

## CHAPTER –VII

### IRRIGATION PLANNING AND COMMAND AREA

#### 7.0 General

The Kosi-Mechi intrastate link envisages diversion of part of surplus water of Kosi river for extending irrigation in new command areas of Mahananda basin lying between river Parman and Mechi by extending the existing EKMC beyond its tail end at RD 41.30 km upto river Mechi. The link canal will utilize existing EKMC after its remodelling. The link canal beyond Parman river will provide irrigation in new command areas enroute of the link lying in Araria, Kishanganj, Purnea and Katihar districts of Bihar.

#### 7.1 Existing /proposed irrigation status in enroute command

As detailed in Chapter-V Hydrology, a 1149 m long Hanuman Nagar barrage was constructed near Hanuman Nagar town close to Indo-Nepal border with pond level of 74.69 m to enable to provide irrigation through the EKMC and WKMC off-taking from the head regulators situated at both ends of the barrage.

The WKMC provides irrigation in Nepal and some parts in India, while the EKMC is aimed to provide irrigation in India in Katihar and Khagaria district situated in the Eastern side of the Kosi river and western side of the river Mahananda of north Bihar. GCA, CCA and annual irrigation as envisaged in the project report are given in Table 7.1.

The above reported GCA and CCA were reassessed by a committee constituted by Govt. of Bihar under the chairmanship of the then State Minister of River Valley Projects Department in 1975. The committee observed that the GCA and CCA and annual irrigation were on higher side and not responding to the ground truth.

**Table 7.1**  
**GCA and CCA under EKMC canal system**

Sl. No.	Name of canal	Design capacity (cumec)	Length (km)	GCA (lakh ha)	CCA (lakh ha)	Annual irrigation (lakh ha)
1	EKMC	425.0	43.27	7.43	4.95	5.69
i)	Murliganj branch canal	45.0	64.40	1.21	0.80	0.92
ii)	Janki Nagar branch canal	99.0	82.11	2.72	1.81	2.08
iii)	Purnea branch canal	85.2	64.40	2.15	1.44	1.64
iv)	Araria branch canal	41.0	57.96	0.97	0.64	0.75
v)	Direct distributaries from main canal	-	191.59	0.38	0.26	0.30
2	Rajpur branch canal	76.4	9.66	1.76	1.17	1.43

The committee further concluded that the CCA of the existing EKMC and Rajpur canal system would be 3.49 lakh ha and 0.91 lakh ha respectively. The details of the originally proposed and as assessed by the committee are given in Table 7.2.

**Table 7.2**  
**Details of GCA and CCA of existing EKMC and Rajpur canal system**

**Unit: lakh ha**

Sl. No.	Name of canal	As per project report			As assessed by committee		
		GCA	CCA	Annual irrigation	GCA	CCA	Annual irrigation
1	Eastern Kosi Main Canal	7.43	4.95	5.69	6.04	3.49	2.86
2	Rajpur canal system	1.76	1.17	1.43	1.40	0.91	1.62
	<b>Total</b>	<b>9.19</b>	<b>6.12</b>	<b>7.12</b>	<b>7.44</b>	<b>4.40</b>	<b>4.48</b>

*Source: WRD, Govt. of Bihar*

## 7.2 Existing cropping pattern of EKMC

The main kharif crop is paddy, but maize, millets, pulses, oil seeds and vegetables are also grown in some areas. Wheat, paddy and winter maize are the main crops of rabi.

The designed cropping pattern in the basin as per WRD, Govt. of Bihar as given in Table 7.3. As indicated earlier, as per Kosi Project Report, the original intensity of irrigation was proposed as 156.68 %.

**Table 7.3**  
**Designed cropping pattern**

Sl. No.	Crop season.	% of net sown area		
		Irrigated	Rainfed	Total
1	Bhadai (early kharif)	0.14	2.02	2.16
2	Kharif	17.79	43.80	61.59
3	Rabi	32.81	14.11	46.92
4	Hot weather	12.71	32.89	45.60
5	Annual crop (sugarcane)	0.05	0.36	0.41
	<b>Total</b>	<b>63.50</b>	<b>93.18</b>	<b>156.68</b>

## 7.3 Existing cropping pattern in proposed command area

The new command area lies between river Parman and river Mahananda and falls in Araria, Purnea, Kishanganj and Katihar districts of Bihar. As per the information collected from agriculture offices of concerned districts, the cropping pattern in all the districts is almost similar. However, there are some variations in cropped areas. The paddy is the main crop in the area. The districtwise details of existing cropping pattern are given in Table 7.4.

**Table 7.4**  
**Existing cropping pattern in proposed command**

Sl. No	Season / crop	%age cropped area				
		Araria	Purnea	Kishanganj	Katihar	Average
<b>I.</b>	<b>Summer</b>					
i)	Paddy	0	0	20.22	0	5.06
	<b>Sub-total-I</b>	<b>0</b>	<b>0</b>	<b>20.22</b>	<b>0</b>	<b>5.06</b>
<b>II.</b>	<b>Kharif</b>					
i)	Jute	48.60	41.8	59.98	40.70	47.77
ii)	Paddy	0.40	0.5	0.80	0.50	0.55
iii)	Pulses	7.90	9.6	1.74	19.00	9.56
iv)	Maize	12.50	10.4	26.85	10.80	15.14
v)	Oilseeds	0.40	0.5	0.77	0.50	0.54
	<b>Sub-total-II</b>	<b>69.80</b>	<b>62.8</b>	<b>90.14</b>	<b>71.50</b>	<b>73.56</b>
<b>III.</b>	<b>Rabi</b>					
i)	Wheat	21.20	23	16.04	14.00	18.56
ii)	Pulses	3.60	2.5	1.95	3.00	2.76
iii)	Oil seeds	2.20	2	2.79	2.10	2.27
iv)	Maize	1.80	5.7	5.86	6.40	4.94
v)	Pea/Potato	1.40	4		3.00	2.10
	<b>Sub-total-III</b>	<b>30.20</b>	<b>37.2</b>	<b>26.64</b>	<b>28.50</b>	<b>30.64</b>
<b>IV).</b>	<b>Perennial</b>	0.00	0.00	2.79	0.00	0.70
	<b>Sub-total-IV</b>	<b>0.00</b>	<b>0.00</b>	<b>2.79</b>	<b>0.00</b>	<b>0.70</b>
	<b>Intensity (%)</b>	<b>100</b>	<b>100.00</b>	<b>139.79</b>	<b>100.00</b>	<b>109.95</b>

*Source: District Agriculture Offices of Concerned districts of Bihar*

A part of district Purnea located westerly of river Parman, is irrigated by existing EKMC. The farmers of this irrigated area are growing hybrid maize, peas, potato, green vegetables and other valued crops. The production of hybrid maize is reported to the tune of 72 to 78 quintals per ha.

