CHAPTER – 8

IRRIGATION PLANNING

8.1 General

The main objective of Ken-Betwa link project is to provide irrigation facilities to the water short areas in upper reaches of Betwa basin. In the indicative master plan of Betwa basin prepared by the Department of Irrigation, Madhya Pradesh, four projects namely Barari, Neemkheda, Richhan and Kesari dams, which lie in the Upper Betwa basin, are placed in category-B which means that water is not available for these schemes unless the 75% dependable flow at Rajghat exceeds 3379 Mm^3. Annual irrigated area under these four projects is 1.27 lakh ha and the water use is 659 Mm^3. Therefore, 659 Mm^3 of water is proposed to be diverted from Ken to Betwa river at upstream of Parichha weir through the K-B link. The water diverted to the upstream of Parichha weir will meet the water requirement of its downstream commands. The water thus saved is proposed to be utilised in the upper reaches of Betwa through these four projects by way of substitution. The command area under these four projects has been termed as "Betwa command".

As already mentioned, the entire command area proposed under KMPP project will be irrigated by this project. An annual irrigation to 3.23 lakh ha (culturable command area of 2.41 lakh ha) in this command will be provided from the releases of Power House No. 1. The water use in the command is 1375 Mm^3 and the same is to be provided as per the interstate agreement between Uttar Pradesh and Madhya Pradesh on Ken, 1981. This command area has been termed here as "Ken command".

The net water available for diversion from Ken at Daudhan reservoir, after meeting upstream and downstream requirements, is 1020 Mm^3. The drought prone areas of Chhatarpur and Tikamgarh districts of Madhya Pradesh, and Hamirpur and Jhansi districts of Uttar Pradesh in the enroute of the link canal have been identified for providing irrigation. The water use in these areas is planned to be 312 Mm^3 for annual irrigation to 47000 ha. A provision of 11.75 Mm^3 has also been kept for drinking water supply to the enroute villages. After accounting for the above needs and the transmission losses of 37.25 Mm^3, 659 Mm^3 of water is finally dropped in Betwa river.

8.2 Existing/proposed irrigation facilities

8.2.1 Enroute command area

There are quite a few existing irrigation tanks and one proposed scheme namely Issanagar Ranipur in the enroute command of K-B link canal. The particulars of these projects are given in Table-8.1.

8.2.2 Ken command

There are quite a few existing major, medium and minor irrigation schemes in the command. The particulars of these schemes are given in Table-8.2.

8.3 Soil surveys

8.3.1 Enroute command

Based on the information provided by the National Bureau of Soil Survey and Land use Planning (ICAR), Nagpur, the soils of the area can be broadly classified into five categories. They are soil on hills and hill ridges, plateau soils, pediment soils, soils of level alluvial plain and undulating flood plain and soils of dissected flood plain. Detailed description of each type of soil is given in the para-5.2.2 of the chapter on 'Hydrology'.

Table – 8.1
Existing irrigation facilities in the enroute command

Sl. No	Distt./ Tehsil	Name & source of irrigation	Irrigated area (ha)	Water utilization (Mm^3)	
	Existing			**Kharif**	**Rabi**
1	Chhatarpur				
	(i) Chhatarpur	(a)Motisagar tal	405	0.515	0.718
		(b) Issanagar tank	516	0.656	0.915
		(c) Gora tal	1295	1.648	2.296
		(d) Amkhera tal	40	0.05	0.07
		(e) Nandgaon tank	121	0.154	0.214
		(f) Sailab tal	121	0.154	0.214
	(ii) Nowgong	(a) Jagatsagar canal	186	0.176	0.414
		(b) Naigawan	49	0.046	0.109
		(c) Macha Bandhi	49	0.046	0.109
		Total	**2782**		
2	**Tikamgarh**	(a) Chhidari tank	72	0.103	0.115
		(b) Dhanera tal	93	0.131	0.147
		(c) Dharam Sagar	1984	2.80	3.137
		(d) Purenia	134	0.189	0.211
		(e) Ramnagar tal	81	0.114	0.128
	(ii) Tikamgarh	(a) Teharka tal	184	0.275	0.270
		Total	**2549**		
	Proposed				
3	**Chhatarpur**				
	(i) Chhatarpur	Issanagar Ranipur	57		

