CHAPTER – 7

RESERVOIR

7.1   General

The Ken-Betwa link project envisages creation of Daudhan reservoir on Ken river at a location of about 2.5 km upstream of the existing Gangau weir. The total area under submergence at Daudhan reservoir comes to 90 Sqkm. The storage thus created will be utilised for diversion of 1020 Mm^3 of water from Ken river through a canal off taking from the tail race of the Power house No.2. Water will also be released from this reservoir for irrigation uses in the downstream of Daudhan through the tail race-tunnel of the Power house No.1 as well as through the dam sluice in to the Ken river. As the Power house No. 1 of this project is planned to be a pumped – storage scheme, the Daudhan reservoir will, therefore, function as the upper reservoir and the storage created at the existing Gangau weir shall be used as a lower reservoir. Details of these reservoirs are described in the subsequent paragraphs.

7.2   Fixation of storage and reservoir levels

The gross availability of water at 75% dependable annual yield has been worked out as 6188 Mm^3 by the NWDA. This has been approved by the Central Water Commission. Water balance of Ken basin upto Daudhan dam site has been worked out after considering the downstream commitment, upstream domestic, irrigation and industrial water requirements and regeneration thereof. Water needs in the upstream of Daudhan dam for irrigation, domestic and industrial purposes are 2988 Mm^3, 131 Mm^3 and 238 Mm^3 respectively. Downstream commitment of Ken is 2225 Mm^3 (1375 Mm^3 for Madhya Pradesh and 850 Mm^3 for Uttar Pradesh). Thus, the surface water balance at 75% dependability in Ken basin upto Daudhan site comes to 3291 Mm^3. The details are given in Table 5.1 under para 5.5 of Chapter-5 'Hydrology'.

The reservoir simulation study has been done for estimating the capacity of reservoir that would provide the required yield at specified reliability. The flow data of Banda G&D site has been used for the analysis for a period of 32 years from 1957 to 1988. The analysis has been done on computer using CAP-YIELD Programme (developed by NWDA). This programme also takes into account the losses due to evaporation. The analysis shows that for 75% dependability performance the gross capacity of   2775 Mm^3 gives the yield as 3346 Mm^3.

7.2.1   Dead storage level (DSL)

The dead storage level of the Daudhan reservoir has been worked out as 238.0 m on the basis of sedimentation studies. The corresponding capacity at this level as per the revised area capacity curve of 50 years sedimentation comes to 22.31 Mm^3.

7.2.2 Minimum draw down level (MDDL)

The minimum draw down level has been fixed at 268 m after carrying out the power generation studies for various alternatives. The reservoir is proposed to be regulated between this MDDL and the FRL of 287 m. The capacity of reservoir at MDDL is 1390 Mm^3.

7.2.3 Full reservoir level (FRL)

Gross storage of Daudhan reservoir has been taken as 2775 Mm^3 and the Full Reservoir Level (FRL) corresponding to the gross storage capacity is fixed at 287 m.

7.2.4 Maximum water level (MWL)

The maximum water level as worked out from flood routing study is found to be 287.42 m with one gate as inoperative and 288.23 m with two gates inoperative. The MWL has, therefore, been fixed as 288 m.

7.3   Free board requirement

The fetch of the reservoir was determined to fix the free board and the top of the dam. The fetch computations were done as per the Indian Standards IS Code: 10635-1983, "Guidelines for Free board Requirement in Embankment Dams".

The maximum fetch length of 8.25 km has been fixed after trial and error and the following factors are taken into consideration while computing the free board requirement.

(a) Wave characteristics, particularly the wave height and wave length.
(b) Upstream slope of the dam and roughness of the pitching.
(c) Height of wind setup above the still water level

The detailed free board computations have been carried out and it is found that the free board requirement is 3 m and accordingly, the top of the dam is fixed as 291 m. In addition, a parapet wall of 0.9 m height with wave deflector is also provided.

7.4   The Elevation-Area-Capacity curves

The area-capacity curves of Daudhan reservoir have been prepared with the help of the reservoir area map prepared by the Survey of India with contours at 3.048 m (10ft) intervals plotted on a scale of 1cm=158.4m (1inch=1320 ft) for the proposed Ken Multi-purpose project.

On the basis of the elevation-area-capacity data and the rate of sedimentation of Ken river, the revised area and capacities of the reservoir have been worked out for 50 years as well as for 100 years sedimentation. The calculations are given in the para-5.8 of Chapter-5 'Hydrology'. Various capacities of the reservoir are worked out as below.

