CHAPTER – 1

INTRODUCTION

1.1 General

This report deals with the feasibility studies of Ken-Betwa link after carrying out detailed survey and investigations. It is proposed to divert the surplus waters of river Ken at Daudhan (2.5 km upstream of existing Gangau weir) through Ken-Betwa link canal to river Betwa for meeting water requirements in the water deficit Betwa basin. The purpose of carrying out this study is to establish the techno-economic viability of the project after considering the water requirements in the donor and acceptor basins. This study is a part of long term planning of water resources development including transfer of water from surplus to deficit regions. The National Water Policy, adopted by the Government of India in 1987, emphasized the need for inter basin transfer of water. It states "water should be made available to water short areas by transfer from other areas including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas/basins". The National Perspective is described briefly in the following paragraphs.

1.2 National perspectives for water resources development

The erstwhile Union Ministry of Irrigation (now Ministry of Water Resources) and the Central Water Commission in the year 1980 formulated the National Perspectives for Water Resources Development, which comprises two main components, viz. Himalayan Rivers Development and Peninsular Rivers Development. Himalayan Rivers Development envisages construction of storage reservoirs on the main Ganga and the Brahmaputra and their principal tributaries in India and Nepal alongwith inter-linking canal systems to transfer surplus flows of the eastern tributaries of the Ganga to the West apart from linking of the main Brahmaputra with the Ganga. Peninsular Rivers Development of the National Perspectives Plan includes interlinking of major rivers flowing in the Peninsular India including the southern tributaries of Yamuna. The major parts of this component are (I) interlinking of Mahanadi-Godavari-Krishna-Pennar-Cauvery, (ii) interlinking of west flowing rivers, north of Bombay and south of Tapi, (iii) interlinking of Ken with Chambal and (iv) diversion of west flowing rivers. The interlinking of these rivers will envisage construction of storage reservoirs at potential sites and canal systems for transferring the waters from surplus to deficit basins/areas. The canals will also include tunnels and lifts, wherever necessary.

1.3 Aims of the project and description of works

The main aim of the Ken-Betwa link project is to make available water to water deficit areas of Upper Betwa sub basin from the surplus waters of Ken basin. A preliminary water balance study of the Ken river upto Greater Gangau dam site was carried out by NWDA, which indicated that surplus waters are available in the Ken basin. Accordingly a preliminary feasibility study for diverting surplus waters of Ken to water short areas of Betwa basin was carried out to ascertain whether the proposal was feasible. It was found that the proposal is techno-economically viable. The proposal included construction of a dam across the Ken river upstream of the existing Gangau Weir, for storing and transferring of the waters through a link canal from Ken river to Betwa river. The quantity of water proposed to be diverted from Ken basin, after considering inbasin demands and downstream commitments (viz. 1375 Mm^3 for Madhya Pradesh and 850 Mm^3 for Uttar Pradesh), is 1020 Mm^3.

The proposed Ken-Betwa link project envisages the following works:

i. A dam at the Daudhan on Ken river 2.5 km upstream of the existing Gangau weir with FRL of 287.0 m and gross storage capacity of 2775 Mm^3.

ii. A 2 km long tunnel followed by about 230 km long link canal for transferring 1020 Mm^3 of water from Ken river. Out of 1020 Mm^3, 659 Mm^3 (after meeting enroute irrigation requirements) will be released into Betwa river upstream of Parichha weir by utilising the existing Barwa Sagar as terminal reservoir. The link canal will offtake from the tail race of Power House No.2 with FSL at 259.0 m.

iii. Two power houses, one at the foot of the dam and other at the end of 2 km long tunnel. The installed capacities of powerhouse No.1 and powerhouse No.2 are 3X20 MW and 2X6 MW respectively.

iv. The existing outlet (i.e. waste weir on the extreme right side) of Barwa Sagar shall be used to drop the link canal water into Betwa, through Barwa river.

v. Diversion of 659 Mm^3 of water to Betwa basin upstream of Parichha weir will be utilised by way of substitution to provide annual irrigation to 1.27 lakh ha (CCA 1.02 lakh ha) of drought prone areas of Upper Betwa sub-basin. This irrigation will be provided through four projects identified by the Water Resources Department, Govt. of

Madhya Pradesh namely Barari, Richhan, Neemkheda and Kesari. This command is termed as 'Betwa command' in this report.

vi. Annual irrigation to an area of 47000 ha enroute of the K-B link, where the level of irrigation is less than 30% of the Culturable area.

vii. Annual irrigation to an area of 3.23 lakh ha (C.C.A. 2.41 lakh ha) as envisaged under "Ken Multi-purpose Project" earlier proposed by Madhya Pradesh State Government. This command is termed as 'Ken command' in this report.

viii. A provision of 11.75 Mm^3 for drinking water supply to the villages and towns enroute of the link canal. This would cater to the needs of about 3.3 lakh people at a rate of consumption of 100 lpcd.

