

## **EXECUTIVE SUMMARY**

### **Cauvery (Kattalai) - Vaigai - Gundar link project**

#### **1.0 National Perspective Plan (NPP) for Water Resources Development**

Realizing the need for achieving a balanced regional development, the erstwhile Union Ministry of Irrigation and the Central Water Commission (CWC), formulated in the year 1980, a National Perspective Plan (NPP) for water resources development which comprises two components viz. the Himalayan rivers development and the Peninsular rivers development.

#### ***Peninsular rivers development***

This scheme envisages, as its **first** part, the diversion of surplus flows of the Mahanadi to the Godavari system and further transfer along with the surplus water from Godavari system to the Krishna, Pennar, Cauvery, Vaigai and Gundar basins through the nine-link system.

This would benefit areas of Andhra Pradesh, Karnataka, Odisha, Tamil Nadu, Telangana and Pondicherry.

#### ***Proposed link canals between Godavari and Vaigai as per NPP***

The hydrological analysis of various river basins by NWDA revealed that the surplus in the Mahanadi basin near Manibhadra is about 12165 MCM and that in Godavari basin at Inchampalli and Polavaram is about 20327 MCM and 15020 MCM at 75% dependability duly considering the demands in the basins at the ultimate stage of development (i.e. by the year 2050 AD).

On the other hand, the deficits in Krishna basin at Nagarjunasagar and Pulichintala will be of the order of 1525 MCM and 671 MCM respectively and the same at Prakasam barrage will be 3235 MCM. Considering these water balance scenarios, it has been proposed to divert 12165 MCM of water from the Mahanadi river to the south through the Mahanadi - Godavari link, the first of the nine link system. The transferred water will be partly used for irrigation

enroute in the States of Andhra Pradesh and Odisha and the remaining quantity of 6500 MCM will be received in Godavari. About 21520 MCM of water including 6500 MCM received from Mahanadi and the 15020 MCM of surplus available in Godavari at Polavaram, will be transferred to Krishna river system through three links, viz.,

1. Polavaram - Vijayawada link,
2. Inchampalli - Pulichintala link, and
3. Inchampalli - Nagarjunasagar link.

These link canals cater to the requirements of irrigation, domestic and industrial uses enroute besides meeting the deficit in the Krishna basin. Part of the water received in Krishna from Godavari is further diverted to Pennar, Cauvery, Vaigai and Gundar river systems through a network of the following link canal projects to meet the deficits as possible in Pennar & Cauvery basins besides providing domestic, irrigation and industrial water benefits enroute.

4. Krishna (Almatti) - Pennar link
5. Krishna (Srisailam) - Pennar link
6. Krishna (Nagarjunasagar) - Pennar (Somasila) link
7. Pennar (Somasila) - Palar - Cauvery (Grand Anicut) link
8. Cauvery (Kattalai) - Vaigai - Gundar link

The link canals proposed under southern water grid i.e Mahanadi - Godavari-Krishna-Pennar-Cauvery-Vaigai-Gundar link system of peninsular component are furnished in **Plate 1.1**.

### **1.1 Aim of the link project and description of works**

The nine link system has been planned based on the surpluses in Mahanadi & Godavari basins and proposed storages at Manibhadra on Mahanadi & Inchampalli on Godavari. These two dams have not been taken up so far by the State Govts in view of submergence and inter-state issues.

Further, the water balance studies in Mahanadi and Godavari have been updated recently. The water balance study in Mahanadi basin at Barmul (2018) indicates a surplus of 6794 Mcum only. Similarly, as per the updated water

balance study in Godavari basin at Inchampalli (2018), there is only surplus of 5002 Mcum. Similar study for Godavari basin upto Polavaram is under preparation. As can be seen, the surpluses in Mahanadi & Godavari have reduced as per the updated WBS. The planning of Mahanadi - Godavari link is therefore under revision in consultation with Govt of Odisha. Once the issue of surplus water in Mahanadi basin is finalized with the concurrence of Govt of Odisha, the amount of water that can be transferred to Godavari basin can be quantified. The reduced surpluses in Mahanadi & Godavari basins are proposed to be supplemented from a part of about 11 BCM of water transfer being envisaged through Himalayan links to the Peninsular nine link system under Phase-II, to ensure water transfer from Godavari and beyond upto Gundar as originally planned. This proposed supplementation from Himalayan component to Mahanadi basin is also under finalisation.

