground water monitoring wells (dug wells), piezometers and exploratory bore wells. Various parameters viz., the depth of ground water table, rate of ground water discharge, storability, transmissivity etc. have been observed. Groundwater in major parts of Raichur district contains fluoride. While in Uttara Kannada district, the ground water study reveals that the quality of ground water in the urban areas is good and useful for all purposes. The detailed information on water quality is furnished in Chapter-10 'EIA and EMP'.

1.9 Earlier proposals

The PFR of Bedti-Varada link project was circulated in 1995 under National Perspective Plan to divert 242 MCM of the monsoon surplus waters of Pattanadahalla and Shalamalahalla, streams of Bedti river to Varada river a tributary of Tungabhadra river to be utilised in the Tungabhadra left bank canal command.

The Govt. of Karnataka has proposed Bedti - Dharma - Varada link which envisages diversion of 566.4 MCM (20 TMC) of water to

Tungabhadra sub-basin of which 283.2 MCM (10 TMC) shall be diverted from the surplus available in Bedti basin and another 283.2 MCM (10 TMC) that would be received from Almatti dam for irrigating 129925 ha in Haveri, Davangere and Bellary districts. Recently, Govt. of Karnataka suggested an alternate proposal to divert the combined waters of Bedti from Pattanadahalla, Shalamalahalla and Suremane diversion sites through ridge of Tungabhadra and Malaprabha to the proposed Hirevaddati reservoir on the ridge on the left flank of Tungabhadra reservoir.

1.10 Present/alternate studies at DPR stage

Keeping in view the merits, the present proposal has been evolved by merging the Bedti - Varda link (**Link I**) and Bedti (Suremane) - Dharma - Varada (**Link II**) to utilise about 524 MCM of Bedti water in Tungabhadra sub-basin. The detailed project report thus covers the NPP proposal as well as the intra - state proposal of Govt. of Karnataka studied by NWDA viz. 1) Bedti (Pattanadahalla&Shalamalahalla)-Varada link project (Link - I) 2) Bedti (Suremane)- Dharma link project (Link - II).

1.10.1 Main components of present proposals.

1.10.1.1 Bedti (Pattanadahalla, Shalamalahalla)-Varada link project (Link-I)

i) Weir on Pattanadahallastream.

It is proposed to construct a weir with FPL of 499.0 m instead of a dam on Pattanadahalla stream at longitude of 74°41' 18" E, and latitude of 14°40' 15" N to avoid submergence of precious forest. The water spread area is proposed to be confined within the river banks. The waters from Pattanadahalla will be diverted through canal/tunnel to Shalamalahalla stream.

ii) Weir on Shalamalahalla stream

Similarly, it is proposed to construct a weir with FPL of 468.0 m instead of a dam on Shalamalahalla stream at longitude of 74°48' 31" E and latitude of 14°42' 26" N to avoid the submergence of precious forest. Here also, the water is proposed to be stored within the river banks and will be lifted instantly to divert to the stream on easternside of Western ghats, leading to Varada river.

iii) Conveyance system

i) An inter connecting system of 6.9 km comprising an approach channel of 0.10km, a 6.5 km tunnel and a canal of 0.30 km is proposed to carry the water from Pattanadahalla to the stream leading to Shalamalahalla.

ii) A raising main is proposed from Shalamalahalla to lift the combined waters of Pattanadahalla and Shalamalahalla weirs for about 107.50m(static). Thereafter, water is carried through a tunnel & canal to a stream leading to Varada river. The conveyance system from Shalamalahalla to the stream will be 18.58 km of which 10.15 km is raising main, 6.7 km is tunnel and 1.73 km is canal. Total length of Link-I will be 25.48 km (6.9+18.58).