1.4 Location of the project

The project area is located in the Panna and Chhatarpur districts of Madhya Pradesh. The dam site is situated in Chhatarpur district near Daudhan village about 2.5 km upstream of the age-old Gangau weir. The Power House No. 1 is located at the foot of the dam on the left bank of Ken river whereas the Power House No. 2 is located at the end of a 2 km long tunnel on the right bank of Pukhraha nalla. The link canal runs through Chhatarpur and Tikamgarh districts of Madhya Pradesh and part of Jhansi and Hamirpur districts of Uttar Pradesh.

1.5 Accessibility

The project area is approachable by road from Chhatarpur-Panna state highway. It is about 19 km (WBM road) towards south-west of this road. The dam site is approachable by a dry weather motorable road about 5 km from the Irrigation Inspection bungalow at Gangau. The project site is also approachable by rail upto Satna railway station, which is about 110 km by road towards Chhatarpur. Khajuraho is the nearest airport, which is 31 km away from the dam site.

1.6 Climate

The climate of the project area is semi-arid to dry sub-humid. It is generally tolerable except during the months of January, May and June. The air being mostly dry except during south west monsoon season. Summer is hot and winter is generally mild. About 90% of the annual rainfall is received during the monsoon period i.e. from June to October.

The average maximum and minimum temperatures are 44.2^0C and 6.7^0C respectively.

1.7 Topography, physiography and geology

The upper reaches of Ken river are flanked by undulating plateau with sandstone, shale and limestone. Down below, recent alluvium engrosses the river upto the Gangau dam. The stratigraphy of rock formations found in the region is mostly alluvial soil, Deccan traps, Lameta beds and Vindhyan system.

1.8 Population

a) Affected and benefited

Due to creation of Daudhan dam and reservoir about 900 families having a total population of approximately 8550 persons will be affected from 10 villages. Classification of the population in the submerged area is given in the Table –7.4 under chapter-7 'Reservoir'. A few clusters of population in some peripheral villages around the reservoir will also be affected as lands of these villages may come under submergence. The alignment of the link canal does not affect any population.

The direct irrigation benefits from this project will be to 47000 ha enroute area of the link and 3.23 lakh ha in the Ken command (as per the earlier proposed Ken Multi-purpose Project of Madhya Pradesh Government). This will cover a large population of about 150 villages enroute in Chhatarpur and Jatara tehsils in Tikamgarh district of Madhya Pradesh and Mahoba and Mauranipur tehsils in Jhansi district of Uttar Pradesh and also Chhatarpur and Panna districts of Madhya Pradesh under Ken command.

The indirect benefits from this project will be irrigation to the drought prone areas of Raisen and Vidisha districts of Madhya Pradesh State through four identified projects namely Barari barrage, Neemkheda, Richhan and Kesari dams, which otherwise are infeasible due to water deficiency in the Betwa basin. Therefore, transfer of the surplus water from Ken to Betwa will also facilitate to irrigate 1.27 lakh ha areas annually through these projects, which in turn shall economically benefit a large population residing there.

b) Occupation

i. Agriculture: About 15 to 20% of the people to be affected in the submergence are having agriculture as their occupation. Also, most of the people to be benefited in the command area are dependent on agriculture, either cultivating their own lands or working as labourers in agriculture fields.

ii. Other than agriculture: The majority of the population in the submergence area is dependent on forest products as the reservoir area is covered mostly by forests. A few of them are either agricultural or industrial workers.

1.9 Natural resources

Forests are the main source of natural resources of the Daudhan reservoir area. About 74 percent of the submerged area comes under forests. Parts of these forests are reserved and a part on the north and south banks of Ken river is under Panna National Park. The area of the national park under submergence is about 45 Sqkm. Almost all the forests are dense and mixed jungles comprising deciduous, a few evergreen to semi-evergreen and a few xerophytic to semi-xerophytic types of species. Some of the important species are Teak, Salai, Ber, Bad, Khair, Babul, Amla, Tendu, Sheesam, Neem, Mahua, Palas, Beja, Haldu, Kari, Ghont, Kullu etc. Some of the species of mammals are also reported to be in these forests, which are Tiger, Panther, Cheeta, Jungle Cat, Wolf, Jackal, Sloth or Indian Bear, Sambhar, Langur etc.