### **1.1.1 Firming up of the proposal for DPR**

Keeping in view the above, it is proposed that the originally contemplated nine link system will be taken up in two phases.

- a) Phase I: Identifying surplus waters in Godavari basin without affecting the interests of the co-basin States and transferring these waters up to Cauvery through Godavari - Krishna - Pennar - Palar - Cauvery link system while meeting the requirements of the areas enroute, to the extent possible.

Phase I comprises the following links:

1. Godavari (Inchampalli)/Janampet - Krishna (Nagarjunasagar) link
2. Krishna (Nagarjunasagar) - Pennar (Somasila) link
3. Pennar (Somasila) - Cauvery (Grand Anicut) link

The draft DPR of Godavari (Inchampalli/ Janampet) - Cauvery (Grand Anicut) link project was circulated to concerned states in March 2019 as Phase I of the peninsular component of inter basin water transfer.

- b) Phase II: On firming up surplus water in Mahanadi at Manibhadra and techno economic viability of linking Brahmaputra - Ganga - Subernarekha - Mahanadi - Godavari rivers, thus enriching the Phase I with suitable modifications.

Phase II comprises the following additional links:

1. Mahanadi (Barmul ) - Godavari (Dowlaiswaram) link
2. Godavari (Polavaram) - Krishna - Pennar link (being planned by Govt of AP)
3. Krishna (Almatti) - Pennar link
4. Krishna (Srisailam) - Pennar link
5. **Cauvery (Kattalai) - Vaigai - Gundar link**

The link canals proposed under southern water grid i.e Mahanadi - Godavari-Krishna-Pennar-Cauvery-Vaigai-Gundar link system of peninsular component are furnished in **Plate 1.1**. The schematic line diagram of the link system indicating the major river linking is given at **Plate 1.2**.

### **1.1.2 The link proposal**

The Cauvery (Kattalai) - Vaigai - Gundar link project which forms part of Phase II of the nine-link system connecting Mahanadi - Godavari - Krishna - Pennar - Cauvery - Vaigai - Gundar is envisaged to divert 2252 MCM of water from Kattalai barrage in partial exchange to the waters received through the proposed Pennar (Somasila) – Palar – Cauvery (Grand Anicut) link. The proposed link canal comprises of the following components.

1. An existing barrage across Cauvery river at Kattalai with pond level of 101.20 m on the U/s of Grand Anicut and about 138km downstream of the existing Mettur dam.
2. A head regulator on the right flank of the barrage with discharge capacity of 180.30 cumec.
3. A link canal of 256.82 km taking off from the Kattalai barrage with FSL of 100.75 m and design capacity of 180.30 cumec.

4. Four tunnels of total length 15.54 km, located at 82.300 km (3.940 km), RD 104.100 km (6.040 km) RD 148.100 km (3.630 km), and RD 156.300 km (1.930 km)
- 5 12 branch canals and 25 direct sluices to facilitate irrigation in the command area.
- 6 464 Nos. of cross drainage/ cross masonry and regulating works across the link canal.
- 7 New command of about 4.48 lakh ha at 100% intensity in Karur, Tiruchirappalli, Pudukkottai, Sivaganga, Ramanathapuram, Virudhunagar and Thoothukudi districts.

## 1.2 Location of project area

The Cauvery (Kattalai) - Vaigai - Gundar link project traverses through Cauvery, Vaigai and Gundar basins and lies in the state of Tamil Nadu. The alignment of the link canal passes through the districts of Karur, Tiruchirappalli, Pudukkottai, Sivaganga, and Virudhunagar.

The index map of the Cauvery (Kattalai) - Vaigai - Gundar link project is shown in **Plate 1.3**.