#### **7.4 Present proposal**

The Kosi–Mechi intrastate link is aimed to extend irrigation in new command areas of Mahananda basin beyond existing EKMC tail end at RD 41.30 km and upto Mechi river. Thus the link canal will carry the combined flow of existing and proposed irrigation requirements. It is proposed to remodel the existing EKMC to provide adequate water to the new canal. The following parameters have been proposed while remodeling the existing Eastern Kosi Main Canal.

- i) The offtake level of the proposed Kosi-Mechi link canal is at 74.371 m and it will utilize the existing EKMC followed by existing escape channel beyond EKMC upto river Parman at RD 44.20 km.
- ii) The existing fall of 3.96 m at RD 3.66 km is considered for power generation at existing canal power house.
- iii) The Govt. of Bihar and Central Water Commission have reviewed the existing utilization of EKMC and it is intimated that the design discharge of EKMC is now 283 cumec instead of 425 cumec.
- iv) A new canal is proposed beyond EKMC upto river Mechi with a bed slope of 1:15,000 and a varying depth of 3.50 m to 2.0 m.

#### **7.5 Existing command area of Eastern Kosi Main Canal**

The command area and water requirement for existing command of EKMC as per the original proposal is as under:

i) CCA of EKMC	3.49 lakh ha
ii) CCA of Rajpur canal system	0.91 lakh ha
Total	4.40 lakh ha

As per the initial proposal the annual water utilization of EKMC inclusive of losses etc is 6082 MCM.

Accordingly, monthwise water breakup water requirement for existing EKMC is Table 7.5.

**Table 7.5**  
**Monthwise break up of water requirement of EKMC**

<b>Month</b>	<b>Water requirement (cumec)</b>	<b>Water requirement MCM</b>
June	174.81	453.11
July	346.74	928.72
August	371.50	995.02
September	383.88	995.02
October	412.14	1103.88
November	94.33	244.50
December	91.29	244.50
January	98.32	263.35
February	108.86	263.35
March	114.90	307.74
April	40.36	104.61
May	66.55	178.26
<b>Total</b>		<b>6082.00</b>

Source: WRD, Govt. of Bihar

### **7.5.1 Review of existing requirements of barrage**

The Hanuman Nagar Barrage on river Kosi is an irrigation project with incidental flood control and hydropower generation. Two main canals, EKMC aimed for providing irrigation to a CCA of 4.40 lakh ha in India utilising 6082 MCM of water and Western Kosi Main Canal (WKMC) to irrigate 3,56,610 ha in Nepal and India utilising 3188 MCM of Kosi water off take from the barrage.

**Table 7.6**  
**Designed and reviewed existing requirements of**  
**Hanuman Nagar Barrage**

**Unit: MCM**

Sl. No.	Month	Existing requirements			Reviewed combined existing requirement
		WKMC	EKMC	Total	
1	June	237.38	453.11	690.49	477.71
2	July	488.5	928.72	1417.22	1087.70
3	August	521.23	995.02	1516.25	264.55
4	September	521.23	995.02	1516.25	684.03
5	October	578.26	1103.88	1582.14	245.96
6	November	128.08	244.50	372.58	127.47
7	December	128.08	244.50	372.58	221.34
8	January	137.95	263.35	401.30	364.26
9	February	137.95	263.35	401.30	481.66
10	March	161.21	307.74	468.95	248.10
11	April	54.8	104.61	159.41	598.23
12	May	93.35	178.26	271.61	834.59
	<b>Total</b>	<b>3188.02</b>	<b>6082</b>	<b>9270.02</b>	<b>5635.60</b>

The system serves with 90.80 km long main canal, 31.10 km in Nepal and 56.70 km in India, respectively. In practice, it observed that both the canals could not irrigate the designed CCA and a part of both canals is still undeveloped. As per the information received from WRD, Govt. of Bihar, the design discharge of EKMC is now reduced to 283 cumec instead of 425 cumec. As detailed in Chapter-V Hydrology, the Central Water Commission has reassessed the existing barrage requirements. Combined monthwise existing water requirements of WKMC and EKMC are given in Table 7.6.

### **7.5.2 Enroute command area beyond RD 44.20 km and water needs**

The enroute command area beyond RD 44.20 km has been identified using latest land use statistics of Govt. of Bihar 2005-06 to 2009-10. Suggested cropping pattern in enroute command area has been adopted using climatological approach and as per approval of agriculture department, Govt. of Bihar.

Cropwise and monthwise water requirements for suggested cropping pattern have been worked out for enroute command area using climatological data of IMD station of Purnea. A brief description is given in following paragraphs.

### **7.6 Agro-climatic conditions**

As per the agro-climatic zoning of north Bihar, the command area of the Kosi-Mechi link falls in Mahananda basin. The climate of the region is tropical. The climate remains hot and is pleasant in winter. The temperature normally varies from 47.3<sup>0</sup>C in summer to 4<sup>0</sup> C in winter.

### **7.7 Irrigated crops in the adjoining area**

The irrigated crops grown in the adjoining area of command are mainly paddy, maize, arhar, wheat, pulses, potato and other green vegetables like peas, beans etc. In some areas, farmers having irrigation facilities are switching over to tea gardening due to availability of rich market in adjoining area of Bagdogra.

### **7.8 Suggested cropping pattern for proposed command**

The cropping pattern for the proposed command as suggested by the Agricultural Department Govt. of Bihar has been adopted in this study and furnished in Table 7.7.

**Table: 7.7****Suggested cropping pattern in the command of link**

<b>Sl. No.</b>	<b>Name of crop</b>	<b>Total Cropped area (ha)</b>	<b>%age of CCA</b>
<b>A.</b>	<b>Kharif</b>		
i)	Paddy	103110	48.00
ii)	Pulses	24703	11.50
iii)	Vegetables	17185	8.00
iv)	Maize	54777	25.50
v)	Fodder/jowar	8592	4.00
vi)	Oil seeds & others crops	2148	1.00
	<b><i>Sub-total</i></b>	<b><i>210516</i></b>	<b><i>98</i></b>
<b>B.</b>	<b>Rabi</b>		
i)	Wheat	65518	30.50
ii)	Pulses	8592	4.00
iii)	Oilseeds	2148	1.00
iv)	Maize	17185	8.00
v)	Pea/potato	18259	8.50
	<b><i>Sub-total</i></b>	<b><i>111702</i></b>	<b><i>52.00</i></b>

However, since the water is available for kharif only, cropping pattern for kharif is only considered. Rabi crop can be irrigated after construction of Sapt Kosi High Dam. In existing scenario, the link canal will provide irrigation in kharif season only at irrigation intensity of 98%.

