

Chapter - 8

Irrigation Planning and Command Area Development

8.1 General

The main objective of Parbati-Kalisindh-Chambal link project is to provide irrigation facilities to the water-short areas in upper reaches of Chambal basin where the level of irrigation is only 5.54% of culturable area. The National Water Development Agency has identified seven dams namely Chitabad, Padunia, Sekri sultanpura, Sewarkheri, Ramwasa, Sonchiri and Bachora to serve the above area. Parbati-Kalisindh-Chambal link project envisages diversion of 1360 Mm³ of balance water available in Parbati, Newaj (a tributary of Kalisindh) and Kalisindh rivers to Chambal River after meeting in-basin demands. The last reach of the link canal from Kalisindh reservoir to Chambal River will either tail into Gandhi Sagar or Rana Pratap Sagar reservoir. For storing and diverting the balance water available in these rivers, three dams namely Patanpur across Parbati, Mohanpura across Newaj and Kundaliya across Kalisindh River have been proposed. The diverted water after meeting enroute demand, is proposed to be utilised for power generation at Gandhisagar or Rana Pratap Sagar and for irrigation in the existing command of Kota barrage in the Chambal canal system and water of Chambal river thus saved will be tapped in the upper reaches of Chambal at proposed project sites which will irrigate areas in the drought prone districts of upper Chambal sub-basin where the level of irrigation is only 5.54% of culturable area. The transfer of water is proposed from Parbati (a tributary of Chambal), Newaj (a tributary of Kalisindh) and Kalisindh (a tributary of Chambal) to the Chambal River. Thus the link is confined to the Chambal basin only.

8.2 Existing /proposed irrigation facilities

8.2.1 Enroute command area

Rajgarh, Guna, Shajapur and Mandasaur districts of Madhya Pradesh and Jhalawar, Kota and Chittorgarh districts of Rajasthan fall under the enroute command of the link canal in case of alternative (a) i.e. linking to Rana Pratap Sagar. Rajgarh, Guna, Shajapur and Mandasaur districts of Madhya Pradesh and Jhalawar district of Rajasthan lie in the command in case of alternative (b)-I i.e. linking to Gandhisagar. Rajgarh, Guna, Shajapur and Mandasaur districts of Madhya Pradesh and Jhalawar district of Rajasthan lie in the command in case of linking to Gandhisagar in alternative (b)-II. The existing irrigation facilities in these areas are very limited and the details of the same are given in Table – 8.1.

Table – 8.1
Existing irrigation facilities in the enroute command

Distt./ Tehsil	Irrigated area (ha.)		
	Alt. (a)	Alt. (b)-I	Alt. (b)-II
M.P. State			
Mandsaur	8	72	100
Shajapur	139	248	135
Guna	99	-	-
Rajgarh	371	-	-
Total	617	320	235
Rajasthan			
Kota	-	-	-
Chittorgarh	-	-	-
Jhalawar	442	504	536
Total	442	504	536
Total for MP + Rajasthan	1059	824	771

8.2.2 Command of seven projects proposed in the upper reaches of Chambal basin

The seven projects are proposed in the upper reaches of the Chambal basin to upgrade the level of irrigation of some of tehsils of drought prone districts of Ujjain, Shajapur and Dhar and adjoining area of Ratlam tehsil in which the level of irrigation is only 8.7% from existing, ongoing and proposed projects. The details of the existing irrigation facilities in the above command is furnished in Table –8.2.

Table – 8.2
Details of the existing irrigation facilities in the command of seven projects

Name of Tehsil	Total culturable area (ha)	Annual irrigation through existing, ongoing & proposed projects (ha)	%age of annual irrigation to culturable area
Ujjain district			
Khachrod	99032	3811	3.85
Mahidpur	88425	7264	8.22
Barnagar	103519	490	0.47
Ujjain	61051	5148	8.47
Dhar district			
Badnawar	42352	376	0.89
Shajapur district			
Barod	34099	408	1.20
Ratlam district			
Alot	70133	6100	8.70

8.2.3 Command area of Ex-Kota barrage

As far as information available with NWDA the tail end command areas of Kota right bank canal lying in Bhind & Morena districts of Madhya Pradesh are not presently getting sufficient water for irrigation for existing canal system due to shortage of water.