## 1.3 Implications of Cauvery -Vaigai -Gundar link proposal

The Cauvery is a deficit basin. No diversion of water from the in basin flows of the Cauvery river to other basins is proposed through the Cauvery - Vaigai - Gundar link canal. The Mahanadi –Godavari link envisages diversion of about 6500 Mm<sup>3</sup> to the Godavari basin at Dowlaiswaram. The surplus in Godavari basin at Polavaram was assessed to be 15017 Mm<sup>3</sup>. This combined surplus of 21517 Mm<sup>3</sup> is proposed to be transferred to Krishna basin through three link projects viz. Inchampalli-Nagarjunasagar, Inchampalli-Pulichintala & Polavaram – Vijayawada. The Inchampalli - Nagarjunasagar link envisages diversion of 16426 Mm<sup>3</sup>, out of which 14200 Mm<sup>3</sup> will be received at Nagarjunasagar, the remaining being utilized for enroute requirements and transmission losses. From Nagarjunasagar, about 12146 Mm<sup>3</sup> is proposed for further transfer to Pennar, out of which 8426 Mm<sup>3</sup> will be received at Somasila

in Pennar basin after meeting enroute requirements and transmission losses. Besides, there will be a diversion of 2095 Mm<sup>3</sup> to Somasila reservoir in Pennar basin through Srisailem-Pennar link. Thus, a total quantum of 10521 Mm<sup>3</sup> (8426 Mm<sup>3</sup> + 2095 Mm<sup>3</sup>) of water is brought to Somasila reservoir in Pennar basin through the two links from Krishna basin. Out of this 1956 Mm<sup>3</sup> is proposed to be utilized for Pennar delta (1066 Mm<sup>3</sup>) and Telugu Ganga project (890 Mm<sup>3</sup>). Of the balance quantity of 8565 Mm<sup>3</sup> (10521-1956), 4710 Mm<sup>3</sup> is proposed to be utilized through Somasila-Grand anicut link for enroute irrigation (3048 Mm<sup>3</sup>), Domestic & Industrial use (1105 Mm<sup>3</sup>) and Transmission losses (557 Mm<sup>3</sup>). Thus the balance quantity of water available for further diversion / utilization is 3855 Mm<sup>3</sup>. The diversion of 2252 Mm<sup>3</sup> of water proposed through the link canal from the Kattalai barrage is out of this 3855 Mm<sup>3</sup> of surplus waters of Mahanadi and Godavari proposed to be brought into Cauvery basin. In view of the reduced surpluses in Mahanadi and Godavari basins as per the updated water balance studies, the peninsular link system is proposed to be supplemented from a part of about 11 BCM of water transfer being envisaged through Himalayan links under Phase-II, to ensure the above water transfers intact. Thus, this link connecting the Cauvery and Gundar rivers serves as a conduit for the transfer of surplus waters of Himalayan, Mahanadi and Godavari rivers.

In view of the above, a consensus has to be arrived at among all the concerned States of the Himalayan and Peninsular river basins, for the implementation of the Peninsular rivers link system including the Cauvery - Vaigai - Gundar link. The existing interstate agreement for various river basins will also have to be reviewed and modified accordingly.

#### **1.4 Survey and investigations**

Detailed surveys and investigations such as topographical surveys, geological, geophysical & geotechnical investigations including foundation investigations i.e. drilling bore holes at identified major CD/CM structures, for obtaining rock cores; Construction materials investigations; Geotechnical investigations (soil) including borrow area surveys; Command area surveys etc.,

that were undertaken departmentally as well as through various specialized organizations during the feasibility studies of the link project have been considered in this report.

## **1.5 Hydrological studies**

The hydrological studies are carried out to assess the available quantity of water in Cauvery basin up to Kattalai barrage site and in the basins lying en route the link alignment.

The annual gross yield series of the catchment of Cauvery basin up to Kattalai barrage site for the period from 1951-52 to 2014-15 have been arrived at by summing up the annual yield series of the part of Tirumanimuttar sub-basin up to Kattalai barrage site and the annual yield series of the 11 upstream sub-basins. From this series, the 75% and 50% dependable annual gross yields are determined to be 14138 Mm<sup>3</sup> and 17126 Mm<sup>3</sup> respectively.