Table – 8.2 Existing irrigation facilities in Ken command				
Name of distt.	**Name of tehsil**	**Name & source of irrigation**	**Irrigated area (ha)**	**Quantity of water utilized (Mm^3)**
Chhatarpur	Chhatarpur	Nawalgarh Regulator	101.20	0.792
Chhatarpur	Laundi	Manariya tank	111.33	0.877
Chhatarpur	Laundi	Luharuk anicut	161.90	1.245
Chhatarpur	Laundi	Sohai anicut	80.90	0.622
Chhatarpur	Chhatarpur	Pathargawan Regulator	101.20	0.792
Chhatarpur	Chhatarpur	Beniganj dam	5708.50	18.253
Chhatarpur	Chhatarpur	Rangawan dam	18727.00	56.600
Chhatarpur	Laundi	Bamhori purwa	303.60	2.348
Chhatarpur	Chhatarpur	Boodha dam	607.30	N.A.
	Total		**25902.93**	**81.529**

8.3.2 Ken command

Soil survey in the command area was carried out by the State Agriculture Department and a preliminary report had been submitted by the Joint Director of Agriculture, Sagar district. According to this report, the soil of the proposed Ken command posses slight to moderate erosion and few areas with severe erosion. The water holding capacity is low to medium. The pH value of the soil is between 7 to 8. The soils have good response to fertilizers and irrigation.

8.4 Land irrigability classification

8.4.1 Enroute command

It may be mentioned that deep to very deep soils in each group may be considered fit for irrigation provided topography, depth of water table and drainage characteristics do not become limiting factors. Appropriate soil water management practices have to be adopted to make irrigated agriculture a success in the command. Shallow soils may however be put under permanent pastures and grazing to check undesirable hazards of soil erosion.

8.5 Existing cropping pattern

8.5.1 Enroute command

It is proposed to provide irrigation to drought prone areas in Tikamgarh and Chhatarpur districts of Madhya Pradesh, and Jhansi and Hamirpur districts of Uttar Pradesh enroute of K-B link canal. Districtwise existing cropping patterns are shown in the Table-8.3.

Table – 8.3
Existing cropping pattern in enroute command

Type and name of crop	Districtwise area (in thousand hectares)					
	Chhat-arpur *	Tikam-garh *	Hamirpur **	Jhansi **	Total cropped area under each crop	% of crop area with respect to total cropped area
Kharif						
Paddy	22.50	25.00			47.5	3.55
Kodikutki	12.00	-			15.1	1.13
Jowar	30.00	30.00	72.00	49.00	181.0	13.52
Maize	9.00	3.00			12.0	0.90
Groundnut	4.00	-		15.00	19.0	1.42
Arhar	9.50	-		9.00	18.5	1.38
Urad	21.50	25.00			46.5	3.47
Oilseeds	4.50	-			4.5	0.34
Others	61.00	61.00			122.0	9.11
Rabi						
Wheat	122.00	64.00	145.00	92.00	423.0	31.57
Gram	68.00	29.00	172.00	77.00	346.0	25.84
Barley	5.00	5.00			10.0	0.75
Moong	4.00	5.00			9.0	0.67
Masur	-	3.00	40.00	25.00	68.0	5.08
Others	14.00	3.00			17.0	1.27
				Total	**1339.1**	**100.0**

*** Source : District Water Resources Booklets for the year 1990**
**** Source : District Statistical Books of Hamirpur (1991) and Jhansi (1986)**

8.5.2 Ken command

The existing cropping pattern in terms of percentages of areas under main crops is given in Table-8.4.

