

WATER FOR FOOD SECURITY: KEN-BETWA LINK

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1.0 INTRODUCTION

Water is the most precious gift of nature. It is most crucial for sustaining life and is required for all the human activities i.e. domestic and industrial use, irrigation to meet the growing food and fiber needs, power generation, navigation, recreation etc. The development, conservation and use of water, therefore, forms one of the main elements in country's development planning. The rainfall is confined to few monsoon months and is unevenly distributed both in space and time even during monsoon months. As a result, while large tracts of the country are drought prone, some parts are affected by floods. During this century, water will be a scarce resource and therefore, needs to be harnessed in a scientific and efficient manner. Water is the source of prosperity and is the life and wealth for the people. In our country, the amount of fresh water available (both surface & sub surface) is sufficient to meet the demands but due to confinement of precipitation to a few months of a year, the construction of storage reservoirs is essential and a must for national prosperity and for raising agricultural production, providing water supply, generating hydropower and moderating flood peaks.

India, which has 16% of the world's population, has roughly 4% of world's water resources. The role of water in the overall development process of a country has become an increasingly important issue in recent years. Water is one of the most important natural resources and is a key element in socio-economic development of the country. Not only safe drinking water is essential for human health and well being, but water is also an essential resource of agricultural, industrial and energy related developments. The demand for water is continuously on the increase with the growth of population, industry and agriculture. However, total amount of available water remains more or less constant. This is bound to lead to scarcity of water, if not today, in the foreseeable future.

Agriculture is the major user of water in India. It is estimated that irrigated agriculture, in ultimate stage, will consume nearly 85% of the utilisable water potential. So, there is no doubt that better management and creation of more storage reservoirs are necessary in developing countries like India to increase food production.

The irrigated area can be increased by two ways. First river basins that have not yet been developed can be developed in a sustainable manner and second, irrigation water use could be made more efficient so that land can be irrigated with less water than being released from reservoirs at present, but without sacrificing agricultural yields.

2.0 NEED FOR INTER BASIN WATER TRANSFER

Suggestions for a National water grid for transferring surplus water available in some regions to water deficit areas have been made from time to time. Two proposals, put forth earlier in the seventies which attracted considerable attention, were National Water Grid by Dr. K. L. Rao and Garland Canal by Captain Dastur. These proposals were not pursued further by the Government, as they were not techno-economically feasible.

The population of India, which was around 1000 million in 2001, is expected to stabilise at 1500 to 1800 million in the year 2050, and that would require about 450 million tonnes of food grains. For meeting this requirement, it would be necessary to increase irrigation potential to 160 million hectare by 2050. India's maximum irrigation potential that could be created through conventional sources has been assessed to be about 140 million hectare. For attaining a potential of 160 million hectare, inter Basin Water Transfer is one of the techno-economically viable solutions. **Inter Basin water transfer is appearing as a more attractive option than before to several countries including India to increase the ultimate Irrigation potential.**

NATIONAL WATER POLICY-2002

The National Water policy-2002 adopted by the Government of India emphasizes the need for inter basin transfer of water in view of several water surplus and deficit areas within the country. 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 requirements of the areas/basins.**”

In 1980, the Ministry of Water Resources has prepared a National Perspective Plan for Water Resources Development. The National Perspective comprises of two main components:

- a. Himalayan Rivers Development and
- b. Peninsular Rivers Development

a) Himalayan Rivers Development

Himalayan Rivers Development envisages construction of storage reservoirs on the principal tributaries of the Ganga and the Brahmaputra in India, Nepal and Bhutan, along with 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 and its tributaries with the Ganga and Ganga with Mahanadi and augmentation of flow at Farakka.

b) Peninsular Rivers Development

This component is divided into four major parts:

- i) interlinking of Mahanadi-Godavari-Krishna-Pennar-Cauvery rivers and building storages at potential sites in these basins.
- ii) Interlinking of west flowing rivers, north of Mumbai and south of the Tapi.
- iii) Interlinking of Ken-Chambal Rivers

The scheme provides for a water grid for Madhya Pradesh, Rajasthan and Uttar Pradesh and interlinking canal backed by as many storages as possible.

- iv) Diversion of other west flowing rivers

Map showing various Inter Basin Water Transfer links are enclosed as PLATE-1.