The water balance has then been worked out by deducting the ultimate water requirements for various uses like irrigation, industrial, domestic and others from the overall availability duly considering the regeneration, import and export.

### **1.5.1 Surface water requirement**

The water requirements of the 11 sub basins of Cauvery basin are computed keeping in view the ultimate stage of development. The irrigation water requirement for all the existing, ongoing and future major, medium and minor projects in the sub basin are worked out to be 16778 MCM based on the latest available information.

The domestic water requirement is computed by projecting the rural and urban human population and the livestock to 2050 AD. The domestic requirement for the entire urban population and 50% of the rural population to be met from surface water sources works out 1294 MCM. In the absence of relevant data on the industrial water needs, the same have been assumed to be equal to the total domestic water requirement. Thus, the industrial water requirements of the sub basin are worked out to be 1700 MCM.

The regeneration from irrigation uses at 20% of net water utilisation from all the existing, ongoing and identified future major and medium projects is worked out to 1359 MCM. The regeneration from domestic and industrial water uses is considered at 80% and are estimated to be 1035 MCM and 1360 MCM respectively. The evaporation losses from the hydroelectric projects is worked out to 70 MCM.

### 1.5.2 Surface water balance in Cauvery basin at Kattailai barrage

The surface water balance in Cauvery at Kattailai barrage at 75 % and 50% dependability duly considering the availability, import, export, regeneration and water needs, are worked out to be (-) 12635 MCM and (-) 9647 MCM respectively. However, as already discussed, the diversion through Cauvery (Kattalai) -Vaigai - Gundar link project is envisaged from the surplus waters of Himalayan rivers and Mahanadi river only.

### 1.5.3 Duration of the water diversion

Keeping in view the upstream utilizations, downstream commitments and the minimum lean season flow in the Cauvery river, the diversion of water is proposed only during the monsoon months. The maximum diversion is kept at 438 MCM (15.5 TMC) during December. The link canal will be operated from 5<sup>th</sup> June to 30<sup>th</sup> January for 240 days. The monthly proposed water diversion and duration are given in the table below:

#### Monthly proposed water diversion and duration

Month	No. of days	Quantity of diversion	
		MCM	TMC
June	26	98.2	3.47
July	31	222.3	7.85
August	31	273.3	9.65
September	30	143.8	5.08
October	31	410.2	14.49



November	30	285.0	10.07
December	31	438.4	15.48
January	30	381.2	13.46
<b>Total</b>	<b>240</b>	<b>2252.4</b>	<b>79.55</b>

## 1.6 Design and layout

### 1.6.1 Headwork and reservoirs

The existing Kattalai barrage is located across Cauvery at about 138km downstream of Mettur dam on the river Cauvery in Karur district. The latitude and longitude of the barrage are 10° 58' N and 78° 14' E. The length of the barrage is about 1233.20 m. The gross capacity of the pond is about 29.40 Mm<sup>3</sup> at full pond level (FPL) of 101.200m. The crest level is fixed at 96.300 m. The submergence area at FPL is about 9.10 Km<sup>2</sup> and the drainage area of Cauvery basin up to the proposed barrage site is 63694 km<sup>2</sup>. The link canal will take off from the right side of Kattalai barrage with FSL of 100.75 m. The barrage is designed for the historic flood of 13111 cumec.

### 1.6.2 Design of canal

The cut-off Statement of the canal considering the water requirement of branch canals and direct sluices and transmission losses enroute is prepared and the design of canal is carried out wherever the discharge is reduced by 10% from its previous reach. The shape of the canal has been selected as trapezoidal with rounded corners as per provisions of IS code: 10430 (2000) - 'Criteria for Design of Lined Canals and Guidance for Selection of Type of Lining'. The fluming of canal is considered by increasing the canal FSD by about 0.5 m wherever the deep cut reaches are encountered on hard /weathered rock strata.

The discharge at head and tail end of the link canal are designed to be 180.30 cumec and 17.00 cumec respectively. The canal has been designed for 1.1 times the peak discharge. A free board of 0.75 m is provided throughout the length of the link canal.