Table – 8.4
Existing cropping pattern in Ken command

		Name of crop	% Area of CCA
1.	Kharif	Paddy	3.18
		Pulses	3.00
		Others	36.72
		Sub-total	42.90
2.	Rabi	Wheat local	21.29
		Other Rabi	38.68
		Sub-total	59.97
3.	Perennial	Sugarcane	0.13
		Total	103.00

8.5.3 Betwa command

Cropping pattern of four proposed projects command in the Upper Betwa sub-basin is given in Table-8.5.

Table – 8.5
Cropping pattern in Upper Betwa sub-basin

Sl. No.	Crop type	Percentage Cropwise
1.	Paddy	1.01
2.	Jowar	8.83
3.	Wheat	48.52
4.	Maize	1.58
5.	Pulses	26.98
6.	Sugarcane	0.20
7.	Vegetables and fruits	0.29
8.	Other food crops	1.20
9.	Oilseeds	4.04
10.	Fodder	7.35
	Total	**100.00**

8.5.4 Rainfall and rain fed cultivation

(a) Rainfall during monsoon

Based on the statistical record from 1987 to 1991, it has been observed that the annual normal rainfalls in the districts of Chhatarpur, Panna and Tikamgarh are between 700 mm to 1200 mm and the average annual rainfall is around 950 mm in Chhatarpur and Tikamgarh districts. As per the same statistics, the numbers of rainy days in monsoon are 40 in case of both the districts. Maximum rainfall occurs in the month of July during monsoon, which is of the order of 400 mm and the minimum rainfall in the month of June is of the order of 50 mm.

(b) Rainfall during non-monsoon

Very little rainfall occurs during the period from November to May in the districts of Chhatarpur and Tikamgarh. The average monthly rainfall during the non-monsoon period is about 20 mm.

(c) Area under rain fed cultivation

As per the agricultural statistics for the years 1987 to 1992, the average areas under rain fed cultivation in the districts of Tikamgarh, Chhatarpur and Panna are 27,500 ha, 20,500 ha and 52,500 ha respectively.

8.6 Proposed cropping pattern

Keeping in view the existing cropping pattern, soil suitability, climatic conditions, water availability etc., different cropping pattern have been proposed in the enroute, Ken and Betwa commands. These are described in the subsequent paragraphs.

8.6.1 Enroute command

The proposed cropping pattern in enroute command is given in Table-8.6.

Table – 8.6
Proposed cropping pattern in enroute command

Type of crop	Percentage of CCA	Area in hectares
Kharif		
Paddy	32.0	15040
Jowar	2.0	940
Maize	2.0	940
Vegetables	2.0	940
Pulses	2.0	940

Groundnut	4.0	1880
Bajra	2.0	940
Fodder	2.0	940
Sub-total	**48.0**	
Rabi		
Wheat	32.0	15040
Vegetable	4.0	1880
Pulses	4.0	1880
Fodder	4.0	1880
Oilseeds	4.0	1880
Sub-total	**48.0**	
Perennial		
Sugarcane	4.0	1880
Total	**100.0**	**47000**

8.6.2 Ken command

The proposed cropping pattern in the Ken command is given in Table-8.7.

Table – 8.7
Proposed cropping pattern in Ken command

Type of crop	Percentage of CCA	Area in hectares
Kharif		
Paddy	20	48,238
Jowar/Maize	8	19,295
Pulses	15	36,178
Oilseeds	12	28,943
Vegetables	5	12,059
Sub-total	**60**	**1,44,713**
Rabi		
Wheat (HYV)	40	96,475
Wheat (Local)	5	12,059
Gram	8	19,296
Linseed	5	12,059
Sunflower	5	12,059
Barseem	3	7,236
Masoor	8	19,295
Sub-total	**74**	**1,78,479**
Total	**134**	**3,23,192**

8.6.3 Betwa command

The details of CCA and irrigation intensities of the four projects in Upper Betwa are not available. Therefore, the annual irrigation for the command of these four projects has been kept as 1.25 times the irrigated area. The suggested cropping pattern has been adopted from the report of preliminary water balance study of Upper Betwa sub-basin. The proposed cropping pattern and cropwise water use in the command of the four projects of Upper Betwa basin are given in the Table-8.8.