**7.9 Monthwise water requirement for link canal**

The purpose of Kosi-Mechi intrastate link is to extend irrigation in new command areas of Mahananda basin lying between river Parman and river Mahananda. The link canal will utilize existing EKMC after its remodelling to provide irrigation to new command areas. Thus in its initial reach, the link canal will carry a combined flow of Existing EKMC and the water to be diverted to the new command. The details of overall water to be carried are given in following paragraphs.

**(a) Existing Eastern Kosi Main Canal**

In its initial reach from RD 0.00 km to RD 41.30 km , the Kosi-Mechi link canal will follow the existing EKMC off taking from the left

bank head regulator of Hanuman Nagar barrage. The monthwise water requirement of EKMC is given in Table 6.5.

**(a) Irrigation requirement of new command**

The new command of Kosi-Mechi link is bounded by river Parman on the west and river Mahananda on the east. The entire command is located in the south of link alignment and lies in Araria, Purnea, Kishanganj and Katihar districts of Bihar.

The climatological data of IMD observatories of Purnea located in the command area is considered to work out the crop wise delta on climatological approach as given in Annexure 7.1. The monthwise average rainfall and normal potential evapotranspiration (PE) of Purnea IMD station are given in Table 7.8.

The monthwise ten daily crop water requirements were worked out using modified Penman method. The details are furnished in Annexure 7.2 and Annexure 7.3.

**Table 7.8**  
**Monthly rainfall and normal potential evapotranspiration at Purnea station**

Sl. No.	Month	Monthly Average rainfall (mm)	Normal Evapotranspiration (mm)
1	January	6.1	55.2
2	February	8.8	76.6
3	March	14.8	131.7
4	April	38.5	167.6
5	May	125.8	178.7
6	June	250.3	133.5
7	July	405.4	117.2
8	August	287.0	113.2
9	September	250.5	108.8
10	October	100.6	111.5
11	November	9.8	73.6
12	December	5.2	51.8
<b>Year</b>		<b>1502.8</b>	<b>110.0</b>

*Source: IMD*

As explained in Chapter-V Hydrology, the irrigation through link canal is assessed for pre and post Sapt Kosi High Dam scenarios.

In pre Sapt Kosi High Dam scenario, the canal will run from June to October to provide irrigation in monsoon months only. Water to the tune of 1718 MCM will be utilized for enroute irrigation in new command.

In post Sapt Kosi High Dam scenario, the canal can provide irrigation to rabi crop also. In case of annual irrigation under post Sapt Kosi High Dam scenario, water to the tune of 2252 MCM will be utilized for enroute irrigation in new command. The details are given in Table 7.9.

**Table: 7.9**  
**Monthwise area irrigated and corresponding water requirement**

Month	Total area under irrigation (ha)	Water requirement (MCM)	Remarks
June	103110	251.74	Irrigation proposed by link canal in kharif
July	210516	363.70	
August	210516	373.68	
September	210516	311.91	
October	210516	416.87	
<b>Sub-total kharif</b>		<b>1717.58</b>	
November	111702	39.47	Can be irrigated after construction of Sapt Kosi high dam
December	111702	55.41	
January	111702	106.52	
February	111702	150.95	
March	76473	158.34	
April	17185	23.22	
May	0	0.00	
<b>Annual</b>		<b>2252</b>	

**(c) Augmentation to river Mechi/river Mahananda**

In earlier studies (PFR), it was proposed to divert a monthly quantum of 1000 MCM through link canal during monsoon months, out of which the remaining quantum after meeting the enroute irrigation and other requirements, was proposed to drop into river Mechi for further utilization by Govt. of Bihar. In DPR, proposed augmentation is not considered due to increased water requirements of Hanuman Nagar barrage.

#### (d) Drinking water requirements

The link canal will run only for 5 months in kharif season only.

As the canal will not run continuously throughout the year, no provision is made towards the drinking water supply. However, the provision for domestic and industrial water supply may be made if the Kosi High Dam comes up in future.

#### 7.10 Transmission losses

The transmission losses due to seepage and evaporation have been considered as 0.6 cumec /sq.km of wetted area. Based on the design features, the transmission losses have been estimated for peak discharge. The total transmission losses of link canal work out to 96 MCM out of which 71 MCM of remodelled EKMC and 25 MCM of new canal. The reachwise transmission losses are given in Annexure 7.4.

The monthwise transmission losses in the EKMC and new canal beyond Parman river are shown in Table 7.10.

**Table 7.10**

#### Monthwise transmission losses in link canal

Sl. No.	Months	Transmission losses (MCM)		
		EKMC	New canal	Total
1	June	5.87	4.90	10.77
2	July	6.07	5.06	11.13
3	August	6.07	5.06	11.13
4	September	5.87	4.90	10.77
5	October	6.07	5.06	11.13
6	November	5.87	0.00	5.87
7	December	6.07	0.00	6.07
8	January	6.07	0.00	6.07
9	February	5.48	0.00	5.48
10	March	6.07	0.00	6.07
11	April	5.87	0.00	5.87
12	May	6.07	0.00	6.07
	<b>Total</b>	71.43	25.00	96.43

### 7.11 Monthwise water requirement of new command of proposed Kosi-Mechi link

As detailed earlier, the crop water requirement were computed using climatological approach and evapotranspiration values of Purnea IMD station recommended by IMD and then computing the water requirement of each crop as per Ministry of Agriculture guidelines.

In pre Sapt Kosi High Dam scenario, the canal will run from June to October to provide irrigation only. Water to the tune of 1743 MCM is proposed to be diverted to new command through the link canal, out of which 1718 MCM will be utilized for enroute irrigation in new command and 25 MCM as transmission losses of new canal. The existing utilization of EKMC is 6082 MCM and the total transmission losses of the link canal is 96 MCM Thus the total diversion through Kosi-Mechi link including utilization of 6082 MCM work out to 7896 MCM.

On the basis of the computed crop water requirements as detailed earlier, the ten daily and accordingly monthly water requirement of New command of proposed Kosi-Mechi link beyond RD 44.20 km has been worked out and given in Table 7.11.