### **1.6.3 Tunnels**

Four tunnels of total length 15.54 km are located 3.94 km long tunnel at RD 82.300 km; 6.04 km long tunnel at RD 104.100 km; 3.63 km long tunnel from at RD 148.100 km; and 1.930 km long tunnel at RD 156.300 km. The tunnels are designed for varying discharge with varied bed slope. The value of Manning's coefficient adopted is 0.014 for the concrete lined tunnels.

### **1.6.4 Canal structures**

There will be 464 CD/ CM works all along the link canal from Kattalai barrage to Gundar. There will be aqueducts and super-passages across major rivers and streams, under tunnels across small streams. The four/ double lane road bridges are proposed across major road crossings and single lane road bridges are proposed across roads of lesser traffic. The rail bridges are proposed wherever the canal crosses the railway lines. Besides, there will be branch canal regulators, direct sluice regulators, canal escapes and cross regulators all along the link canal. The design flood value of each drain has been worked out using flood estimation reports of east coast zone (4 (c)) by the Central Water Commission (CWC). The cost of each structure is obtained using cost curves generated for each type of structure.

## **1.7 Water planning**

The Cauvery (Kattalai) - Vaigai - Gundar link project is envisaged to provide irrigation domestic and industrial water supply benefits in the identified new areas in the State of Tamil Nadu.

The total diverted water of 2252 Mm<sup>3</sup> from the Kattalai barrage through the link is proposed to be utilised as follows

**Unit: Mm<sup>3</sup>**

1.	Irrigation requirement of the proposed command area en-route the link in the basin area between Cauvery and Gundar rivers	1931
2.	Domestic & industrial requirement in the proposed command area	218
3.	Enroute transmission losses	103
<b>Total</b>		<b>2252</b>

### 1.7.1 New areas proposed enroute the link canal

Efforts are made to identify the command areas using toposheets of 1:50000 scale and Irrigation Atlas of India. The identified command area is proposed to be served through a network of branch canals and direct sluices. The command area under the link canal lies in five basins/sub-basins and the area is spread in 7 districts.

#### Details of new command areas

Sl.No.	Name of the State/ district	CCA/ AI (ha)	Quantity (MCM)
	<b>Tamil Nadu</b>		
1	Karur	2942	12.67
2	Tiruchirappalli	2917	12.56
3	Pudukkottai	49787	214.43
4	Sivaganga	91805	395.40
5	Ramanathapuram	211192	909.60
6	Virudhunagar	39922	171.94
7	Thoothukudi	49775	214.38
	<b>Total</b>	<b>448340</b>	<b>1931.00</b>

The gross command area under the link canal is 840041 ha. After excluding the land under forests, scrubs and barren land from the area, the area available for irrigation is 620101 ha. However, due to planning of only 2252

Mm<sup>3</sup> of water in exchange, an area of 448340 ha is only envisaged to be irrigated annually and hence this area is considered as culturable command area under the link canal.

### **Particulars of the proposed command area**

<b>Sl. No.</b>	<b>Particulars of the command area</b>	<b>Area (lakh ha)</b>
1.	Gross command area	8.40
2.	Culturable command area	6.20
3.	Currently irrigated area under all sources (i.e. wells/tanks/canals/ other sources)	1.52
4.	Balance CCA available for new irrigation	4.68
5.	CCA considered under this link canal	4.48

#### **1.7.2 Domestic & industrial water supply**

The requirement of water for domestic consumption in the rural and urban areas and for livestock has been computed by projecting the rural and urban human population and livestock population of the proposed command area to 2050 AD and considering their per capita daily requirement at 70, 135 and 50 litres for the rural, urban and livestock population respectively.