Table – 8.8
Proposed cropping pattern and cropwise water use in the command of the four projects of Upper Betwa basin

Type of crop	% of area	Cropwise water use in ham *			
		Neem-kheda	Richhan	Kesari	Barari
Kharif					
Paddy	25.00	270.41	9457.43	472.51	22343.91
Maize	2.50	1.73	60.40	3.02	142.69
Jowar	2.50	1.66	58.19	2.91	137.47
Vegetables	2.50	3.14	109.75	5.48	259.29
Pulses	6.25	3.95	138.10	6.90	326.28
Groundnut	5.00	3.95	138.47	6.92	327.15
Soyabean	2.50	1.39	48.61	2.43	114.85
Fodder	1.25	0.68	23.94	1.20	56.56
Rabi					
Wheat	50.00	166.37	5818.82	290.72	13747.42
Vegetables	5.00	14.78	517.06	25.83	1221.61
Grams	12.50	32.75	1145.35	57.22	2705.98
Oilseeds	6.25	12.21	427.20	21.34	1009.30
Perennial					
Sugarcane	3.75	34.62	1210.90	60.50	2860.86
Total	125.00	547.64	19154.22	956.98	45253.37

*** Water use for evaporation losses may be met out from ground water.**

8.7 Proposed irrigation facilities

8.7.1 Enroute command

The proposed link canal passes through Ken basin and Betwa basin. The culturable area of Ken basin is 16,15,000 ha and that of Betwa basin is 29,80,000 ha. The preliminary water balance studies of these basins indicate that on an average 72% of the culturable area in Ken basin is likely to be irrigated by 2025 AD. In the lower portion of Ken basin alone, the annual irrigation will be about 87% of the culturable area. In contrast to this, the Betwa basin is a water deficit basin. With the available water resources of the basin about 32% of the culturable area is expected to be brought under irrigation. In some of the areas in this basin, this is as low as 15%. In view of this, it is proposed to provide irrigation to those of the areas where annual irrigation is less than 30% of the culturable area. Keeping in view the availability of water, the annual irrigation is limited to 40% of culturable areas. Besides these, this project will also provide irrigation to the command areas identified under the four proposed projects in the upper Betwa basin.

8.7.2 Ken command

There is no other proposed major project in the command area. However, the present proposal will get linked up (for operation) with the existing Beniganj, Rangawan, Bariarpur left bank canal and the Urmil projects for the integrated development of the lower zone of Ken valley.

Table – 8.9
Tehsilwise break-up of command area

Sl. No	Name of tehsil	Name of canal	G.C.A. (ha)	C.C.A. (ha)
Chhatarpur distt.				
1.	Chhatarpur	(a) Ken L.B.C.	67801	42203
		(b) Mukuna Lift	3988	2492
		(c) Kuraha Lift	24154	18275
		(d) Lugasi & Satna Lift	25298	19751
2.	Laundi	Urmil L.B.C.	110441	90132
3.	Laundi & Chhatarpur	Bariarpur L.B.C.	58291	46269
Panna distt.				
1.	Ajaygarh	(a) Bariarpur R.B.C.	21989	15107
		(b) From existing Ken	9307	7077
		Total	**321269**	**241306**

The total culturable command area is 2.412 lakh ha. The annual irrigation to be provided from the proposed Ken canal system of Ken command is given in table-8.10.

Table – 8.10
Proposed annual irrigation in Ken command

Season	Cropping intensity	Annual irrigation (lakh ha)
Kharif	60%	1.447
Rabi	74%	1.785
Total	**134%**	**3.232**

8.8 Scope for change in cropping pattern

In this regard, the available information is discussed as below:

(a) Agro-climatic conditions

As per the agro-climatic zoning of Madhya Pradesh, the command area of the K-B link falls in the Bundelkhand region, which is deficit in water and prone to frequent droughts. The climate of the region is tropical. The climate remains hot and is pleasant in winter. The temperature normally varies from 47.30C in summer to 40C in winter.