**Table 7.11**  
**Irrigation water needs of Kosi-Mechi link (excluding EKMC)**

Sl. No.	Season	Month	Decadays	Irrigation needs (cumec)	Irrigation needs (MCM)
1	Kharif	June	1-10	55.08	47.59
			11-20	112.54	97.23
			21-30	123.76	106.92
2		July	1-10	135.79	117.32
			11-20	135.79	117.32
			21-31	135.79	129.05
3		August	1-10	133.27	115.15
			11-20	141.96	122.66
			21-31	142.96	135.87
4	September	1-10	122.56	105.89	
		11-20	120.32	103.95	
		21-30	118.12	102.06	
5	October	1-10	171.86	148.48	
		11-20	155.48	134.33	
		21-31	141.05	134.05	
<b>Total kharif</b>					<b>1718 MCM</b>

As stated earlier, rabi irrigation can also be made after construction of Sapt Kosi High Dam. The irrigation water needs for rabi crops for cropping pattern suggested by Govt. of Bihar are as given in Table 7.11(A).

**Table 7.11(A)**  
**Water needs for rabi crops in new command**

<b>Sl. No.</b>	<b>Season</b>	<b>Month</b>	<b>Dates</b>	<b>Irrigation needs (cumec)</b>	<b>Irrigation needs (MCM)</b>
<b>1</b>	<b>Non-monsoon</b>	November	1-10	11.31	9.77
			11-20	17.18	14.85
			21-30	17.19	14.86
<b>2</b>		December	1-10	14.07	12.16
			11-20	19.05	16.46
			21-31	28.19	26.79
<b>3</b>		January	1-10	38.07	32.89
			11-20	39.64	34.25
			21-31	41.44	39.39
<b>4</b>		February	1-10	63.12	54.54
	11-20		61.40	53.05	
	21-28		62.73	43.36	
<b>5</b>	March	1-10	75.12	64.91	
		11-20	59.70	51.58	
		21-31	62.73	41.85	
<b>6</b>	April	1-10	10.71	9.25	
		11-20	8.08	6.98	
		21-30	8.08	6.98	
<b>7</b>	May	1-10	0.00	0.00	
		11-20	0.00	0.00	
		21-31	0.00	0.00	
<b>Total non-monsoon</b>					<b>534 MCM</b>
<b>Total annual</b>					<b>2252 MCM</b>

## **7.12 Firming up of irrigation success**

The irrigation success is firmed up for kharif irrigation in existing scenario without considering Sapt Kosi high dam and also firmed up in post Sapt Kosi high dam scenario by carrying out working tables of existing Hanuman Nagar barrage. The outcomes of working tables are as detailed below.

### ***(a) Working table in pre Sapt Kosi High dam scenario***

In pre Sapt Kosi High Dam scenario, the irrigation success is assessed with the available inflows at Hanuman Nagar barrage and also as per the net inflows available at Hanuman Nagar barrage as recommended by CWC as described below.

#### ***(i) Working table by considering observed inflows of Hanuman Nagar barrage***

For assessing the irrigation success in new command, working table of Hanuman Nagar barrage for meeting the link demands during period June to October is prepared by considering the observed inflows from 1980-81 to 2012-13 at Hanuman Nagar barrage site as shown in Annexure 5.13. As per the working table, no shortfall is found in entire period and the irrigation is found at 100% success.

#### ***(ii) Working table by considering net inflows available at Hanuman Nagar barrage (As recommended by CWC)***

As explained in Chapter-V Hydrology, the CWC has assessed the net inflows available at Hanuman Nagar barrage after meeting the demands of Hanuman Nagar barrage with its full development of irrigation potential. A working table considering the net inflows available at Hanuman Nagar barrage after meeting the full irrigation potential as recommended by CWC is also prepared to firm up the kharif demand of link canal as given in Annexure 5.14. As per the working table, no shortfall is observed and hence, the irrigation is firmed up at 100% success.

The results of working table showing success status for meeting the irrigation requirements of new command alongwith other barrage requirements is given in Table 7.12.

**Table 7.12**

**Result of Working Table as per observed inflows of Hanuman Nagar barrage**

Sl. No.	Year			June			July			August			September			October		
				1-10	10-20	20-30	1-10	10-20	20-31	1-10	10-20	20-31	1-10	10-20	20-30	1-10	10-20	20-31
1	1980	-	1981	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
2	1981	-	1982	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
3	1982	-	1983	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
4	1983	-	1984	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
5	1984	-	1985	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
6	1985	-	1986	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
7	1986	-	1987	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
8	1987	-	1988	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
9	1988	-	1989	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
10	1989	-	1990	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
11	1990	-	1991	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
12	1991	-	1992	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
13	1992	-	1993	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
14	1993	-	1994	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
15	1994	-	1995	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
16	1995	-	1996	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
17	1996	-	1997	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
18	1997	-	1998	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
19	1998	-	1999	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
20	1999	-	2000	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
21	2000	-	2001	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
22	2001	-	2002	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
23	2002	-	2003	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
24	2003	-	2004	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
25	2004	-	2005	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
26	2005	-	2006	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
27	2006	-	2007	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
28	2007	-	2008	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
29	2009	-	2010	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
30	2010	-	2011	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
31	2011	-	2012	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
32	2012	-	2013	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
<b>%age success</b>				<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**S: Success F: Failure**

**Table 7.13**

**Result of working table with releases of Sapt-Kosi High Dam**

Sl. No.	Years			Months											
	From		To	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May*
1	1980	-	1981	S	S	S	S	S	S	S	S	S	S	S	S
2	1981	-	1982	S	S	S	S	S	S	S	S	S	S	S	F
3	1982	-	1983	S	S	S	S	S	S	S	S	S	S	S	S
4	1983	-	1984	S	S	S	S	S	S	S	S	S	S	S	S
5	1984	-	1985	S	S	S	S	S	S	S	S	S	S	S	F
6	1985	-	1986	S	S	S	S	S	S	S	S	S	S	S	S
7	1986	-	1987	S	S	S	S	S	S	S	S	S	S	S	F
8	1987	-	1988	S	S	S	S	S	S	S	S	S	S	S	S
9	1988	-	1989	S	S	S	S	S	S	S	S	S	S	S	S
10	1989	-	1990	S	S	S	S	S	S	S	S	S	S	S	S
11	1990	-	1991	S	S	S	S	S	S	S	S	S	S	S	S
12	1991	-	1992	S	S	S	S	S	S	S	S	S	S	S	F
13	1992	-	1993	S	S	S	S	S	S	S	S	S	S	S	S
14	1993	-	1994	S	S	S	S	S	S	S	S	S	S	S	S
15	1994	-	1995	S	S	S	S	S	S	S	S	S	S	S	S
16	1995	-	1996	S	S	S	S	S	S	S	S	S	S	S	S
17	1996	-	1997	S	S	S	S	S	S	S	S	S	S	S	S
18	1997	-	1998	S	S	S	S	S	S	S	S	S	S	S	S
19	1998	-	1999	S	S	S	S	S	S	S	S	S	S	S	S
20	1999	-	2000	S	S	S	S	S	S	S	S	S	S	S	S
21	2000	-	2001	S	S	S	S	S	S	S	S	S	S	S	S
22	2001	-	2002	S	S	S	S	S	S	S	S	S	S	S	S
23	2002	-	2003	S	S	S	S	S	S	S	S	S	S	S	S
24	2003	-	2004	S	S	S	S	S	S	S	S	S	S	S	S
25	2004	-	2005	S	S	S	S	S	S	S	S	S	S	S	S
26	2005	-	2006	S	S	S	S	S	S	S	S	S	S	S	S
27	2006	-	2007	S	S	S	S	S	S	S	S	S	S	S	S
28	2007	-	2008	S	S	S	S	S	S	S	S	S	S	S	S
29	2008	-	2009	S	S	S	S	S	S	S	S	S	S	S	S
30	2009	-	2010	S	S	S	S	S	S	S	S	S	S	S	F
% success				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	83.30%