1.10.1.2 Bedti(Suremane) - Dharma link project (Link-II)

i) Barrage on Bedti river near Suremane village

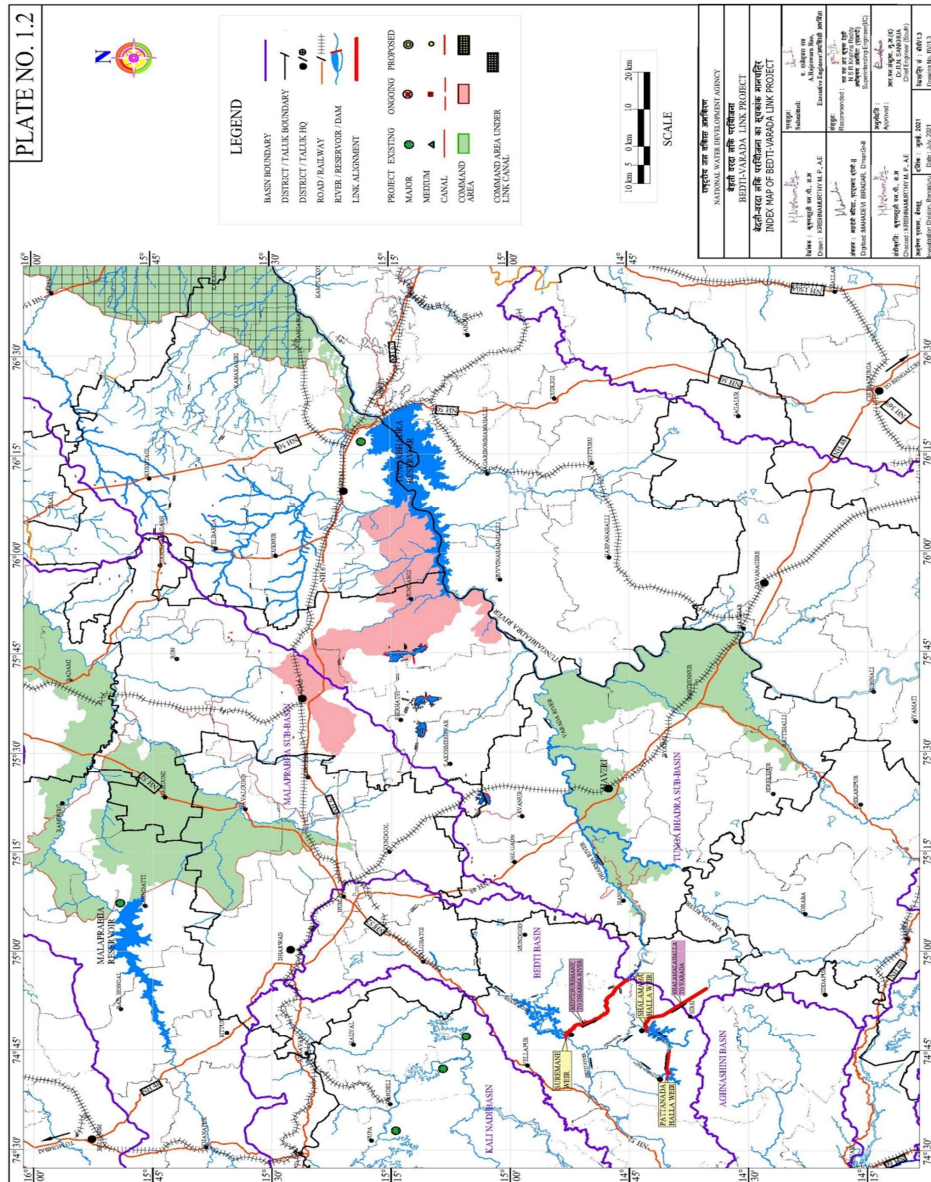
A barrage with FPL 426.0 m is proposed on Bedti river near Suremane village instead of a dam at longitude of 74°47' 13" E and latitude of 14°52' 53" N to avoid the submergence of precious forest. The water is stored within the river banks and will be lifted instantly to divert to a stream on easternside of Western ghats, leading to Dharma river.

ii) Conveyance system.

A raising main is proposed to lift the water from Suremane village to the delivery cistern and further the water will be carried through an approach and a tunnel to a stream leading to Dharma river. The water is to be lifted for a static head of about 185.5 m (120+65.5) in two stages. Total length of the conveyance system in link-II will be 26.88 km which includes 22.3 km long raising main, 0.35 km DC cum approach and 4.23 km long tunnel.

The vicinity map of the link project is available at **Plate 1.1**. The Index map of Bedti-Varada link project is given at **Fig. 1.1** and appended as **Plate 1.2**. The schematic diagram of the proposed link project is depicted in **Fig. 1.2**.