8.3 Soil surveys

8.3.1 Enroute command

8.3.1.1 Soil capacity classification

The terrain through which the canal alignment is proposed to pass is undulating and horizon is broken up here and there by hillocks are found. The general soil of the tract is medium black cotton soil according to the older system of classification of soil of India. The texture of these soils varies from sandy loam to clay and silty clay loam depending upon the topography. Most of these soils are deep to very deep. These soils are calcareous to non-calcareous in nature, moderately alkaline, moderately to slowly permeable with low to medium infiltration and moderately well to well drained. These soils contain montomorrillonite as the predominant clay mineral and are characterised by swelling on wetting and shrinking on drying murrum patches in very small areas are also found in very shallow soils and these are under either grass lands or miscellaneous uses.

The soil in the portion of Rajasthan region is mostly riverine alluvium in nature. The soils are very deep and occur in the alluvial plains on flat to gentle sloping lands. They are finer in texture, alkaline in reaction and free of salts. There is a evidence accumulation of calcium carbonate in lower layers. Black soils (with a depth of 30 feet to 40 feet) cover 70% to 80% of the cultivable area, deep dark grey, or brown soils (more than 8 feet deep) cover an area of nearly 10% to 15% and remaining are red or reddish brown or yellowish brown soils. Practically all the sub-soils have a high content of clay and have fairly high water holding capacity and would absorb water slowly when surface soil become saturated.

8.3.1.2 Land Irrigability classification

No detailed soil surveys for land Irrigability classification have been conducted so far in the area under consideration. It may not be possible to assign specific land Irrigability class to each soil group found in the command. However based on general physiochemical characteristics of soils, it may be pointed out that deep to very deep soils can be brought under irrigation provided the depth of water table, land slope and drainage do not become limiting factors. In addition, appropriate soil and water management practices have to be adopted to make irrigation a success. While proposing the cropping pattern, agro-climatic conditions, the soils available in the command area, the existing cropping pattern and the local practices prevailing in the area are taken into account.

8.4 Existing cropping pattern

8.4.1 Enroute command

The cropping pattern varies from district to district. The existing cropping pattern and its area under each crop in the districts of Guna, Rajgarh, Shajapur, Mandasaur,

Jhalawar, Kota and Chittorgarh are obtained from the State Governments and studied for designing the proposed cropping pattern in the new enroute command area of the link project Soyabean is the predominant crop covering about 30.5% of the net area sown, followed by Wheat and Gram crops covering 15.3% and 13 % respectively of the net area sown.

The source wise existing irrigation details in the command area have also been studied. Accordingly, the first alternate linking to Rana Pratap Sagar dam 23.33% of the irrigated area is served by canals, 0.90% by tanks and 9.28% by tube wells, 60.22% by other wells and the balance 6.28% by other sources. While in the 2nd alternate linking to Gandhi Sagar dam 6.56% of the irrigated area is served by canals, 1.49% by tanks, 6.59% by tube wells, 78.24% by other wells and 7.12% by other sources.

8.5 Proposed cropping pattern

8.5.1 Enroute command

It is seen from existing cropping pattern that soyabean, Jowar, gram, wheat and fodder crops are predominant crops grown in the command area. However, after taking into account the soils available, the agro-climatic conditions and the local practices, a broad cropping pattern as given in Table 8.3 is suggested by NWDA. A crop intensity of 150% is proposed.

Table 8.3
Proposed cropping pattern for enroute command to be brought under irrigation

Crop	Percent of CCA
Kharif	
Paddy	18
Jowar	6
Maize	6
Oil seed	12
Pulses	12
Fodder	6
Rabi	
Wheat	48
Barley	6
Gram	6
Pulses	6
Oil seeds	12
Vegetable	6
Perennial	
Sugarcane	6
Total	150

8.5.2 Command of seven dams proposed in upper reaches of Chambal basin

Keeping in view the existing cropping pattern, soil suitability, climatic conditions, water availability etc., different cropping pattern have been proposed in the command of seven dams, proposed in the upper reaches of Chambal basin. The suggested cropping pattern for the said command is given in Table – 8.4.