Extensive geological survey made by the Madhya Pradesh State Geology and Mining Department reveals that large quantities of limestone occur in the project area. These areas are highly siliceous and magnesious and do not fetch much economic value. No other valued mineral mines are found in the project area. The Panna diamond mine is nearby the project area but does not fall in the jurisdiction of the proposed project boundary.

1.10 Land use and socio-economic aspects

On the basis of the statistics available for the year 1991-92, it is seen that the area under non-agricultural uses in the enroute command is 6.45%. The net sown area is 60.23% and the area sown more than once under miscellaneous crops is 0.16%. Thus the gross cropped area works out to 60.4%. Details of the land use aspects are described in the Chapter-5 ‘Hydrology’ of this report. Moreover, a comprehensive study of agro-

economic and socio-economic aspects of this project has been carried out by the National Council of Applied Economic Research, New Delhi and their findings are presented in brief in the para – 9.5 of the Chapter-9 of this report.

1.11 History of the project

(a) Earlier proposals

The Government of Madhya Pradesh formulated proposals for Ken Multi-purpose project (KMPP) on the Ken river which is also known as Greater Gangau dam and accordingly a detailed project report (1982) had been prepared. As per the report, the project envisaged construction of a dam across the Ken river about 210 m downstream of the existing Gangau weir. The proposed FRL of the Greater Gangau dam was 278.89 m and corresponding live storage was 2062 Mm^3. This project was expected to provide annual irrigation to 3.23 lakh ha in Chhatarpur and Laundi tehsils of Chhatarpur district and Ajaigarh tehsil of Panna district. In this proposal hydro power generation was also envisaged through construction of two power houses, one (PH-1) at the foot of the dam and the other (PH-2) on the left bank of Ken river at 630 m downstream from the first power house. The installed capacities of the power houses were proposed as 2 x 15 MW for PH No.1 and 2 x 10 MW for PH No.2.

As per the studies carried out by National Water Development Agency (NWDA) in the context of the Ken-Betwa link, it was proposed earlier that the above said Greater Gangau reservoir would be utilised as the head works for the link. For this purpose, the reservoir at Greater Gangau was planned with FRL of 284.2 m with live storage capacity of 2544 Mm^3, keeping the other features similar as per the KMPP of Madhya Pradesh State Government. The Ken-Betwa link was proposed to offtake from the tail race of the power houses No.1 with FSL 245.5 m to transfer (1100 Mm^3) surplus waters of Ken basin to water short Betwa basin. Accordingly the preliminary feasibility report on K-B link was prepared in 1990 by NWDA and circulated to all the concerned basin states. Based on the comments received and discussions held in the TAC and with basin states, these proposals were further studied and reviewed whereby it was opted to provide link canal alignment to offtake at F.S.L. 260.0 m as against the earlier proposed F.S.L. 245.5 m. This is mainly to serve the command area at higher elevations where the present level of irrigation is seen to be low. Also it is seen that by the construction of Greater Gangau dam, the existing Gangau weir, which has been functioning well since 1915, will be submerged. It was, therefore, felt better to locate the dam

upstream of this weir with possibility of utilising the arrangement for generation of hydropower as a pumped storage scheme.

(b) Present proposals

Keeping in view of the above mentioned suggestions, it is decided to realign K-B link canal with higher offtake level. To ascertain the potential reservoir sites on Ken river, toposheet studies of Ken basin were carried out in the upper reaches of Greater Gangau dam site. Three reservoir sites are identified viz. Jhalar reservoir (C.A. 18205 Sqkm), Ghari Ghat reservoir (C.A. 18055 Sqkm) and Daudhan reservoir (C.A. 19534 Sqkm). These sites are identified on the downstream side of the confluence of Sonar and Bearma tributaries with Ken with the obvious advantage of having adequate yield for the proposed irrigation in Ken basin as planned, as well as transfer of the requisite quantity of water through the link canal. Several parameters like submergence area, capacity of the reservoir at different elevations, number of villages affected, forest and culturable areas under submergence etc. are studied and finally Daudhan dam site has been found suitable, which is located near Daudhan village at 2.5 km upstream of Gangau weir. The catchment area at Daudhan site is 19534 Sqkm, which is only 0.16% less than that at Greater Gangau. Therefore, the annual yield at Greater Gangau has been taken as valid at Daudhan site also.