BENEFITS OF INTER BASIN WATER TRANSFER

The National Perspective Plan would provide additional irrigation benefits of 35 Million hectare i.e. 25 Million hectare from surface waters and 10 Million hectare by increased use of ground waters over & above the ultimate irrigation potential of 140 Million hectare from Major, Medium & Minor projects and generation of 34 Million KW of power, apart from the benefits of flood control, navigation, water supply, fisheries, salinity, augmentation of flow at Farakka and pollution control etc. **Ken-Betwa link project is one of the Inter Basin Water Transfer project proposed under peninsular component of NPP.**

3.0 BUNDELKHAND REGION

Bundelkhand Region comprising of four districts in Madhya Pradesh and seven districts of Uttar Pradesh, is **one of the poorest regions** of the country. **Out of 108 poorest districts in India identified by the government of India, nine districts are in the Bundelkhand region.** One of the major problems in the region is lack of livelihood opportunities & poor management and productivity of existing natural resources. Groundwater is the most common source for drinking and irrigation. Although agriculture is the mainstay of the population, less than 30% of the net sown area is only irrigated. Rainfall is very erratic and falls in sporadic showers. Being a pastoral economy, the livestock population is very high but milk productivity is low.

Bundelkhand region lying in Madhya Pradesh is one of the underdeveloped regions of our country, which requires attention and efforts of development. Irrigation facilities are also less developed in this part of the region.

The regional economy of the **Bundelkhand region** is almost exclusively based on agriculture, owing to the predominantly rural population and lack of exploitable natural resources. Industry is nearly absent, even in the larger towns and cities such as Jhansi. Statistics show that the ratio of working factories to 100,000 people is 1.6 in the Bundelkhand versus 6.3 in the rest of Central India. Most of the non-agricultural economy is based on small commercial ventures or the provision of basic services.

Agriculture plays an important role in the Bundelkhand economy. However, even this sector has not been exploited to its full potential due to several factors. Poor soils and uncertain rainfall have made agriculture difficult in many areas. Crop productivity is among the lowest in the country, and even the value of agricultural production per hectare in the region is 1.4 times less than for Central India. Frequent droughts and floods have destroyed crops and undermined social security as well. Poverty has prevented many farmers from switching to more efficient farming methods. As such, most of the agriculture is subsistence and contributes little to the overall economy of the region.

Nonetheless, the principle crops in the Bundelkhand are cereals such as wheat, rice, and barley. Cereals occupy the majority of the cropped area and are sown primarily during the *rabi* (winter/dry) season. In addition, pulses, grams and oil seeds are also important crops. Fruits, vegetables, and fibres are only secondary in importance and are localised to specific geographic areas. Mixed cropping is still practised by farmers as a precautionary measure against crop failure but the method is encountered less and less, particularly where there is access to irrigation.

As mentioned, the **Bundelkhand region** is predominantly rural and as a consequence, agriculture is the mainstay of most inhabitants. However, the generally semi-arid climate of the region has limited agricultural development and prevented it from reaching its full potential in many areas. Irrigation is generally prescribed as the means to achieve adequate agricultural production and improve the livelihoods of the people. Yet to date, the use of irrigation remains low.

Irrigation is not a new concept in the Bundelkhand; as early as the fifteenth century AD tanks and reservoirs were already being used for water harvesting and irrigation. Although many of these structures have fallen into disrepair or have been destroyed, some are still in use today. The majority of the irrigated land receives water from later construction works such as the canals built during the British Raj or the post-Independence Matatila, Lalitpur, and Saprar dams. These structures have done much to increase the irrigation potential of the region, but still only benefit a third of the cultivable area.

Ground water extraction from wells is the primary source of irrigation water over most of the region. However, the relative accessibility of groundwater means that most farmers can obtain water from their own land regardless of their distance to a major surface water source. Mechanized pumping using gasoline or diesel powered pumps has greatly increased the use of groundwater for irrigation.

While the use of irrigation has improved the economic condition of many farmers in the region, the widespread use of groundwater has severely affected the sustainability of this activity. In a region that often suffers from weak monsoons and drought, recharge of the groundwater table is limited. Over extraction has already led to a decrease in the water table and if continued, will pose a serious threat to water security in the region.

Access to abundant water resources has always been one of the major environmental concerns in the region. Irregular rainfall has often led to either drought or flood conditions with consequent effects on the natural and human environment. Increasing dependence on groundwater resources has led to a lowering of the groundwater table in places where withdrawals have exceeded recharge. The decline in groundwater levels has further undermined water security in the region and accelerated desertification and erosion. In recent years water quality has also emerged as a principal environmental concern. Erosion from marginal lands and agricultural fields has increased the sediment load in the rivers and has already shortened the lifespan of many checkdams and water harvesting structures. The growing use of pesticides and chemical fertilizers, which until now has remained quite low, will also affect water quality in the future.