Table 8.4
Proposed cropping pattern for seven dams proposed in upper reaches of Chambal basin

Crop	Percent of CCA
Kharif	
Paddy	18
Jowar	6
Bajra	6
Maize	6
Oil seed	6
Pulses	6
Fodder	6
Vegetable	6
Rabi	
Wheat	54
Barley	6
Pulses	6
Oil seeds	6
Fodder	6
Vegetable	6
Perennial	
Sugarcane	6
Total	150

8.6 Crop water requirement

The water requirements for irrigating the proposed area have been computed on climatological basis. Normal monthly values of potential evapotranspiration at Bhopal, Indore and Jhalawar IMD observatories computed by Penman's method are given in the IMD publication "Potential Evapotranspiration over India". These have been used for estimating the weighted average delta and gross water requirements of different crops considered in the suggested cropping pattern. Evaporation losses from the reservoirs have been considered in the simulation study, and therefore the provision for evaporation losses in the calculation for crop water requirement has not been considered. Thus the value of weighted average delta has been computed and found to be 0.495 m. The gross irrigation requirement for different crops have been worked out considering an irrigation efficiency of 55% for the crops other than paddy and in case of paddy an irrigation efficiency of 65 % is considered. The computation of weighted average delta and net and gross water requirement for different crops proposed under the enroute command and the command of seven dams, proposed

in the upper reaches of Chambal basin has been carried out. Computation of delta is shown in Tables - 8.5 & 8.6 given below:

Table-8.5
Computation of delta for enroute command

Name of IMD station : Bhopal, Indore, Jhalawar
 Type of Project : Major Project
 Culturable command area : 100 ha
 Annual irrigation : 150 ha

SI.No	Name of crops	Area (ha)	NIR (m)	GIR	(m) Water use (ha m)
A Kharif					
1	Paddy	18	0.840	1.293	23.275
2	Jowar	6	0.075	0.136	0.814
3	Maize	6	0.072	0.130	0.783
4	Oil seed	12	0.123	0.223	2.674
5	Pulses	12	0.059	0.108	1.291
6	Fodder/Bajra	6	0.075	0.136	0.814
B Rabi					
1	Wheat	48	0.238	0.433	20.795
2	Barley	6	0.235	0.428	2.567
3	Gram	6	0.234	0.426	2.554
4	Pulses	6	0.234	0.426	2.554
5	Oil seed	12	0.195	0.355	4.266
6	Vegetable	6	0.266	0.483	2.898
Pre-sowing irrigation (20% of Rabi area at the rate of 50 mm/ha considering 55% efficiency of irrigation for major project)		16.8		=0.05x55/100 = 0.0909	1.527
C Perennial					
1	Sugarcane	6	0.686	1.248	7.488
Total		166.8			74.302

Total weighted average delta = 74.302/150= 0.495 m

Table-8.6
Computation of delta for Upper Chambal sub basin

Name of IMD Station : Indore, Ratlam, Neemuch
 Type of Project : Major project
 Culturable command area : 100 ha
 Annual irrigation : 150 ha

SI.No.	Name of crops	Area ha	GIR m	Water use ha m
A	Kharif			
1	Paddy	18.000	1.296	23.334
2	Jowar	6.000	0.11	0.659
3	Bajra	6.000	0.11	0.659
4	Maize	6.000	0.115	0.689
5	Oilseed	6.000	0.13	0.779
6	Pulses	6.000	0.105	0.631
7	Fodder	6.000	0.105	0.628
8	Vegetable	6.000	0.191	1.147
B	Rabi			
1	Wheat	54.000	0.559	30.182
2	Barley	6.000	0.559	3.354
3	Pulses	6.000	0.489	2.931
4	Oilseed	6.000	0.411	2.465
5	Fodder	6.000	0.47	2.822
6	Vegetable	6.000	0.418	2.507
	Presowing irrigation (20% of Rabi area at the rate of 50 mm/ha considering 55% efficiency of irrigation for major project)	16.800	0.05x55/100 =0.0909	1.527
C	Perennial			
	1 Sugarcane	6.000	1.383	8.301
	Total	166.800		82.614
Total weighted average delta		= 82.614/150 = 0.551		