The FRL of Daudhan dam site has been proposed as 287.0 m and the corresponding gross storage capacity will be 2775 Mm^3. While keeping the general operational features of the State KMPP proposal more or less the same, the power generation is proposal is slightly modified as under. One power house will utilize the irrigation releases from the reservoir at the tail race water level at 234.75 m. This power house is proposed to function as a pumped storage power plant i.e. the water released will be further picked up by Gangau weir, which can be pumped back to generate additional power during peak period. The other power house is planned at right bank of Pukhraha Nalla, 2 km away from the dam with a tail water level 259 m from where Ken-Betwa link canal offtakes. The other details of the proposal are already discussed in Para 1.3. It can be seen that this site is more preferable to the Greater Gangau dam site because: (i) it would not submerge the existing Gangau weir, (ii) it would provide enroute irrigation to higher level command area along the link canal alignment and (iii) additional power generation by pumped storage scheme during peak period.

1.12 Interlinking of the proposed project with other existing and future projects

As mentioned in the para-1.1, with the transfer of water from Ken river to Betwa river, four identified irrigation projects in the upper reaches of Betwa basin can be taken up. Otherwise these projects can not be implemented due to shortage of water in Betwa basin. Moreover, there are numerous existing ponds (also called Tals) and reservoirs falling in the vicinity of 231.45 km long link canal, some of which can either be fed and/or water can be picked up from them in case of emergency.

Although no detailed study has been taken up on this aspect, however, on the basis of the toposheet studies and the proposed alignment of K-B link canal, the following tals (or ponds) can be considered:

	Name of Tal	**Tehsil/district**
A	Tals where K-B link water can be used	
1	Bhitar tal	Maharajpur/Chhatarpur
2	Motisagar	Issanagar/Chhatarpur
3	Issanagar tal	Issanagar/Chhatarpur
4	Ramnagar tal	Palera/Tikamgarh
5	Kamla Sagar	Mauranipur/Jhansi
6	Sidh Sagar	Mauranipur/Jhansi
7	Barua Sagar	Jhansi/Jhansi
B	Tals from where water can be picked up:	
1	Sareri tal	Nowgong/Chhatarpur
2	Gajadhar tal	Nowgong/Chhatarpur
3	Sukh Sagar	Maharajpur/Chhatarpur
4	Kotra tal	Palera/Tikamgarh
5	Gora tal	Nowgong/Chhatarpur
6	Nand Sagar	Issanagar/Chhatarpur
7	Dhanera tal	Palera/Tikamgarh
8	Bahru tal	Jatara/Chhatarpur

1.13 Interstate aspects

As the project is interstate between Madhya Pradesh and Uttar Pradesh, a consensus on the sharing of water is a very important issue. The sharing of Ken water between these two states is governed by the interstate agreement of 1981, which is based on the yield assessed at that time. The National Water Development Agency has played a key role in bringing together the concerned states for a consensus with regard to the yield of Ken basin at the dam site and efforts are still on for the optimum utilisation of surplus waters for irrigation development in these states.

1.14 Stages of development of the project

As an alternative to the Ken Multi-purpose Project (KMPP) proposed by the State Water Resources Department, Govt. of Madhya Pradesh the first and the foremost demand of the Ken-Betwa link canal project is to fulfill the requirements of irrigation to the entire culturable command area identified in the KMPP and then to transfer the surplus waters of the Ken river through a 231.45 km long canal to the Betwa river. While doing so, a direct irrigation from the link canal to water short enroute areas in 47000 ha annually shall be taken up in stages alongwith the provision of domestic water supply enroute and generating electricity through the proposed power houses.

1.15 Fitment of the scheme in overall development plan of the river basin

As a result of transferring 659 Mm^3 of Ken water to the Betwa river, four proposed projects upstream of Rajghat dam, which otherwise can not be taken up for construction due to shortage of water in Betwa basin, can be implemented. This will provide irrigation to the areas as mentioned below against the respective projects.

Sl. No.	**Name of project**	**Annual irrigation**
i	Barari barrage	87009 ha
ii	Neemkhera dam	1053 ha
iii	Richhan dam	36828 ha
iv	Kesari dam	1840 ha
	Total	**126730 ha**

1.16 Cost and benefits of the scheme

The total estimated cost of the project has been worked out to be Rs. 1988.74 crore (1994-94 price level). The unitwise cost is as under:

A	Main Project	
	Unit – I : Head works	Rs. 367.92 crore
	Unit – II : Canals	Rs. 572.44 crore
	Unit – III : Power	Rs. 50.72 crore
B	Ken Command	Rs. 554.11 crore
C	Betwa Command	Rs. 443.55 crore

The annual benefits to be accrued from the project when completed with the annual irrigation to areas of about 4.97 lakh ha (47000 ha in enroute command, 3.23 lakh ha in Ken command and 1.27 lakh ha in Betwa command) has been worked out to be Rs. 449.79 crore.

The benefit cost ratio for K-B link project as a whole works out to be as 1.87. The internal rate of return works out to be as 13.0%.