Gross storage	2775.00 Mm^3
Live storage	2752.69 Mm^3
Dead storage	22.31 Mm^3
Storage at MDDL	1390.00 Mm^3

7.5   Water tightness of the reservoir

On the basis of the comprehensive studies made by different geologists of the G.S.I. within a span of 14 years from 1961 to 1975, on behalf of the proposed KMPP project Authority, it has been found that the reservoir area is covered by semiquartzitic sandstone, which is compact and hard, and there is no possibility of leakage in the reservoir. Hence the reservoir can be considered watertight.

7.6   Evaporation losses

The average monthly rates of evaporation losses, as considered in the Ken Multi-purpose project report, have been adopted in this study. The values are given below in Table 7.1.

Table 7.1
Monthly evaporation losses

Sl. No.	Month	Evaporation losses (in mm)
1	January	69.85
2.	February	88.90
3.	March	171.45
4.	April	292.10
5.	May	400.05
6.	June	260.35
7.	July	114.30
8.	August	95.25
9.	September	114.30
10.	October	95.25
11.	November	69.85
12.	December	63.50
	Total:	**1835.15**

The simulation study has been carried out for Daudhan reservoir. The average annual evaporation loss from the reservoir, obtained from the simulation analysis, is about 104 Mm^3.

7.7   Utilisation from reservoir

The proposed Daudhan Dam shall be utilised to meet the storage requirements for utilization of water for K-B link project including Ken command and other downstream commitments.

(i) The quantity of water required to be transferred through K-B link is as follows :

(a) Water required by substitution for the four proposed projects in Upper Betwa basin viz. Barari barrage, Neemkheda dam, Richhan dam and Kesari dam amounting to 659 Mm^3 for irrigating an area of 1.27 lakh ha annually.

(b) Enroute irrigation to 47000 ha of land which requires 312 Mm^3 of water.

(c) Transmission losses along the 231 km long canal works out to be 37.25 Mm^3.

(d) Provision for drinking water supply to enroute areas is kept as 11.75 Mm^3.

Thus, the total quantity of water equal to 1020 Mm^3 of water is proposed to be transferred from Ken basin.

(ii)   The irrigation requirements in the downstream, to be met directly from Daudhan reservoir, are 1375 Mm^3 for Madhya Pradesh, which will be utilised in Ken command, and 850 Mm^3 for Uttar Pradesh. Thus, the total quantity of 2225 Mm^3 is to be utilised from the reservoir for downstream requirements.

Thus the total annual demand from Daudhan reservoir works out to 3245 Mm^3. The month wise demand is shown in the Table 7.2.

Table – 7.2
Monthwise water utilization from the Daudhan reservoir

Months	For M.P. (Mm^3)	For U.P. (Mm^3)	For Link (Mm^3)	Total (Mm^3)
June	76.18	124.73	-	200.91
July	50.81	129.00	140.00	319.81
August	101.54	129.00	185.00	415.58
September	132.55	69.49	185.00	387.04
October	123.64	13.77	102.00	239.41
November	152.35	32.88	102.00	287.23
December	174.67	88.62	102.00	365.29
January	218.39	115.78	102.00	436.17
February	192.52	101.61	102.00	396.13
March	152.35	20.73	-	173.08
April	-	11.20	-	11.20
May	-	13.15	-	13.15
Total	**1375.00**	**850.00**	**1020.00**	**3245.00**

7.8   Submergence

The details of submergence upto maximum water level have been worked out. A list of villages alongwith their population coming under complete submergence is given in the Table 7.3. The submergence plan is prepared upto R.L.300 m with the actual submergence at FRL 287.0 m. The plan will almost be the same except for short stretches where the contours are steep all along the periphery of the reservoir. On the basis of field visits it is estimated that about 900 families having a total population of approximately 8550 will be affected from these villages. A small population of some peripheral villages will also be affected as lands of the people belonging to these villages are in the submergence area. Besides, some important species of trees like Teak, Solai, Babul, Amla, Tendu, Sheesam, Neem, Mahua, Palas, Keri, Kullu etc. in the forest may come under the possible submergence.