(b) Water and other inputs like seeds, fertilizers etc.

It is seen from the survey conducted by the NCAER that the farmers use sufficient inputs to take full advantage of the good situation particularly in irrigation condition. The use of manure and fertilizers is common in all the areas. Similarly the use of pesticides and weedicides is also popular in the command areas. It also confirms the use of modern agricultural technology in the proposed command areas. The suggested input pattern for the crops grown under the irrigated and unirrigated conditions is given in Table-8.11.

(c) Attitude of farmers towards modern irrigated agricultural Practices

(i) Enroute command

During the course of field enquiry conducted by the NCAER, it was found that more than 72% of the households in the proposed command area are not satisfied with the existing irrigation facilities. This indicates the need for augmenting the irrigation facilities, which is supported by the majority of the farmers. In these areas, the preference is obviously for the canal irrigation supplemented by the use of modern agricultural machineries, which will result in higher income and enhancement of socio-economic conditions.

Table – 8.11 Input pattern for crops *			
Sl. No.	**Input items**	**Rupees per hectare**	
		Irrigated Condition	**Unirrigated condition**
1.	Seed	373	284
2.	Manure	115	91
3.	Fertilisers	364	57
4.	Pesticides	11	-
5.	Irrigated materials	941	432
6.	Hired human labour	193	60
7.	Hired animal labour	17	18
8.	Hired machinery	93	83
9.	Other misc. input	112	75
	Total	**2219**	**1100**

*** Source : Report of NCAER on K-B link project**

(ii) Ken command

The proposed command area is bordering Uttar Pradesh and Madhya Pradesh and the economic condition of farmers are comparatively inferior to that of farmers of the adjoining state of Uttar Pradesh. Hence majority of the farmers are keen to adopt modern agricultural practices, which would naturally improve their economic conditions through better and efficient irrigation.

8.9 Crop water requirements

The command areas of K-B link project fall under the Yamuna basin. The crop water requirements assessed for various crops under different commands are discussed in the following paras.

8.9.1 Enroute command

The crop water requirements for enroute irrigation, based on IMD values of potential evapo-transpiration, have been worked out by modified Penman method. The values of gross irrigation requirement (GIR) are indicated in the Table-8.12. The total water requirement is also computed for annual irrigation of 47000 ha and the same is given in the Table-8.12.

Table – 8.12 Annual irrigation in the enroute command					
Type	**Crop**	**% of C.C.A**	**Area (ha)**	**G.I.R. (m)**	**Water requirement (ha m)**
Kharif	Paddy	32	15040	1.308	19672.32
	Jowar	2	940	0.123	115.62
	Groundnut	4	1880	0.129	242.52
	Bajra	2	940	0.123	115.62
	Fodder	2	940	0.117	109.98
	Maize	2	940	0.117	109.98
	Pulses	2	940	0.118	110.92
	Vegetables	2	940	0.189	177.66
Rabi	Wheat	32	15040	0.393	5910.72
	Fodder	4	1880	0.318	597.84
	Pulses	4	1880	0.345	648.60
	Oilseeds	4	1880	0.290	545.20
	Vegetables	4	1880	0.317	595.96
Perennial	Sugarcane	4	1880	1.209	2272.92
	Total	**100**	**47000**		**31225.86**

8.9.2 Ken Command

The crop water requirements as approved by the State Agricultural Department are given in Table-8.13 and the same have been adopted.

Table - 8.13 Crop water requirements in Ken command					
Type	**Crop**	**Area in % of C.C.A.**	**G.I.R. (m)**	**Area (ha)**	**Water requirement (Mm3)**
Kharif	Paddy	20	0.649	48238	313.06
	Jowar/Maize	8	0.3048	19295	58.81
	Pulses	15	0.127	36178	45.95
	Oilseeds	12	0.2286	28943	66.16
	Vegetables	5	0.3048	12059	36.76
	Sub-total	**60**		**144713**	**520.74**
Rabi	Wheat (HYV)	40	0.6096	96475	588.11
	Wheat(Local)	5	0.4572	12059	55.13
	Gram	8	0.4318	19296	83.32
	Linseed	5	0.3302	12059	39.82
	Sunflower	5	0.3302	12059	39.82
	Barseem	3	0.3302	7236	23.89
	Masoor	8	0.127	19295	24.50
	Sub-total	**74**		**178479**	**854.60**
	Total	**134**		**323192**	**1375.34**

8.9.3 Betwa command

Details of computations of crop water requirements for the four projects are given in Table-8.14 to 8.17 below.