8.7 Water planning

The month wise enroute demand for all the three reaches of link canal for irrigation, domestic & transmission losses have been assessed. The monthly evaporation losses for each reservoir has been computed by multiplying monthly PAN Evaporation values of Guna IMD station with the average submergence area available at the beginning and end of the month. The canal capacities for each

reach of the link has been fixed considering the enroute requirement for the particular reach and also the quantum of water to be carried by the link to the destination reservoir. In case the storage capacity at the succeeding reservoir is not sufficient to store the additional quantum of water, then the water at preceding reservoir is proposed to be spilled during the monsoon period. The operation of the reservoirs have been proposed in such manner that the requirements of the destination reservoir i.e. RPS/GS can be met from the immediate preceding reservoir i.e. Kundaliya, no water will be drawn from the reservoir preceding Kundaliya i.e. Mohanpura and so on. However, the quantum of water from preceding reservoirs i.e. Mohanpura & Patanpur will be released for catering the enroute requirement of their respective reaches. For optimum utilisation of water through destination and intermediate reservoirs, the water is proposed to be stored in Kundaliya and then transferred to Rana Pratap Sagar/Gandhi Sagar reservoir. Whereas, the water available at Patanpur & Mohanpura reservoirs beyond their live storage capacities during monsoon months is proposed to be released in such a way that it can meet the enroute demand in the respective reaches and divert the water to Kundaliya reservoir to the extent of capacity available at Kundaliya. During lean season, the water stored in Patanpur & Mohanpura reservoirs are proposed to be utilised to cater the enroute demands in their respective reaches only. In view of reduced inflow of Chambal river received at Gandhi Sagar due to tapping of water in upper reaches by the 7 proposed projects, it is proposed to reduce the power house /machine releases at Gandhisagar. This reduction in power house release will affect the power generation at Gandhi Sagar. The inflow at Rana Pratap Sagar will be reduced due to reduction in the power house release at Gandhi Sagar. The reduction in inflow at Rana Pratap Sagar will be supplemented by waters of link canal of the Parbati-Kalisindh-Chambal link project. Thus, the existing power generation at RPS will not be disturbed. The power house/machine releases at Gandhi Sagar has been planned in such a way that these releases alongwith the water received from PKC link could be accommodated at RPS without any spill at RPS. It is also seen that the water received at RPS can be accommodated even during peak flow period by generating the power at RPS with full installed capacity. It has also been taken care of that the existing requirement at Kota barrage will be met from the releases of RPS.

The requirement of proposed seven projects in Upper Chambal sub basin, the enroute demands for irrigation, domestic use, transmission losses , the total quantity of 1360 Mm³ of water will be diverted through the Parbati-Kalisindh-Chambal link project. Out of this 684 Mm³ quantity of water to be utilised in the enroute command including 13.2 Mm³ of water for water supply and 90 Mm³ for transmission losses and remaining 676 Mm³ of water to be utilised in upper Chambal basin through seven proposed projects and in the existing command of Ex-Kota barrage. The district wise details of enroute area to be irrigated, its water use, domestic and industrial use and transmission losses are given in Table 8.7.