The area under submergence at MWL of 288 m and at FRL of 287 m comes to 9000 ha and 8650 ha respectively. The details of area irrigated, unirrigated and culturable wasteland areas are given in Table 7.3. A comparison of this area with the total of enroute irrigation and irrigation in Ken command gives the submergence ratio as 1.4%. Besides, no railway line, major bridges, telephone lines and main power lines or any valuable mineral deposits, historical and archeological monuments etc. are coming under submergence. The nearest railway station Satna is 110 Km away from the project site.

7.9   Rehabilitation and resettlement of the project affected population

The primary objective in good rehabilitation strategy should be to reinforce the traditional ethos and aspiration of the displaced people to develop a society living in perfect harmony with nature. Besides, the main thrust of the rehabilitation strategy should aim at providing fair and equitable treatment of persons displaced from their homes, professions, farms etc. by the construction of the project.

The population affected is to be resettled in the adjoining areas. The persons are to be provided with proper housing facilities. Other basic amenities like drinking water, access road, schools, medical facilities, atleast one shopping center for 3 to 5 villages and electricity are also to be provided at reasonable cost. It is proposed that, as far as possible the entire population displaced by the project is to be resettled at one place in

the form of a model village so that their social and cultural life remains undisturbed.

The entire land coming under submergence of Daudhan reservoir at FRL 287.0 m shall have to be acquired for the project, which includes 2068 ha of land physically possessed by the families of the ten villages coming under complete submergence. The existing norms of the Government will have to be followed for the purpose of land acquisition.

7.10   Soil conservation measures

To reduce the silt being carried by the rivers and streams leading to the Daudhan reservoir and also to compensate for the loss of forestland in the submergence, soil conservation measures would be taken to develop new forest areas in and around the reservoir. Necessary provision for this work has been kept in the project estimate.

7.11   Reservoir at Gangau weir

Gangau weir is an existing structure located on Ken river 2.5 km downstream of proposed Daudhan dam in Rajnagar tehsil of Chhatarpur district. The crest level of the weir is 232.40 m. The dead storage level and full reservoir level of Gangau weir are 219.30 m and 234.90 m respectively. The gross storage capacity of the reservoir at Gangau weir is 56.4 Mm^3.

As the power house No. 1 of Ken – Betwa link project is planned to be a pumped storage scheme, the releases from power house No.1 will be stored in the reservoir at Gangau weir. The water stored in this reservoir will be pumped back to Daudhan reservoir during off peak period by the reversible type of turbine of power house No.1.

Table No. 7.3

Details of villages coming under submergence of Daudhan Reservoir

S.No	Name of villages	Area under submergence (ha)	Land use area under different types of land					Population in nos.												Total
			Forest land (ha)	Irriga-ted land by source (ha)	Unirri-gated land (ha)	Cultur able waste land (ha)	Area not available for cultiva-tion (ha)	General		Schedule Caste		Schedule Tribe		Literate		Workers		Cultiva-tors		
								M	F	M	F	M	F	M	F	M	F	M	F	
1.	Sukwaha	2442.33	1807.04	-	196.73	77.55	20.23	297	258	36	28	208	194	16	5	208	81	140	-	1471
2.	Bhorkhuwa	644.29	476.70	-	6.00	25.32	1.70	36	40	-	-	1	3	1	-	23	6	8	-	118
3.	Kharyani	1880.87	1391.62	-	170.88	390.26	17.77	340	343	39	38	99	128	89	15	206	80	114	2	1493
4.	Palkoha	1197.23	885.81	-	88.79	737.12	8.36	480	435	138	140	27	19	73	11	282	68	88	31	1792
5.	Daudhan	440.22	325.71	-	8.38	51.45	8.41	173	151	-	-	73	75	40	8	79	-	28		627
6.	Kupi	873.61	646.37	23.60	100.71	102.25	2.06	560	506	116	103	154	160	105	17	320	119	173	57	2390
7.	Basudha	260.75	192.94	0.46	13.52	76.65	3.79	51	43	-	-	30	25	3	-	28	15	19	-	214
8.	Ghughari	685.05	506.86	-	8.99	42.33	12.83	25	24	-	-	22	23	1	-	15	2	9	-	121
9.	Sahpura	225.65	166.95	23.26	9.42	17.33	3.85	82	88	-	-	-	-	27	5	53	25	42	1	323
10.	Mainari	Included under Sukwaha																		
	Total	8650.00	6400.00	47.32	603.42	1520.26	79.00													8549

Note : All villages come under Bijawar tehsil of Chhatarpur district.
Source : District Census hand book of Chhatarpur district (1981).