4.0 KEN-BETWA LINK

The Ken-Betwa link project is first Inter Basin Water Transfer project proposed under National Perspective Plan prepared by Ministry of water resources, Govt. of India. **A tripartite Memorandum of Understanding was signed amongst the Centre, Madhya Pradesh and Uttar Pradesh on 25.8.2005 for preparation of DPR of Ken-Betwa link**

This project envisages diversion of surplus waters of Ken basin to water deficit Betwa basin. The quantity of water proposed to be diverted from Ken basin, after considering inbasin demands and downstream commitments earmarked for providing irrigation in Madhya Pradesh and Uttar Pradesh, is 1074 Mm³. This link canal will provide irrigation to water short areas of upper Betwa basin of Madhya Pradesh by way of substitution and also to enroute areas of Madhya Pradesh & Uttar Pradesh. The command envisaged in the earlier proposed Ken Multi-purpose Project (KMPP) by Madhya Pradesh State Government in the **Bundelkhand region** is also to be irrigated from this project. Apart from drinking water facility & enroute irrigation of 60294 ha in Chhatarpur & Tikamgarh districts of Madhya Pradesh and Hamirpur & Jhansi districts of Uttar Pradesh, downstream commitments of 1375 Mm³ (M.P) and 1700 Mm³ (U.P) water for providing irrigation in the entire command of KMPP proposed in Chhatarpur & Panna districts of Madhya Pradesh and to the areas of Banda district of Uttar Pradesh respectively have also been kept.

A dam is proposed on river Ken at Daudhan 2.5 km upstream of existing Gangau weir. The 75% dependable yield of Ken upto Daudhan site has been assessed as 6188 Mm³. The net water availability at dam site after accounting all the upstream requirements including regeneration is obtained as 4364 Mm³. The downstream commitments from Ken at Daudhan are 3075 Mm³. Out of which, 1700 Mm³ is provided to Uttar Pradesh and 1375 Mm³ to Madhya Pradesh as per the MOU of K-B link project between Centre and States signed on 25.08.2005. This 1375 Mm³ will be utilised to irrigate the entire command of KMPP. The surplus water for diversion at Daudhan is 1074 Mm³. Out of which, 591 Mm³ is transferred to Betwa river upstream of Parichha weir and 366 Mm³ is utilised in the enroute command. In addition to this, 49 Mm³ water has been kept for enroute domestic water supply.

Salient features of project

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

- (i) A dam at the Daudhan on Ken river 2.5 km upstream of existing Gangau weir with FRL of 288.0 m and gross storage capacity of 2853 Mm³.
 - (ii) The dam proposed at Daudhan is an earthen dam with a side channel spillway with FRL of 288 m and gross storage capacity of 2853 Mm³. The maximum height of the dam is
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77 m. The total length of the side channel spillway is 536 m. 27 gates of 16 m x 18.5 m size are provided to pass the design flood of 57202 cumecs.

- (iii) A 1.93 km long upper level tunnel followed by about 218.7 km long link canal for transferring 1074 Mm³ of water from Ken river. Out of 1074 Mm³, 591 Mm³ (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 canal will offtake from the upper level tunnel with FSL at 257.0 m.
- (iv) Two power houses, one at the toe of the dam and other at the end of 1.1 km long lower level tunnel. The installed capacities of powerhouse No.1 and powerhouse No.2 are 2X30 MW and 3X6 MW respectively.
- (v) According to the DPR of Ken-Betwa link project, 1375 Mm³ water for M.P. and 1700 Mm³ water for U.P. have been earmarked in the storage reservoir for providing annual irrigation of 3.23 lakh ha area in Chhatarpur and Panna districts of M.P. and 2.52 lakh ha area in Banda district of U.P. downstream of the dam.
- (v) Total 1074 Mm³ water is proposed to be transferred from Daudhan reservoir to Betwa river upstream of Parichha weir through about 218.7 km long link canal. Out of this, 366 Mm³ water will be used enroute for irrigating 46599 ha area in Chhatarpur and Tikamgarh districts of M.P. and 13695 ha area in Hamirpur and Jhansi districts of U.P.
- (vi) Total 591 Mm³ water shall be utilised by substitution for irrigation in drought prone areas of Shivpuri, Datia, Raisen and Vidisha districts of M.P. through construction of projects proposed by Govt. of M.P. in upper Betwa basin.
- (vii) 9000 ha area including 5258 ha forest area is likely to be submerged because of the reservoir in Panna and Chhatarpur districts of M.P., 1585 families and 7224 persons are likely to be affected due to construction of the project.
- (viii) A provision of 49 Mm³ has been kept for drinking water supply to the villages and towns enroute in the vicinity of the link canal. This would cater to the needs of about 13.42 lakh people at a rate of consumption of 100 lpcd.