Fig 1.1 Index map of Bedti – Varada link project



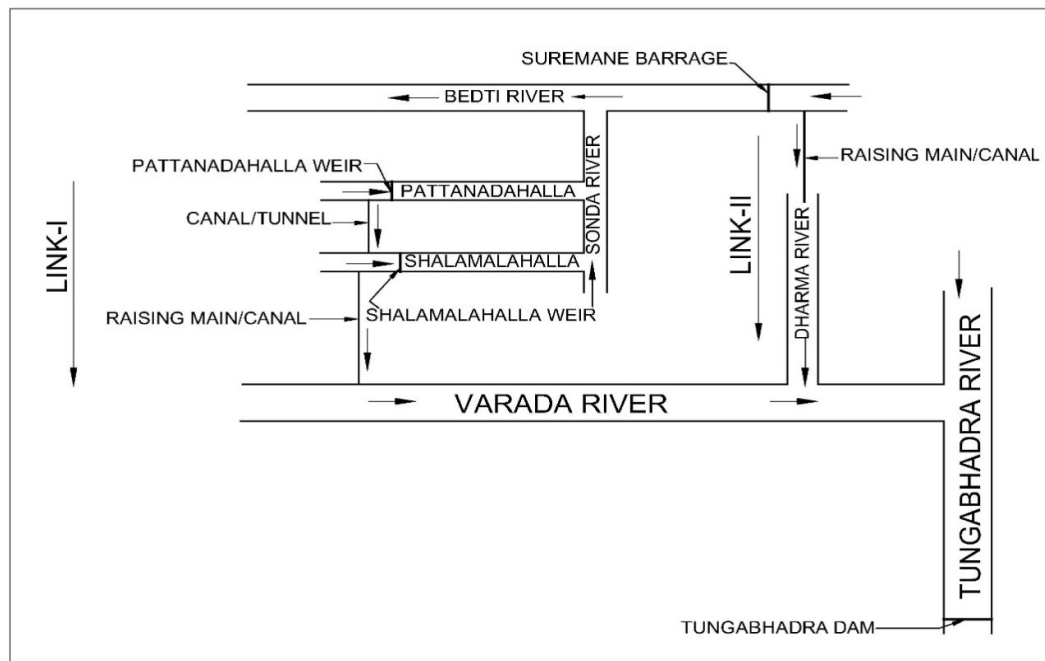


Fig 1.2 Schematic diagram of Bedti - Varada link project

1.11 Project planning and optimisation of benefits and stages/phases of development

The Bedti (Pattanadahalla, Shalamalahalla)-Varada Link (Link-I) and Bedti (Suremane) – Dharmalink(Link-II) are proposed to divert 302 MCM and 222 MCM respectively, of surplus monsoon water from Bedti basin to Varada, a tributary of Tungabhadra river to be utilised in the Tungabhadra left bank canal command since the water balance at Tungabhadra dam is deficit to the tune of (-)712 MCM and TBLBC is not achieving 100% intensity of irrigation due to shortage of water. This diversion will augment the existing command area of Tungabhadra dam.

The overall benefits from the Bedti - Varada link project are described below:

a) Irrigation benefits

The Bedti-Varada link project will help in augmenting the existing command area of Tungabhadra left bank canal by envisaging to provide annual irrigation to the extent of 104900ha.

b) Domestic and Industrial water supply

The link project will provide 14 MCM of domestic water which will serve population of 438988 Nos. and 24 MCM of industrial water in Raichur district of Karnataka.

c) Ground water recharge

The link proposal is likely to recharge/increase the ground water table. It enhances the scope for additional irrigation during rabi season in the command area through conjunctive use.

III Other benefits

Many other incidental benefits like development of agro based industries, food processing units, employment generation during construction and operation periods, development of infrastructure, improvement of ground water table and quality of water etc. will accrue from the project. The living standards along with socio-economic status of the people of the region will be greatly improved. The project being just a short west-east link unlike other mega ILR projects, can be executed in a single stage.

1.12 Fitment of scheme in overall development of region

The Tungabhadra project is not able to meet its envisaged requirements under various uses. As a result, the command area under the project is not getting the required quantum as per the needs. Therefore, Bedti-Varada link project is essential to provide the necessary impetus to the irrigation development in the project command (TBLBC). The link canal will immensely benefit the Tungabhadra project by envisaging to cover an extent of 104900ha under TBLBC. Besides, the project will improve the ground water condition and provide opportunities for tourism development, fisheries development apart from providing employment to people during its construction and maintenance phases.

Thus, the link project will fit well in contributing to the overall development of the region, like a spoke in the wheel. The project will contribute to all-round development of the region and reduce the socio-economic imbalance by enhancing agricultural production and employment opportunities.