The total population as per Census 2011 in the command area has been projected to 2050 AD using compound growth rates as suggested in 'World Population Prospects-2017 revision'. Out of the total projected population, 50.3% is taken as urban population as indicated in 'World Urbanization Prospects-2014'. The livestock in the command area as estimated on proportionate area basis from district wise census data of 2012 is projected to 2050 AD assuming a uniform annual compound growth rate of 1%. The estimated total municipal and industrial water needs are furnished in table given below;

### **Municipal and industrial water needs in the command area**

<b>Sl No.</b>	<b>Name of the link</b>	<b>Domestic MCM</b>	<b>Industrial MCM</b>	<b>Total MCM</b>	<b>Population served for domestic water supply (Nos)</b>
I	Cauvery (Kattalai barrage) -Vaigai- Gundar link project	79	139	218	2805095

#### **1.7.3 Transmission Losses**

The transmission or conveyance losses i.e., the amount of water lost through evaporation and seepage in the link canal in its course from Cauvery to Gundar have been estimated considering 0.6 cumec per million square metre of wetted area of the canal as per the Bureau of Indian Standard Code. The loss on this account works out to 103 MCM annually.

#### **1.7.4 Environmental releases**

The diversion through the Cauvery (Kattalai barrage) -Vaigai - Gundar link project is proposed mostly during the monsoon period. Adequate flows would still be available in river Cauvery at Kattalai barrage during this period. Therefore, no provision is made for environmental flow in Cauvery river downstream of Kattalai barrage.

#### **1.7.5 Water utilization of the link project**

The district wise and sector wise water allocation for various uses is furnished below.

### **District wise and Sector wise water use under the link project**

Sl.No.	State/District	Requirement for (Mm <sup>3</sup> )		
		Irrigation	Domestic	Industrial
	<b>Tamil Nadu</b>			
1	Karur	12.67	0.57	1.01
2	Tiruchirappalli	12.56	0.57	1.00
3	Pudukkottai	214.43	13.83	24.33
4	Sivaganga	395.40	17.95	31.59
5	Ramanathapuram	909.60	34.72	61.08
6	Virudhunagar	171.94	5.69	10.01
7	Thoothukudi	214.38	5.67	9.98
	<b>Total</b>	<b>1931.00</b>	<b>79.00</b>	<b>139.00</b>

#### **1.7.6 Conjunctive use / ground water support**

The ground water storage in command area can get recharged through irrigation in the command. Thus, there will be a considerable scope to further intensify the irrigation in the command areas by conjunctive use of the available surface and ground water resources. This may inter alia help in checking the hazards of water logging and soil salinity that may crop up in the command, if better water management practices are not followed. This aspect will be studied in detail during the comprehensive environmental impact assessment (CEIA) studies at a later stage.

#### **1.8 Construction programme**

The construction of Cauvery (Kattalai) - Vaigai - Gundar link project is proposed to be completed in 5 years. The year wise schedule is discussed in Chapter 12: **Construction programme, manpower and equipment planning.**

#### **1.9 Estimates**

The cost of Cauvery (Kattalai barrage) - Vaigai- Gundar link project is

estimated under two main components.

**Unit I: Head works:** Includes the cost of head regulator at Kattalai barrage.

**Unit II: Conveyance system:** Includes the cost of main canal, branch canals, canal structures, tunnels, cross regulators, canal escapes, outfall regulators, branch canal regulators/direct sluices and distribution system.

The total cost of the project at 2019-20 price level is worked out as Rs 827716/- lakh.

The abstract of cost of link project is given in the table given below:

#### Abstract of cost of the link project

Sl.No	Unit	Cost component	Amount (Rs lakh)
<b>Cauvery (Kattalai) - Vaigai – Gundar link</b>			
1	I	Head works	2077
2	II	Conveyance system	808905
3	VI	Cost of command Area development works	16734
4		<b>Estimated cost of the project</b>	<b>827716</b>

#### 1.9.1 Annual costs

The annual cost of the link project is estimated as per the prevailing norms and furnished in the table given below:

#### Annual cost of the link system

Sl.No.	Item	Amount (Rs lakh)
I	<b>Capital cost</b>	
	Estimated cost of the project	827716
II	<b>Annual cost</b>	
a)	Interest at 10%	82772

b)	Depreciation	
	a) Head works @1%	21
	b) Canal @1% (Rs. 543315/-)	5433
	c) Piped distribution @3% (Rs. 265590/-)	7968
e)	Annual O&M in command area	6725
f)	Maintenance of headworks at 1% of cost	21
	<b>Annual cost</b>	<b>102940</b>