**S: Success**

**F: Failure**

*\* In month of May, the link canal has no demand. Hence the success is 100%.*

The annual demand pattern of new link canal is firmed up by considering the release pattern of Sapt Kosi high dam for the period 1980-81 to 2009-10 as given in Annexure 5.15.

As per the studies, it is firmed up that if Sapt Kosi high dam comes into existence, then the available regulated flows will be sufficient for providing irrigation in Rabi season also as well as kharif season with an irrigation success of 100%. Some shortfalls were seen in the months of May, where in, the link canal has no demand. The maximum discharge in new canal will be in the month of August (kharif season) as shown in Table 7.13 above. Therefore, the same canal section can be utilized for non-monsoon irrigation also.

### **7.13 Command area**

The new command area of Kosi–Mechi intra-state link lies in Araria, Purnea, Kishanganj and Katihar districts of Bihar. The total CCA covered under the link canal is 214812 ha further details are given in following paragraphs.

### **7.14 Command area development**

Development of command is being described in following paragraphs:

#### **7.14.1 Details of enroute command**

##### **7.14.1.1 Location**

The link command comprising 214812 ha is falling in Araria, Purnea, Kishanganj and Katihar districts of Bihar. The link canal forms its northern boundary while river Parman and river Mahananda form the western and eastern boundaries. In south it is spread upto river Ganga. The District wise breakup of the enroute command area is given at Table 7.14. Map showing enroute command area is given as Plate-1.

**Table 7.14**  
**Gross command area of link**

**Unit: ha**

Sl. No.	Name of district	Area of the District	Area falling in the command	% of the district	% of Total Command area	Area under command
1	Araria	271712	88000	32.39	31.98	88000
2	Purnea	313883	85750	27.32	31.17	85750
3	Katihar	291349	49235	16.90	17.89	49235
4	Kishanganj	189080	52150	27.58	18.95	52150
			275135		100.00	275135

**7.14.2 Classification of land use and computation of CCA under the link command**

The CCA has been worked using latest 5 years land use statistics for the period 2006-07 to 2009-10. It was seen that culturable area is highest in the year 2006-07. Taking that land use data of 2006-07, the gross command area under the new canal is worked out as 2,75,135 ha and CCA works out to 2,14,812 ha. The classification of land use in the enroute command area is furnished in Table 7.15 below:

**Table 7.15**  
**Abstract of land use of command area lying under the link**

**Unit: ha**

Sl. No.	Particulars	Name of districts				Total area
		Araria	Purnea	Katihar	Kishanganj	
1	Gross command area	88000	85750	49235	52150	275135
2	Forest	271	31	302	98	702
3	Barren & un-cultivable land	1646	3394	3764	3139	11943
4	Land put to non-agricultural use	16394	12235	9472	9301	47403
5	Cultivable waste land	183	317	133	341	974
6	Permanent pastures & grazing land	46	120	45	64	275
7	Land under Misc. tree, crop & groves	6127	2389	1856	1374	11746
8	Fallow land other than Current fallow	969	1306	1029	854	4159
9	Current fallow	3152	8907	4033	2335	18427
10	Net area shown	59211	57052	28601	34644	179507
11	Area shown more than once	30962	19995	15356	12396	78708
12	Total Culturable land (5+7+8+9+10)	69642	69970	35653	39548	214812

*Source: Bihar Statistical Hand Book-2012*

There is no existing or ongoing major, medium or minor irrigation scheme within the identified GCA of link command. There is a proposal to construct a barrage on Mahananda river near Bagdob. As per the agreement, this project would provide irrigation in Purnea district. As per the studies carried out, the right main canal of Bagdob project will provide irrigation in a GCA of 19865 ha. However, as per the salient features of the project, the irrigation will be provided in Katihar district of Bihar. The topographical condition also favours to irrigate in Katihar district. Therefore, the CCA if link canal is worked out by considering the proposed irrigation of Bagdob Barrage in Katihar district. The salient features are given in Annexure: 7.5.

### **7.15 Climate**

The climate of enroute command is given below

#### **(a) Rainfall**

As per the Bihar Statistical Hand Book-2012, annual normal rainfalls in the districts of Araria, Purnea, Kishanganj and Katihar are between 1218 mm to 2041 mm and during monsoon the average annual rainfall is between 1067 mm to 1785 mm. The numbers of rainy days in monsoon are 55 in case of these districts.

Maximum rainfall occurs in the month of July during monsoon, which is of the order of 542 mm and the minimum rainfall in the month of June is of the order of 251 mm in Purnea.

Some rainfall occurs during the non-monsoon in the districts of Kishanganj, Araria and Purnea. The average monthly rainfall during the non-monsoon period is about 110 mm. The Minimum rainfall occurs in month of December.

#### **(b) Temperature**

As per IMD, the command area experience moderate heat during summer. The climate is quite cold in winter. Maximum temperature recorded in Purnea district is 39.9°C and the minimum as 4.3°C.

**(c) Relative humidity**

As per IMD, in Purnea district which lies in centre of command area the maximum and minimum relative humidity in & around the command area are 88% and 39% respectively.

**(d) Evaporation**

As per IMD data of Purnea observatory, the monthly mean evaporation in the command area varies between 5.18 cm to 17.87 cm.

**(a) Present sources of irrigation in the command**

The present sources of irrigation in the new command area are mainly tube wells. The maximum irrigation is being done by ground water. The districtwise details of present irrigation in the districts are given in Table 7.16.