1.13 Intimation to the other development authorities regarding this scheme

The Bedti-Varada link (Link-I) is an NPP proposal. The pre-feasibility report of the proposal has been prepared by NWDA during 1995 and circulated to all the concerned. The PFR was approved in the 25th meeting of the TAC of NWDA held on 23.12.1996 after detailed discussions.

The Bedti-Dharma-Varada link (Link-II) is an intra state link proposal of Govt. of Karnataka. The detailed study has been carried out on the proposal i.e., availability of water, proposed command area etc. and PFR of

the proposal was prepared by NWDA during 2017 and circulated to the all stake holders.

The above proposals (Link-I&II) are within Karnataka state. The reports have been sent to the Govt. of Karnataka, Central Water Commission, Central Electricity Authority and riparian states. Govt. of Karnataka has nominated the Superintending Engineer, Malaprabha Project Zone, Dharwad as Nodal officer to coordinate with NWDA about the scheme.

1.14 Experiences of Inter linking of rivers in India

There are several living examples of interlinking of rivers are there in India. Periyar project of the 19th century to transfer of water from Periyar basin to Vaigai basin; Parambikulam-Aliyar to transfer water from Chalakudy basin to Bharatapuzha and Cauvery basins; Kurnool - Cudappah canal to transfer water from Krishna basin to Pennar basin; Telugu Ganga project to transfer water from Krishna basin to Chennai city; Ravi-Beas-Sutlej- Indira Gandhi Nahar project; Sardar Sarovar project to transfer surplus water to Saurashtra and Kutch region of Gujarat and desert area of Jalore and Barmer districts in Rajasthan are some of the examples. These examples indicate that the uneven distribution of rainfall with respect to space and time can be made even with interlinking of rivers.

1.15 Methodology adopted

The Pre-feasibility reports Bedti-Varada NPP proposal and Bedti-Dharma-Varada intra state link proposal prepared by NWDA formed the basis for the preparation of Detailed Project Report.

1.15.1 Surveys & Investigations

The work for preparation of detailed project report of Bedti-Varada link project has been taken up by office of the Executive Engineer, Investigation Division, National Water Development Agency, Bengaluru under the administrative control of the Superintending Engineer, Investigation Circle, Hyderabad in the jurisdiction of the Chief Engineer (South), Hyderabad. The present DPR is prepared based on toposheets and DEM data. The field surveys & investigations shall be carried out at pre – construction stage.

1.15.1.1 Topographical surveys

The following field surveys & investigations of the project have to be carried out. Survey for connection of GTS Benchmarks and establishing Permanent Benchmark (PBMs) and Temporary Benchmark (TBM) levels along the link canal /tunnel/raising main and at various locations in the vicinity of the project area.

- (i) Weir/barrage axis survey for Pattanadahalla/Shalamalahalla and Suremane diversion sites
- (ii) River surveys of Pattanadahalla, Shalamalahalla and Bedti rivers about 10 km from d/s of the weir/barrage locations, Dharma river from link outfall to confluence with Varada river and Varada river from link outfall to confluence with Tungabhadra river.
- (iii) Firming up of the link canal/tunnel/raising main alignment and L-section and cross section surveys

No new command area is proposed as the proposal is to augment the existing command area of Tungabhadra left bank canal command. As such, no sample command area surveys are required to be carried out.

1.15.1.2 Investigations by other agencies

Along with the topographical surveys, the following investigations required to be carried out by engaging expert organisations are also proposed to be carried at pre-construction stage as mentioned in **Table1.9**.

Table1.9
Investigations to be carried out by engaging expert organisations

Geological investigations, geological mapping	GSI, Bengaluru
Geophysical investigations	CSIR–NGRI, Hyderabad
Geotechnical investigations and borrow area Survey	CSMRS, New Delhi
Construction Material Investigations	CSMRS, New Delhi
Testing of Rock core samples	CSMRS, New Delhi
Mineral Survey	GSI, Bengaluru
Archaeological Surveys	Archaeological Survey of India

1.15.2 Technical studies

1.15.2.1 Hydrological studies

NWDA has carried out the hydrological studies of entire Bedti basin, Bedti Basin up to Suremane, Pattanadahalla and Shalamalahalla diversion sites and assessed the gross monsoon yields at 75% and 50%

dependabilities. Based on this, the surface water balance upto diversion sites, taking in to account the availability, import, export, regeneration and water needs for the basin upto the diversion sites was worked out at 75% and 50% dependabilities. Further from daily simulation, the diversion quantities from these sites have been firmed up as 302 MCM from Link-I (114 MCM from Pattanadahalla and 188 MCM from Shalamalahalla diversion sites) and 222 MCM from Suremane diversion site (Link-II).