Table – 8.14 Computation of crop water requirement for Barari project			
C.C.A. = 87009 ha			
Crops	**Intensity (%)**	**G.I.R. (m)**	**Water use (ha.m)**
Kharif			
Paddy	25.0	1.284	22343.91
Maize	2.5	0.082	142.69
Jowar	2.5	0.079	137.47
Vegetable	2.5	0.149	259.29
Pulses	6.25	0.075	326.28
Groundnut	5.0	0.094	327.15
Soyabean	2.5	0.066	114.85
Fodder	1.25	0.065	56.56
Rabi			
Wheat	50.0	0.0395	13747.42
Vegetable	5.0	0.351	1221.61
Gram	12.5	0.311	2705.98
Oilseeds	6.25	0.232	1009.30
Perennial			
Sugarcane	3.75	1.096	2860.86
Total	**125.00**		**45253.37**
		Say :	**452.53 Mm3**

Table – 8.15 Computation of crop water requirement for Neemkheda project			
			C.C.A. = 1053 ha
Crops	**Intensity (%)**	**G.I.R. (m)**	**Water use (ha.m)**
Kharif			
Paddy	25.0	1.284	270.41
Maize	2.5	0.082	1.73
Jowar	2.5	0.079	1.66
Vegetable	2.5	0.149	3.14
Pulses	6.25	0.075	3.95
Groundnut	5.0	0.094	3.95
Soyabean	2.5	0.066	1.39
Fodder	1.25	0.065	0.68

Rabi			
Wheat	50.0	0.0395	166.37
Vegetable	5.0	0.351	14.78
Gram	12.5	0.311	32.75
Oilseeds	6.25	0.232	12.21
Perennial			
Sugarcane	3.75	1.096	34.62
Total	**125.00**		**547.64**
		Say :	**5.476 Mm3**

Table – 8.16
Computation of crop water requirement for Richhan project

C.C.A. = 36828 ha

Crops	**Intensity (%)**	**G.I.R. (m)**	**Water use (ha.m)**
Kharif			
Paddy	25.0	1.284	9457.435
Maize	2.5	0.082	60.40
Jowar	2.5	0.079	58.19
Vegetable	2.5	0.149	109.75
Pulses	6.25	0.075	138.47
Groundnut	5.0	0.094	138.47
Soyabean	2.5	0.066	48.61
Fodder	1.25	0.065	23.94
Rabi			
Wheat	50.0	0.0395	5818.82
Vegetable	5.0	0.351	517.06
Gram	12.5	0.311	1145.35
Oilseeds	6.25	0.232	427.20
Perennial			
Sugarcane	3.75	1.096	1210.90
Total	**125.00**		**19154.22**
		Say :	**191.54 Mm3**

Table – 8.17 Computation of crop water requirement for Kesari project			
C.C.A. = 1840 ha			
Crops	**Intensity (%)**	**G.I.R. (m)**	**Water use (ha.m)**
Kharif			
Paddy	25.0	1.284	472.51
Maize	2.5	0.082	3.02
Jowar	2.5	0.079	2.91
Vegetable	2.5	0.149	5.48
Pulses	6.25	0.075	6.90
Groundnut	5.0	0.094	6.92
Soyabean	2.5	0.066	2.43
Fodder	1.25	0.065	1.20
Rabi			
Wheat	50.0	0.0395	290.72
Vegetable	5.0	0.351	25.83
Gram	12.5	0.311	57.22
Oilseeds	6.25	0.232	21.34
Perennial			
Sugarcane	3.75	1.096	60.50
Total	**125.00**		**956.98**
		Say :	**9.569 Mm3**