**Table 7.16**  
**Districtwise gross area irrigated (in 000' ha) 2009-10**

Sl. No.	District	Sources					Total
		Canals	Tube wells	Other wells	Tank	Other sources	
1	Araria	0	113	0	0	0	113
2	Purnea	0	150	0	0	0	150
3	Kishanganj	0	43	0	0	0	43
4	Katihar	0	141	0	0	0	141
	Total	0	447	0	0	0	447

*Source: Bihar Statistical Hand Book-2012*

**(b) Methods of irrigation followed**

Most of the farmers are providing irrigation by ground water through tube wells. Some farmers are using electric/diesel pump sets to lift water from the local streams and ground water.

**(c) Status of land development for irrigated area**

**(i) Slope**

The command area is flat and having its slope from west to east and north to south. The average slope in both directions varies from 1:4000 to 1:7000. Being a flatter ground, the requirement of land development works will be minimum height of the upper northern part of

the command from MSL is about 65 m in North direction and about 52 m in North East corner. The southern most part is about 35 to 40 m above MSL

There are number of streams in the entire command which ultimately join river Mahananda. The special characteristics of the rivers are their migrating nature and shallow depth. Due to migrating nature, the villages located on the banks also change their location frequently. The West Kankai and Mechi carries a lot of silt .After shifting their course, large quantum of silt gets deposited in old path and the old river course become almost plain.

***(ii) Condition of channels***

As explained earlier, there is no any existing irrigation project in the command area. Hence no irrigation channels exist in the command.

**7.15.1 Socio-economic aspects**

The population in rural areas is mixed with all categories. The maximum percentage of livelihood belongs to lower income group. The main occupation in the command area is agriculture. Labour for agriculture is easily available. The districtwise scheduled caste and scheduled tribes population in districts is given in Table 7.17.

**Table 7.17**  
**Scheduled caste and scheduled tribe population in districts**  
**(Population in number)**

Sl. No.	Districts	Scheduled Tribe			Scheduled Caste		
		Males	Females	Total	Males	Females	Total
1	Araria	15041	14382	<b>29423</b>	152069	141419	<b>293488</b>
2	Purnea	57714	54233	<b>111947</b>	161322	150766	<b>312088</b>
3	Kishanganj	24176	22940	<b>47116</b>	44304	41529	<b>85833</b>
4	Katihar	72066	68352	<b>140418</b>	107870	100514	<b>208384</b>
	<b>Total</b>	<b>168997</b>	<b>159907</b>	<b>328904</b>	<b>465565</b>	<b>434228</b>	<b>899793</b>

*Source: Bihar Statistical Hand Book-2012*

The districtwise socioeconomic aspects are furnished in Table 7.18 below.

**Table: 7.18**  
**Districtwise socio-economic aspects**

Sl. No.	Description	Araria	Purnea	Kishanganj	Katihar
1	Population in Districts	2806200	3273127	1690948	3068149
2	Population density per sqkm	992	1014	898	1004
3	Sex ratio (females to male for 1000 male)	921	930	946	916
4	Landholdings	Maximum number of holdings belongs to marginal farmers owning less than 0.5 ha			
5	Literacy rate	55.10%	52.49%	57.04%	53.56%
6	Educational institutions	2705	2465	N.A.	4652
7	No. of Cultivators	58135	52347	27805	27058
8	No. of Agricultural labours	127180	129401	55663	64126

*Source: Bihar Statistical Hand Book-2012*

### 7.15.2 Income sources

The agriculture is the main source of income in the project area. The area is thickly populated and the land holdings are small. Therefore the income is very limited. Besides agriculture, livestock is also a source of income. In most of the area, the goats are dominant among the pets. The bullocks are used for ploughing the fields. Buffaloe, camel, ass, donkey, horse are the main livestocks beside goats. The districtwise numbers of livestock are given in Table 7.19.

**Table 7.19**  
**Districtwise livestock**

	Districts				Total
	Purnea	Araria	Kishanganj	Katihar	
Cow	743621	526184	512218	653928	2435951
Buffalo	215851	201334	62901	143636	623722
Sheep	1433	668	79	1346	3526
Goat	534277	657998	578839	455710	2226824
Horse	1352	1841	5	338	3536
Ass/donkey	9	0	99	0	108
Camel	0	0	0	0	0
Sookar jati	14930	13985	8283	22107	59305
Total	1511473	1402010	1162424	1277065	5352972
Dog	12920	17882	13842	4609	49253
Rabbit	5	34	45	308	392

*Source: Bihar Statistical Hand Book-2012*

The milk production is considerable, but in absence of sufficient infrastructure, the dairy industries could not be developed consumption of eggs is also an important factor. A major part of the habitant is non-vegetarian.

Besides agriculture, fisheries are also a source of income in the command area. There are number of tanks in rural areas for fish production. The link canal will be helpful to promote fish production by proving water to these tanks / ponds .The details of fish production in the districts of Araria, Purnea, Kishanganj and Katihar are given in Table 7.20.

**Table 7.20**

Sl. No.	Name of District	Total	
		No. of reservoirs	Water land (ha)
1	Purnea	1295	2205
2	Araria	4652	889
3	Kishanganj	506	890
4	Katihar	7635	6399
	Total	14088	10383

*Source: Bihar Statistical Hand book, 2012*

## Industries:

The command area is lagging in view of industries. In whole command area, there is no public sector industry. However, there are some private firms / industries. The numbers of such industries and the numbers of labour engaged is given in Table 7.21.

**Table 7.21**  
**Numbers of factories and workers employed**

Sl. No.	Name of District	Public sector factories		Private sector factories						Total	
				Section 2m (I)		Section 2m (II)		Section 85			
		F	W	F	W	F	W	F	W	F	W
1	Purnea	0	0	42	652	13	865	116	419	171	1936
2	Araria	0	0	4	103	0	0	52	151	56	254
3	Kishanganj	0	0	5	230	3	300	87	305	95	835
4	Katihar	0	0	82	4442	12	1075	151	1064	245	6581

*F: Factory                      W: Workers*

*Source: Bihar Statistical Hand book, 2012*

## Infrastructure facilities

### a) Roads and railways

The command area is well connected by road and railway network. The Katihar is an important railway junction and number of trains connecting north-east part of country to other cities like New Delhi, Kanpur, Patna, and Kolkata run daily. The Indian railway is constructing a bridge across river Kosi and in near future the command area will be connected by train from Darbhanga and Muzaffarpur cities also.

Similarly, the entire command is well connected by a developed road net work. The details of important highways and railway network are given below.

**Connectivity:****Highways**

1. Birpur – Forbesganj road.
2. Purnia-Murliganj-Madhepura-Saharsa-Mahisi road.
3. Purnia- Dhamdaha- Rupauli- Bijayghat road.
4. Purnia- Korha- Kursella road.
5. Katihar – Korha – Farrakha road.
6. Pratapganj – Narpatganj – Forbesganj road (N.H.57).
7. Supaul – Pipara – Tribeniganj – Jadia road.
8. Jogbani – Forbesganj – Araria.
9. Kursela – Mirganj – Sarsi –Raniganj – Forbesganj road.