The link canal (218.7km long) will offtake from the end of upper level tunnel with offtake FSL of 257 m to its outfall in Barwa sagar terminal reservoir. The design discharge of the link canal at its head is 76.23 cumecs. The canal is designed as a trapezoidal section with rounded corners and lined for the entire length. The full supply depth and bed width of the canal at its head are 3.44 m and 13.2 m respectively with the bed slope varying from 1 in 9,000 to 1 in 12,000 in different reaches .The side slopes of the canal are 1.5 (H): 1 (V). The canal crosses several rivers/streams. The link canal outfalls in an existing reservoir namely Barwa Sagar from where the diverted water will join Betwa river through a natural stream in the upstream of Parichha weir.

The Betwa command comprises of ten projects namely Lower Orr, Babnai, Tharr, Madhopur, Narkheraghat, Rajkhera, Kotha, Barari, Neemkheda and Kesari in the Betwa basin. An area of 1.11 lakh ha in the Shivpuri, Datia, Raisen and Vidisha districts of Madhya Pradesh will be benefitted by utilising 591 Mm³ of water annually from this link by way of substitution. This link is also to provide annual irrigation to 60294 ha area enroute in the drought prone Chhatarpur and Tikamgarh districts of Madhya Pradesh and Hamirpur and Jhansi districts of Uttar Pradesh. Besides, an area of 3.23 lakh ha annually under earlier proposed KMPP command (termed as Ken command in this report) in the Chhatarpur and Panna districts of Madhya Pradesh will be benefitted. The water use in this command is 1375 Mm³, which will be met from releases of Daudhan dam into Ken river through Power House No.1.

The link will also provide 49 Mm³ water in the enroute of the link for drinking water supply to the enroute villages of Chhatarpur & Tikamgarh districts of Madhya Pradesh and Hamirpur & Jhansi districts of Uttar Pradesh. The DPR of Ken-Betwa (Phase –I) link i.e. Ken Projects has been completed in April 2010 and sent to State Governments in May 2010. Work of phase-II studies i.e. Betwa Projects are in progress.

The total cost of the link project (Phase I) has been estimated as Rs. 9393 crore excluding upper Betwa projects at 2007-08 price level. The schedule of construction of the link project is planned for a period of 9 years including pre-construction year.

The Benefit-Cost ratio for the Ken-Betwa link project as a whole has been computed based on the corresponding annual costs and annual benefits from this project, which comes to 1.71. The internal rate of return (I.R.R.) of the project works out to 13.00%.

5.0 BENEFITS TO BUNDELKHAND REGION

The direct irrigation benefits from this project to **Bundelkhand region** will be about 6.76 lakh ha. Out of this, 60294 ha enroute area of the link, 3.23 lakh ha in the Ken command (as per earlier proposed Ken Multi-purpose Project of Madhya Pradesh Government), 30,000 ha in Datia district through Lower Orr project and 2.52 lakh ha area in the Banda district of U.P. d/s of the proposed Daudhan dam will get irrigation facilities. This will provide benefit to large population in Chhatarpur, Panna, Datia and Tikamgarh district of Madhya Pradesh and Mahoba, Banda and Jhansi district of Uttar Pradesh.

A provision of 49 Mm³ has been kept in the DPR of Ken-Betwa link for providing drinking water supply to the villages and towns enroute in the vicinity of the link canal. This would cater to the drinking water needs of about 13.42 lakh people of Bundelkhand region. Details are summarized below.

Benefits from K-B link project to Bundelkhand region

SN	Details	
1	Irrigation benefits	
	A) Ken command (MP)	323350 ha
	B) (UP)	252017 ha
	C) Enroute command (MP)	46599 ha
	D) Enroute command (UP)	13695 ha
	E) Lower Orr command (Datia district)	40000 ha
	Total	675661 ha
2	Domestic Water Supply (49 MCM)	13.42 lakh person

Auxiliary and incidental benefits that will occur by the commissioning of this scheme are of immense value to the people of the region. Ground water will get supplemented through the seepage of surface water used for irrigation and will increase in water table. The scarcity of drinking water in these dry areas will be mitigated considerably. The afforestation programme could be implemented on canal banks resulting in environmental improvement. The communication system will improve because of canal roads and CD works raising marketing opportunities. The formation of the reservoirs will help tourism development, fish and aquaculture, bird sanctuaries etc. Besides, there will be an increase in employment opportunities during the construction of project.