### 1.10 Sources of revenue

The benefits from the proposed Cauvery (Kattalai) - Vaigai - Gundar link project includes revenue from agriculture produce, irrigation service fee, domestic and industrial water supply, pisciculture and plantations on canal banks. These are the direct benefits which are regular and expected net benefits due to implementation of the link project. The annual benefits to be accrued from the link project are furnished in the table given below:

#### Annual benefits from the link project

Sl.No.	Component	Annual benefit (Rs. lakhs)	Remarks
1	Irrigation	428064	
2	Water supply		
i)	Domestic	1586	Rs. 2 per KL
ii)	Industrial	101470	Rs. 73 per KL
3	Irrigation service fee	6725	Rs 1500/ha
4	Pisciculture	232	
5	Plantation	2035	
	<b>Total</b>	<b>540106</b>	

Apart from the direct benefits, many indirect benefits would also accrue from the link project leading to tremendous development in all the socio - economic indicators in the region. Employment generation, rising living standards of people, development of agro based industries, market facilities for agricultural inputs like pesticides and fertilizers, enhanced ground water availability in the region,



improved communication facilities, increase in industrial activity etc are some of the indirect benefits. These indirect benefits could be visualized or quantified in broad perspective only.

### **1.11 Benefit cost ratio (BCR) and Internal rate of return (IRR)**

The benefit - cost ratio (BCR) of the Cauvery (Kattalai) - Vaigai - Gundar link is worked out considering the annual cost of the link project and the annual likely benefits from the link project at 2019-20 price level. The economic parameters are furnished below.

#### **Economic parameters of the link system**

<b>Name of the link project</b>	<b>BCR</b>	<b>IRR</b>
Cauvery(Kattalai) - Vaigai - Gundar link project	5.25	38.18%

The above statistics are looking on higher side as the same are arrived considering full benefits and part costs for the completeness of the report. The economic analysis has to be carried out for whole system under Phase II which depends on the Himalayan rivers and river Mahanadi for intended diversion of water. The apportioned cost of the link project will be considered after finalization of the source and the conveyance system involved for such transfer. However, the link project will be economically viable keeping in view the experience with other link projects.

#### **1.12.1 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**

<b>Sl. No.</b>	<b>Clearance</b>	<b>Agency</b>
(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, RD & GR/NITI Aayog for investment clearance.

#### **1.12.2 Stages / phases of development of the link project**

The Cauvery (Kattalai) - Vaigai - Gundar link project is a multipurpose water resources development project with several integrated components as discussed above. The development of the project can be planned in the following stages in sequence or in parallel.

1. First stage may include irrigation to the commands under existing irrigation sources in the command area
2. Second stage may include the new areas after duly developing command area and distributary network.
3. Third stage may include integration of existing infrastructure for domestic and industrial water supply

Integration of existing tanks is the prominent feature of this project. In each stage of development, the existing enroute tanks play vital role in supplying regulated flow as per the monthly demands. The benefits of the project can be partially accrued right from the completion of first stage of development.

### **1.12.3 Fitment of the scheme in overall development of the region**

There are vast tracks of culturable area in Tamil Nadu which need to be brought under irrigation. Moreover, the over-exploitation in the Cauvery basin has led to an increase in hydrological droughts and inter-state conflicts. Farmers are mostly dependent on open wells, tanks and other sources which usually fail during dry years. The usual practice among the farming community is to irrigate the fields through pumping of water which often leads to groundwater depletion. All these factors suggest that a water resources development project like Cauvery (Kattalai) - Vaigai - Gundar link project is essential to provide the necessary impetus to the irrigation development in southern states of Tamil Nadu.

### **1.12.4 Organisation of chapters**

The detailed project report comprises the following chapters (Volume-I) along with their annexures (Volume-II), appendices (Volume-III) and drawings (Volume-IV).

1. Introduction
2. Physical features
3. Inter-state aspects
4. Survey and investigations
5. Hydrology and water resources
6. Design and layout
7. Reservoirs
8. Irrigation and water planning
9. Power
10. Environmental impact assessment and environmental management plan
11. Socio - economic studies and resettlement & rehabilitation plan
12. Construction, manpower deployment and plant planning
13. Cost estimates
14. Other aspects