**Railways (North Eastern Railway):-**

1. Purnia – Murliganj – Madhepura – Saharsa station (M.G.)
2. Supaul – Saharsa – Mansi section (B.G. & M. G.)
3. Supaul – Narpatganj – Forbesganj section (M.G.)
4. Banmankhi – Bihariganj section (M.G.)
5. Katihar – Barauni section (B.G.)
6. Katihar – Purnia – Jogbani section (North East frontier railways)

**Table 7.22**  
**Distribution of districtwise road length**

District	Length in km		
	NH	SH	MDR
Purnea	103	161.48	286.25
Araria	85	138.69	267.80
Kishanganj	0	117.06	233.5
Katihar	90	115.98	375.93
<b>Total</b>	<b>278</b>	<b>533.21</b>	<b>1163.25</b>

*Source: Bihar Statistical Hand Book-2012*

**(b) Marketing facilities**

The marketing facilities in and around the command area are less as compared to other parts of Bihar .Agriculture is the main occupation of the people. The command area is also lagging in the growth of industries. Most of the population belongs to lower income group. The land holdings are small in entire command. The public transport facilities are very less. Private communication is the important means of transport to approach rural areas.

Due to shortage of this infra-structure, the marketing facilities are not so developed.

**i) Araria district**

**a) Araria:** The Araria town is the districts headquarter. The city is not so developed in point of view of infra structure. It is well connected by National highway, State highway with Madhepura. Katihar, Kolkata Bagdogra, Kishanganj, Purnea, Darbhanga etc.

**b) Forbesganj:** The nearest market to the starting of link command is Forbesganj. The market is well developed. The town is well connected by railway (Broad gauge) It is located about 30 km from Indo-Nepal Border. This is one of the best markets for agricultural product, fertilizers, Banking and other day to day needs.

**c) Jogbani:** Another market is Jogbani located on Indo Nepal boarder and the main centre of export & import with Nepal. The city is thickly populated etc. and very crowdie and a popular market of adjacent Nepalese.

**d) Jokihat and Raniganj:** This is a small market where the local farmers can sale their products and can purchase their house hold goods & fertilizers.

**ii) Purnea district**

**a) Purnea:** The Purnea city is well developed and a good market for all consumers and nowadays it is one of the largest markets in and around the command area. The city is well connected by road network as well as railways network. It can be approach by train via Katihar.

**b)** Another marketing places in Purnea district are Kasba, Baisi, Bammanki, Dhamdaha are small market to meet the day to day requirements of local farmers. These cities are also well connected by roads.

**(iii) Kishanganj district**

**a) Kishanganj:** Kishanganj town is located near the border of Bihar and west Bengal. The city is well connected by road and railway

network. It is one of the biggest centres of jute production and fisheries in the command. The market facilities are well developed.

**b) Bahadurganj:** Bahadurganj town is located on NH joining Araria to Siligudi. The market is good for sale & purchase of agricultural products.

c) Haldikhera, Pawakhali, Kashiban are the other market places in district Kishanganj district and in and around the command area where the nearby farmers trades their agricultural products.

**(iv) Katihar district**

**a) Katihar:** Katihar is the most developed market place located in southern most part of the command area. The city is well connected by road and railway network and can be approached easily from any part of the country. At present this town is the entry of command area.

**b)** Besides above Kara, Pathia, Manihari and Kursela are also good market places in Katihar district which located in and around the command area.

**7.15.3 Topography and soils**

**(i) Topography and relief**

The command has a monotonous flat topography with gentle slope in the south east direction Topographical features of the command area include isolated hilltops, valleys, reserve forests, nallas, streams and rivers. The geological formations include sedimentary quaternary unclassified Holocene recent alluvium unconsolidated rocks having clay, grey silt, fine sand, grey medium to coarse sand pebble and calcareous concretion formations are predominantly found in the command area.

**(ii) Land slopes**

The command area is flat and having its slope from west to east and north to south. The average slope in both directions varies from 1:2000 to 1:7000. Being a flatter ground, the requirement of land development works will be minimum height of the upper northern part of

the command from MSL is about 65 m in North direction and about 52 m in North East corner.

**(iii) Soils**

In the entire command area unfluents (Younger alluvial) soils are found based on the information, the soils contains clay, silt, qoravel & pebble. In most of the part the soils are non calcareous and non – saline in nature.

**7.15.4 Ground water and drainage**

**a) Mode of occurrence**

Quaternary unconsolidated sediments consisting of sand, gravel and pebbles constitute potential ground water aquifer. The thickness of granular zone is about 50-70 meter within a depth of 80 meter. The persistent clay layers are absent and ground water occurs under pheratic condition in major part of the command. The aquifer is highly potential and discharge of 100 m<sup>3</sup>/hr may be obtained for nominal drawdown of 2m.

**b) Chemical quality**

Chemical quantity of water is important in deciding the suitability for irrigation industrial and drinking purposes. Chemical analysis of ground water phreatic aquifer is found suitable for drinking and irrigation purposes. The ground water is mildly alkaline in nature having PH above 8.0. Electrical conductivity (EC) is the range of 250-450 micro seimens/cm. All the major parameters are within the permissible limit. However, Public Health Engineering Department (PHED), Araria & Purnea reported iron content more than its permissible limit of 1.0 ppm (BIS, 1991). While in Katihar district, the Arsenic content is more than permissible limit. It is advisable to adopt iron-removal measures before the utilization of ground water for drinking purposes.

The soils of the command area are characterized with good surface drainage and sub-surface drainage, the water holding capacity being low to medium. With the network of a number of tributaries namely Parman,

Lohandra, Bakra, Ratua, Kawal, Kankai etc. the command area has good drainage facilities.

**c) Ground water fluctuation**

The command area is rich in ground water potential. As per Central Ground Water board, the long term water level data does not show any significant changes. In the command area, the stage of groundwater development is less than 70% and hence falls under the “Safe Category”

The present groundwater level in the phreatic zone, during May, 2006 is between 2.9 m to 6.8 m bgl and in post monsoon is 2.5 to 3.40 m bgl in most of the command area. Due to interlinking of Kosi & Machi river, the water levels may further rise by another 1 to 1.5 m and may not bring in water logging conditions or other hazards.

**7.15.5 Agriculture**

The classification of lands and the present land use has already been discussed in this chapter. Proposed land use will change due to increase in cultivated area and increase in developmental activities due to this project.