Interlinking river development programs, particularly those that include the development of one or more dams and reservoirs, can produce far-reaching changes in the environment of the region. Environmental effects, or changes resulting from project development, may occur upstream, on site, downstream or along the link project as well as changes in population distribution and land use in the immediate reservoir area as

well as other zones due to increased development for irrigated agriculture, industry or other purposes (fisheries, resettlement). Adequately planned such big projects like Ken-Betwa link will provide major economic benefits to the large population residing there.

This project will provide irrigation to the drought prone areas of Raisen, Shivpuri and Vidisha districts of Madhya Pradesh State on substitution basis through identified projects in the Betwa basin. Therefore, transfer of the surplus water from Ken to Betwa will also facilitate to irrigate about 1.1 lakh ha areas annually through these projects, which in turn shall economically benefit a large population residing there.

The Ken-Betwa link project is first Inter Basin Water Transfer project proposed under National Perspective Plan prepared by Ministry of water resources, Govt. of India. *As already described, this link project will provide irrigation facility to about 6.76 lakh ha (3.23 lakh ha for Ken command, 0.603 lakh ha for enroute command, 40,000ha in Lower Orr command(Datia Distt.) and 2.52 lakh ha in Banda district of U.P.) area of Bundelkhand region.* In addition to this, link canal will provide drinking water facility to about 13.42 lakh population in the region. Agriculture production will increase drastically in the region, which will lead to economic prosperity of the people living in the **Bundelkhand region**. Auxiliary and incidental benefits that will occur by the commissioning of this scheme are of immense value to the people of the area. Ground water will get supplemented through the seepage of surface water used for irrigation and will increase in water table. The scarcity of drinking water in these dry areas will be mitigated considerably. The afforestation programme could be implemented on canal banks resulting in environmental improvement. The communication system will improve because of canal roads and CD works, which will lead increase in marketing opportunities there. The formation of the reservoirs will help tourism development, fish and aquaculture, bird sanctuaries etc. Besides, there will be an increase in employment opportunities during the construction of project. Hence, it is concluded that proposed Ken-Betwa link project is a boon to the **Bundelkhand region** that will lead to the overall socio-economic development of the area.

References

- **“Feasibility Report of Ken-Betwa link project”**. Available on the website of NWDA.
- **DPR of Ken-Betwa link project prepared by NWDA (2008 & 2010).**
- **“Study on Bundelkhand”** conducted by Rakesh Nath Tiwary with the valuable guidance and support of Dr. Yogesh Kumar, Executive Director of **Samarthan**.
- **“India’s Water Wealth, Its assessment, uses and projections”** by Dr. K.L. Rao.

Upper betwa projects

Sl. NO.	Name of the Project	Type	Delta adopted	Intensity of Irrigation	CCA	Annual Irrigation
1	Neemkheda	Medium	0.45 m	125	5192	6490
2	Madhopur	Minor	0.45 m	100	1860	1860
3	Barari	Medium	0.45 m	125	2784	3480
4	Narkheraghat	Medium	0.45 m	125	2520	3150
5	Rajkhera	Medium	0.45 m	125	2512	3140
6	Kotha	Minor	0.45 m	100	1480	1480
7	Tharr	Medium	0.45 m	125	2862	3577
8	Babnai	Major	0.45 m	150	7213	10820
9	Kesari	Medium	0.45 m	125	5320	6650
10	Lower Orr *** (Major project)	Major	0.581 m	150	47045	70568
	Total					111215

BIOGRAPHICAL DETAILS OF THE AUTHOR

Shri R K Jain is graduated in Bsc.Engineering from the Aligarh Muslim University of in 1984. He obtained M.E.(Hydrology) from University of Roorkee in 1994. From 1986 to 1989 he worked as Assistant Engineer, 1989 to 1992 worked as Assistant Executive Engineer, 1992 to 1998 worked as Executive Engineer, 1998 to 2004 worked as Superintending Engineer, 2004 to 2009 worked as Director (Technical) in National Water Development Agency (NWDA) and from 2009 to till date he is working as Chief Engineer (level II) in NWDA.