8.10 Water planning

8.10.1 Water availability and requirements of Ken basin upto Daudhan dam site

The gross water availability, different requirements, regeneration from various uses and net water availability in Ken basin upto Daudhan dam site are given in Table-5.7 in chapter-5. As seen the gross water availability of Ken basin upto Daudhan site at 75% dependability is 6188 Mm3. The total upstream water requirements of Ken basin upto Daudhan site are 3357 Mm3. This includes water requirements for irrigation, domestic and industrial uses till 2025 AD. The total water requirement in the downstream of Daudhan dam site is 2225 Mm3. Out of this, 1375 Mm3 is for Madhya Pradesh and 850 Mm3 for Uttar Pradesh. Net availability of water after meeting all the upstream requirement is 3291 Mm3.

8.10.2 Annual utilization of water through link canal

Annual utilization of 1020 Mm3 water, which is to be diverted from Daudhan reservoir through link canal is described in subsequent paragraphs:

8.10.2.1 Enroute command

The water requirement for enroute irrigation of 47,000 ha is assessed to be 312 Mm3, which is proposed to be provided through the link canal.

8.10.2.2 Betwa command

Utilisation in the upper reaches of Betwa through four proposed projects is termed as Betwa command area of this project. The annual irrigation envisaged for Betwa complex i.e. Barari barrage, Neemkheda dam and Richhan dam, accounting for a uniform irrigation intensity of 125% works out to 124890 ha. Considering net delta of upper Betwa sub-basin, based on climatological approach, the water use for 124890 ha of annual irrigation comes to 649.42 Mm3. The balance quantity of water i.e. 9.58 Mm3 (659-649.42 Mm3) will be made available to achieve annual irrigation of the order of 1840 ha from Kesari dam. Projectwise water utilizations are shown in Table-8.18.

Table – 8.18
Water utilization in Betwa command

Sl. No	Name of projects	Area irrigated As per Master Plan (ha)	Annual irrigation @ 125% of intensity of irrigation (ha)	Water use (Mm3)
1.	**Betwa complex**			
	(i) Barari barrage	69607	87009	452.44
	(ii) Neemkheda dam	842	1053	5.47
	(iii) Richhan dam	29462	36828	191.51
2.	**Kesari dam**	2106	1840	9.58
	Total	**102017**	**126730**	**659.00**

8.10.2.3 Provision for drinking water

A provision of 11.75 Mm3 has been made for drinking water supply in enroute areas of the link canal.

8.10.2.4 Transmission losses

Transmission losses for the 230 km long canal are worked out as 37.25 Mm3 as per the provision in IS Code 4745-1964.

Thus, the total quantum of water required for utilization through the link canal is 1020 Mm3 (659+312+37.25+11.75 Mm3).

8.11 Ground water support

Districtwise ground water resources for the districts of the enroute command show that the position of balance ground water for the future development is not very encouraging. Hence, the transfer of water through K-B link is essential.

8.12 Ground water quality

Majority of water bearing formations of command area of proposed Ken-Betwa link consists of crystaline rocks, which by virtue of being consolidated in nature do not pose any adverse chemical effect on its waters. Chemical quality of ground water, thus, is observed to be within limits prescribed for waters of domestic and irrigation purposes. It varies from 300 to 1500 micro mohs/cm at 250C. There may, however, be localized concentrations of trace elements in the waters, which are harmful for drinking purposes. This aspect could not be ascertained due to non-availability of requisite data.

8.13 Conjunctive use

In order to make an economic and efficient use of available water resources, it is essential that a judicious mix of surface and ground water are resorted to for irrigation purposes. There is considerable scope to further intensify the irrigation in the command areas by making use of the ground water resources available. This may further facilitate in checking the hazards of water logging and soil salinity in the command. Detailed study on this aspect will be carried out at the time of preparation of DPR.