**7.15.6 Farmers’ attitude towards improved agricultural practices**

The farmer’s attitude towards improved agricultural practices is positive.

**(a) Use of improved implements and seeds**

The use of bullock power for ploughing of land is common in the area of proposed command. The use of tractor is also done in these areas but the percentage is very low i.e. 10%. Likewise, the use of traditional types of implements is also very common among majority of the farmers.

**(b) Use of fertilizers, insecticides, pesticides, etc.**

About 55% of the farmers use fertilizers and manures for increasing the crop yield, very few of them are particular about use of insecticides/ pesticides for control of plant diseases.

**(c) Extension services**

Occasional extension services are provided by the State Agriculture Department to educate the farmers about the use of improved and modern agriculture technology, and cultivation of high value crops viz. groundnut, soyabean, sunflower, chillies etc. But due to various reasons including inadequate financial resources, the extension services are yet to become popular among the farmers of proposed command area.

**7.15.7 Identification of problems in enroute command area**

**(i) Physical problems including hazards**

**(a) Land slopes:** The land is generally flat therefore; canal distribution system can be aligned easily.

**(b) Soil depth:** There may not be any problem on this account, as sufficient soil depth is available in the area for providing canal irrigation.

**(c) Salinity/alkalinity:** Since the Kosi river water is to be used for irrigation in these areas, which does not have salinity problem, it need not be a cause of concern.

The land capability in command area is good in general. The soils in these areas are stable and not prone to erosion. However, in certain area, the soils may be prone to erosion due to their coarse texture. Such soils can be stabilized by putting them under permanent pastures and grazing lands.

**(d) Water logging:** No water logging problem of serious nature has been reported from the area.

**(e) Drainage:** Looking the general condition and topography of the command construction of field channels and drainage will have no problem, which can be managed by the Agricultural Department at farmers' cost or funding from the various land development banks. It is proposed that the surplus irrigation water shall be discharged to river Mahananda by improving the drainage system of the new command. An

adequate provision for improving of drainage system has been made in the cost estimate.

#### **7.15.8 Financial problems**

Most of the farmers are of small land holdings. The agriculture live stocks are the main source of income. Farmers should be provided fund assistance for adopting the new techniques of cultivation and to produce the beneficial crops with adequate use of fertilizers.

#### **7.16 Land development work proposals**

An adequate provision has been made in the estimate for land development works. At the time of implementation of the project, detailed survey of entire command will be carried out and based on the requirement, land development works will be taken up. This work will be done by State Irrigation Department or State Agriculture Department or Command Area Development Authority (to be decided by State Government). For On Farm Development works, the sample command area survey in 4 number of patches lying in different blocks as mentioned in Chapter-V Survey and Investigation has been carried out.

A number of commercial banks and co-operative banks have their branches in the command area there. Branches of land development banks are also located in some rural areas of the command. Moreover, the agricultural materials like seeds, fertilizers, insecticide, pesticides, etc. are provided to the farmers by the concerned government department at subsidized rates through different sale booths or fair price shops. However, due to numerous reasons, especially inadequacy of financial resources, extension services have not yet become very popular.

#### **7.17 Ayacut roads**

Suitable provisions for CD structures will be made to avoid traffic disruption through ayacut roads.

#### **7.18 Benefits**

##### **(i) Cropwise increase in yield per ha and total estimated output from the command**

The cropwise yields in pre & post project scenarios are given in Table 7.23.

**Table 7.23**  
**Cropwise yield under pre and post project scenarios**

S. No.	Name of crop	Pre-Project Scenario			Post Project Scenario		
		Area (Ha)	Yield (quintal/ha)	Gross Yield (quintal)	Area (ha)	Yield (quintal/ha)	Gross Yield (quintal)
<b>A</b>	<b>Summer</b>						
	Paddy	11492	18	206864	0	0	0
<b>B</b>	<b>Kharif</b>						
i)	Paddy	117695	18	2118519	103110	50	5155488
ii)	<b>Pulses:</b>						
A	<i>Moong</i>	0	0	0	9667	28	270663
B	<i>Urad</i>	1912	18	34413	7518	25	187961
C	<i>Arhar</i>	0	0	0	7518	35	263145
	<b>Total pulses</b>	1912					
iii)	Vegetables	0	0	0	17185	70	1202947.2
iv)	Maize(Hybrid)	23887	20	477742	54777	75	4108279.5
v)	Fodder	0	0	0	8592	1000	8592480
vi)	Oil seeds & others crops	1224	10	12244	2148	10	21481.2
	Jute	35702	15	535526	0	0	0
	<b>Total kharif</b>	<b>182332</b>		<b>3178444</b>	<b>210516</b>		<b>19802444</b>
<b>C</b>	<b>Rabi</b>						
i)	Wheat	44960	23	1034083	44960	23	1034083
ii)	Pulses	6638	18	119478	6638	18	119478
iii)	Oil seeds	5542	10	55421	5542	10	55421
iv)	Maize	11621	20	232427	11621	20	232427
v)	Pea/Potato	5327	100	532734	5327	100	532734
	<b>Sub-total rabi</b>	<b>74089</b>		<b>1974144</b>	<b>74089</b>		<b>1974144</b>
<b>D</b>	<b>Perennial</b>						
	Pineapple	1504	50	75184	1504	50	75184
	<b>Total Annual</b>	<b>256421</b>		<b>5434636</b>	<b>284605</b>		<b>22058636</b>

**(ii) Estimated cost of increased production**

The yield in pre and post project scenarios (without considering Sapt Kosi High dam) has been assessed in Table 7.23.

**(iii) Likely socio-economic aspects**

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

**7.19 Use of ground water for intensification of irrigation in new command**

Assessment of balance ground water potential for development of irrigation in Kosi basin (Indian portion) has been made based on the assessment made by Central Ground Water Board for the year 2009 of the project area. The status of total replenishable ground water resources and net draft in the project area are furnished in Table 7.24.

**Table 7.24**  
**Balance ground water potential (MCM)**

<b>Sl. No.</b>	<b>Particulars</b>	<b>Balance ground water potential</b>
1.	Total replenishable ground water resources	3366.25
2.	Provision for drinking, industrial & other use	298.24
3.	Utilizable ground water resources for irrigation	3068.01
4.	Net draft	1172.41
5.	Balance ground water potential available for exploitation (3-4)	1895.60

The intensity of irrigation is considered as 98% in kharif utilizing 1718 MCM of surface water. The Govt. of Bihar in their proposal has desired to provide irrigation with an annual intensity of 250%. It is proposed that the balance utilizable ground water potential to the tune of 1895.60 MCM as described above may be utilized for further intensification of irrigation as proposed.