1.15.2.2 Irrigation planning and command area

The project is proposed to augment the existing command area of Tungabhadra left bank canal command which is reeling under water shortage. Stabilisation of existing command through supply in Kharif season is the priority under this proposal.

1.15.2.3 Design of important project components

Bedti-Varada proposal(Link-I)

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) 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.

Bedti-Dharma proposal(Link-II)

The design components involved are i) barrage at Suremane on Bedti river, ii) 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.

1.15.2.4 Construction program, man power and plant planning

The construction program, man-power and plant planning have been carried out departmentally.

1.15.2.5 Socio-economic survey, Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP)

Socio-economic survey, Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) have to be taken up by the project proponent i.e. Government of Karnataka. Approval for Terms of Reference to conduct the CEIA study will be obtained by the state from MoEF&CC, New Delhi submitting the Detailed Project Report of the link project.

1.15.2.6 Cost estimate

The cost estimate has been prepared considering the quantities worked out based on the design of various structures involved in the project. The estimates for the project are prepared based on the 'Guidelines for Preparation of Detailed Project Report of Irrigation and Multipurpose Projects' (2010) of the then Ministry of Water Resources (Now Ministry of Jal Shakti), Govt. of India. The cost estimates have been framed on the basis of the 2020-21 Schedule of Rates of WRD, Govt. of Karnataka.

1.16 Public announcement and public hearings

The benefits to be accrued from the proposed link project have been brought to the notice of the general public through local news papers by Govt. of Karnataka and the NWDA officials explained from time to time bringing out its importance to meet the water shortage of the region. The public hearings will be taken up at appropriate time during environmental impact assessment study of the link project.

1.17 Inter-linking of the scheme with neighbouring schemes.

The existing Dharma reservoir on Dharma river and Tungabhadra reservoir on Tungabhadra river are planned to be integrated/utilized in Bedti-Varada link project. Dharma reservoir will be used as a transit reservoir for the waters received through Link-II from Suremane. The Tungabhadra reservoir will receive the total link diversion of 524 MCM(Link I & II) during monsoon period and function as storage reservoir to release the water as per the requirements of the TBLBC command in Kharif season.

1.18 Inter-state/International aspects.

There are no International boundaries concerning the project area, hence no such issues are involved. Surplus water is being utilised in the Tungabhadra sub basin of Krishna basin. The Krishna river is inter-state river involving Maharashtra, Karnataka, Telangana and Andhra Pradesh. Hence, the inter - state aspects on account of the link project in accordance with the prevailing Awards, Acts and Agreements governing the Krishna basin may have to be considered. The inter-state issues are dealt in detail in **Chapter 3: Inter-state aspects.**

1.19 Cost and benefit of the scheme.

1.19.1 Cost of the project.

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 in **Table-1.10**.

Table-1.10
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. 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. 290.40crore. The details are presented in **Table-1.11**.

Table-1.11
Annual cost of the link 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 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

1.19.2 Benefits from the project.

The annual benefits from the project will be Rs. 1250.83 crore as revenue from agricultural produce, domestic and industrial water supply, irrigation cess, pisciculture and animal husbandry against the annual cost of Rs.451.87 crore. Thus, the B.C. ratio of the link project has been worked out as 2.77 with that for Link-I at 4.47 and Link-II at 1.82. The internal rate of return is found for the whole project is worked out 26.46% with that of Link I at 38.65% and Link II at 18.95%.

1.20 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 whole hearted 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 be in favour of the project because of the assured water supply and other allied benefits that accrue from it.

1.21 Clearances required

The Bedti-Varada link project will require the following clearances from the departments/agencies indicated below in **Table-1.12**.

Table-1.12
Clearances required from other departments/agencies

Sl. No.	Clearance	Departments/Agencies
(i)	Techno-economic clearance	Central Water Commission/TAC, Ministry of Jal Shakti
(ii)	Forest clearance	MoEF&CC, New Delhi.
(iii)	Environmental clearance	MoEF&CC, New Delhi.
(iii)	Wild life clearance	Central Empowered Committee

The above clearances shall be obtained by the State Government, as project proponent, before taking up the implementation of the project.