Table 8.7
Enroute water use

Reach of the Link canal	Area to be irrigated (ha)	Water uses		
		Irrigation (Mm ³)	Domestic & industrial (Mm ³)	Transmission losses (Mm ³)
Patanpur to Mohanpura				
Madhya Pradesh				
Rajgarh distt.	19839	98	--	24
Guna distt	5238	26	--	--
Total	25077	124	3	24
Mohanpura to Kundaliya				
Madhya Pradesh				
Rajgarh distt	25785	128	3	30
Total	25785	128	3	30
Kundaliya to Rana Pratap Sagar Alt-(a)				
Madhya Pradesh				
Rajgarh distt	270	1	--	--
Shajapur distt	12474	62	--	--
Mandsaur distt.	2051	10		
Rajasthan State				
Jhalawar distt.	19984	99	--	--
Kota distt.	22126	109	--	--
Chittorgarh distt.	972	5		
Total	57877	286	7.8	43
Kundaliya to Gandhi Sagar Alternative-(b)-I				
Madhya Pradesh				
Rajgarh distt.	270	1	--	--
Shajapur distt.	22983	114	--	--
Mandsaur distt.	9413	47		
Mandsaur distt. (Existing Bhanpura Canal)	10121	50	--	--
Rajasthan State				
Jhalawar distt.	25211	125	--	--
Total	67998	337	7.2	36
Kundaliya to Gandhi Sagar Alternative-(b)-II				
Madhya Pradesh				
Rajgarh distt.	270	1		
Shajapur distt.	12474	62	--	--
Mandsaur distt.	16747	83		

Mandsaur distt. (Existing Bhanpura Canal)	10121	50	--	--
Rajasthan State				
Jhalawar distt.	26779	133	--	--
Total	66391	329	7.2	36

8.8 Command area

8.8.1 Enroute command

The gross command area under Parbati-Kalisindh-Chambal link canal in case of alternative (b)-II is 108568 ha. On the basis of project report of Rinsi Project and Chambal Ayacut Project, the culturable command area in the enroute of the link project has been considered as 72% of GCA which comes out to 78169 ha. The annual irrigation is 117253 ha considering 150% intensity of irrigation.

The area 109400 ha is proposed to be irrigated in the Upper Chambal sub-basin. The total CCA and annual irrigation from the P.K.C link project are given in Table 8.8.

Table 8.8
Abstract of CCA and area to be irrigated in P-K-C Link

Link canal reach	CCA (ha)			Annual irrigation (ha)		
	M.P	Rajasthan	Total	M.P	Rajasthan	Total
Patanpur-Mohanpura dam reach	16718	-	16718	25077	-	25077
.Mohanpura-Kundaliya dam reach	17190	-	17190	25785	-	25785
Kundaliya- Rana Pratap Sagar dam reach Alt-(a)	9864	28721	38585	14795	43082	57877
Kundaliya –Gandhi Sagar dam reach [Alt-(b)-I]	28525	16807	45332	42787	25211	67998
Kundaliya-Gandhi Sagar dam reach [Alt(b)-II]	26408	17853	44261	39612	26779	66391
Total						
linking to RPS dam (Alt-(a))	43772	28721	72493	65657	43082	108739
linking to Gandhi Sagar dam(Alt-(b)-I)	62433	16807	79240	93649	25211	118860
Linking to Gandhisagar dam (Alt. (b)-II)	60316	17853	78169	90474	26779	117253
In the Upper reaches of Chambal basin			109400			109400
Ex-Kota barrage Command			2150			2150

The command area under link canal is not receiving adequate supplies from existing projects, tanks and wells for the growth of the crops since the rainfall in the

command is erratic and also due to the reduction in capacities of the tanks consequent on siltation. The existing irrigation supplies to the crops is therefore, far from satisfactory, with the result that the crops in this area are failing periodically.

As the existing irrigation supplies to the crops are far from satisfactory, the Parbati-Kalisindh-Chambal link canal waters are proposed to be supplied to fulfill the requirement of crops without depending upon the erratic rainfall and the flashy flows of streams in the enroute command area and drought prone districts of Upper Chambal sub-basin.

8.9 Transmission losses

Considerable amount of water is lost through evaporation and seepage in the canal system from the head of canal upto the canal outlet where the water is delivered to watercourse. These losses, commonly known as conveyance losses or transmission losses. These losses have been estimated as 97 Mm³ in case of linking to RPS dam and 90 Mm³ in case of linking to GS dam for the link canal considering 0.60 Cumec per million square metre of wetted area of the canal as per Bureau of Indian Standard code IS 10430-1982.

8.10 Command area development

8.10.1 General

As already discussed, two command areas are being covered under Parbati – Kalisindh – Chambal link project. These are enroute command and upper Chambal command. The enroute command lies in Guna, Rajgarh, Shajapur and Mandasaur districts of Madhya Pradesh and Jhalawar, Kota and Chittorgarh districts of Rajasthan. The upper Chambal command lies in Ujjain and Dhar drought prone districts of Madhya Pradesh.

The participation of farmers and other water users in the process of managing and developing irrigation projects particularly its command area can play a vital role with immense benefits. The lessons of this line of research are that farmer involvement in planning, design, water allocation and conflict management has several positive effects on project outcomes. As per the novel thoughts of the social scientists, this will lead to reduction in conflicts and differences in addition to improve water application efficiencies. These thoughts, based on the practical findings, are consistent with the research traditions of the sociology of organizations and nation choice theory, which would suggest that worker or farmer satisfaction and productivity will be linked to the degree to which they as constituents are meaningfully involved in the decision making process.

National Water Policy 2002 also advocates participatory approach in irrigation development and suggests implementation of PIM Participatory Irrigation management in each project by forming water uses Associations at minor/distributary level.

Beside the above, the detailed studies are proposed to be taken up at the time of preparation of DPR of the projects for leveling & shaping of undulating land in the command area and construction of network of water courses & field channels in the

command scientifically, so that farmers could apply their share of water uniformly over the farms. Substantial provision is also proposed to be kept for educating the farmers & water users for adaption of water conservative methods of irrigation, new cropping pattern and application of appropriate depth of water for the growth of various crops.

8.11 Climate of command area

The climate in the link project command area is sub humid except in certain portions of the Rajgarh and Jhalawar districts where it is semiarid. The monthly maximum and minimum temperatures are 41.5⁰ C in June and 7.9⁰ C in Oct. respectively. Mean monthly humidity is minimum (i.e. 20%) in April and maximum (i.e 82%) in August. Minimum wind velocity is 2.1 km/hr in November and maximum is 24.29 km/hr in June. Clouds are least in November and maximum in August.

8.12 Topography of command area

The topographical features of the routes of the conveyance system include isolated hill tops, valleys, reserved/protected forests, nallas, streams and rivers. The northern part of the Rajgarh and the southern part of Jhalawar which are in the command of link form the Jhalawar plateau with an average elevation of 300-450 m and inter spread by the Ratibar Dungar ranges. The land slopes are gentle from south to north. The command area in M.P. lies in the northern part of the great Malwa plateau. It is largely covered by the Deccan Trap rocks. However, in the northern part and in the denuded tops of some hillocks elsewhere, the underlying Vindhyan strata, the Kaimurs and allied are exposed. The Malwa plateau extends from the Narmada Valley in the south to the northern plains. It is an undulating plain, marked by steps of various long and low rounded hillocks of traps, capping the underlying sand stone hill in series. The lower part is covered with black cotton soil brought from the erosion of the bara uphill rocks. This soil being fertile and topography less formidable to the cultural expansion, a very great proportion has been occupied for agriculture.

The northern Vindhyan range is a low staggering range of sand stones under the trappean beds. It runs in a zigzag line often changing directions and dieing out at places, also branching into several ridges at other places on the Malwa plateau.

The valleys are flat plains, with low mounds here and there. The hill ranges are low in height, narrow in width and broken at places. The main hills are aligned in a 'V' shape with an additional short central line. In the Shajapur district the trends of the hills which was north-west to south-east so far, changes suddenly to the north-east at some point thus presenting a 'V' shape.

In the region of the Rajasthan the country slopes gently north wards from the high table land of Malwa in Madhya Pradesh. There are hills in the south, north and eastern portion of the district and it is generally fertile. The Mukandara range of Vindhychal hills in Ramganj Mandi sub-division which runs across the southern portion of State from north –west to south-east is an important feature in landscape.

8.13 Ground water in the command

In the command area of Parbati-Kalisindh-Chambal link the depth of water table varies from 2 m to 15 m from near surface to below ground level depend upon seasonal and topographic conditions.

The ground water utilisation in Rajgarh and Kota districts is even less than 10% whereas it is 45% Shajapur, 38% Mandsaur, 64% Jhalawar and 58% in Chittorgarh districts. Thus there is ample scope for conjunctive use of ground and surface water.

Once the irrigation is introduced after the construction of the canal system, percolation from the irrigated and the canal distributary system will contribute considerable amount of recharge to the ground water. As such the scope for ground water development under the command of the link canal appears to be reasonable good.

Ground water quality in the command area is generally within the permissible limits for irrigation.

8.14 Identification of problems in the command area

(i) Physical problems

There are no significant physical problem in the command area. The land is generally undulating therefore canal distribution system has to be aligned accordingly. The soils are suitable for growing the proposed crops. There is no problem of water logging in the command area.

(ii) Financial aspect

The farmers are already in the field of agriculture. With the introduction of assured irrigation water under the link canal project more inputs have to be put to achieve greater yield. This may call for more finances. Banks in general provide every assistance to the farmers, the present policy of the Government both at Central and State level being to grow more food and achieve self-sufficiency by providing conceivable assistance to the farmers.

8.15 Irrigation Facilities

8.15.1 Present sources of irrigation in the enroute command

The present sources of irrigation in the command area are canals, tanks, wells and tube wells. The source-wise irrigation details are given in Table-8.9.

8.16 Land development works

Sample command area survey of 1000 ha has been carried out by NWDA. The different items considered for estimating the costs under land development are as under:

- a) Land levelling/shaping wherever necessary
- b) Construction of field channels/water courses

- c) Drainage planning of the command area
- d) Construction of farm road

Field channels and drainage are proposed for entire ayacut under the canal. There are a good number of village roads, which in turn are linked to district roads because of the existence of developed towns and villages in the command area. No further roads are contemplated under the link project. Further, development in the road system will automatically take place as a sequence of the economic development of the area.

8.17 Drainage

8.17.1 Existing drainage lines

There are a number of natural streams, chief among them are Ghorapachhar, Ajnar, Kaken, Garganga, Chapi, Chauli, Piplad, Rewa, Ahu, Kanthali, Takli, etc. Practically there would not be much of a drainage problem in the command area as the country has adequate slope along the cross section of the main canal, which will facilitate free flow of drainage water.

8.17.2 Farm drainages

There are no definite courses for collecting the farm drainage. The drainage flows from field to field and enters into minor streams which drains off ultimately into major ones.

Table – 8.9
Source wise irrigation in command Area (1995-96)

District in command area	Canals			Tanks			Tube wells			Other wells			Other sources			Total irrigated area		
	RPS	GS (b)-I	GS (b)-II	RPS	GS (b)-I	GS (b)-II	RPS	GS (b)-I	GS (b)-II	RPS	GS (b)-I	GS (b)-II	RPS	GS (b)-I	GS (b)-II	RPS	GS (b)-I	GS (b)-II
M.P.State																		
1.Mandsaur	8	72	100	8	53	73	20	171	236	440	3810	5246	36	319	440	512	4425	6095
2.Shajapur	139	248	135	97	172	94	419	746	405	2132	3797	2064	431	767	417	3218	5730	3115
3.Guna	99	--	--	8	--	--	113	--	--	203	--	--	188	--	--	611	--	--
4.Rajgarh	371	--	--	76	--	--	576	--	--	7065	--	--	626	--	--	8714	--	--
Total	617	320	235	189	225	167	1128	917	641	9840	7607	7310	1281	1086	857	13055	10155	9210
Rajasthan State																		
1.Kota	--	--	--	26	--	--	985	--	--	1719	--	--	264	--	--	2994	--	--
2.Chittorgarh	--	--	--	7	--	--	131	--	--	--	--	--	2	--	--	140	--	--
3.Jhalawar	442	504	536	13	14	15	78	90	95	4058	4635	4924	83	95	101	4674	5338	5671
Total	442	504	536	46	14	15	1194	90	95	5777	4635	4924	349	95	101	7808	5338	5671
Total for MP+Raj	1059	824	771	235	239	182	2322	1007	736	15617	12242	12234	1630	1181	958	20863	15493	14881
Percentage to irrigated area	5.08	5.32	5.18	1.13	1.54	1.22	11.13	6.50	4.95	74.86	79.02	82.21	7.81	7.62	6.44	100.0	100.0	100.0