

## **CHAPTER - V**

# **IRRIGATION PLANNING AND COMMAND AREA DEVELOPMENT**

### **5.1 General**

The Burhi Gandak-Noon-Baya-Ganga link canal project envisages diversion of 492 cumec flood water of river Burhi Gandak to provide relief to the people living in the lower reaches of Burhi Gandak basin. It is basically a flood moderation scheme but considering large part of fertile land enroute the link canal it is also proposed to provide irrigation to the unirrigated areas lying in Samastipur, Begusarai and Khagaria districts of Bihar during kharif season from the flood water diverted through the project. The diversion of 10% of the estimated flood discharge of river Burhi Gandak at Sikandarpur G&D site corresponding to 50 years' return period is proposed from the barrage through a 28.95 km long link canal offtaking near village Muriaro of Samastipur district and outfalling into river Baya/Ganga near village Bhagwanpur of Begusarai district.

### **5.2 Existing/proposed irrigation facilities in the proposed project command area**

As such there is no existing/proposed irrigation projects through surface water intercepted in the command of the Burhi Gandak-Noon-Baya-Ganga link. The farmers irrigate their fields by wells, tube wells etc. to a limited extent. The sourcewise irrigation of the districts in the command area of Burhi Gandak-Noon-Baya-Ganga link canal project for the year 2009-10 has been computed as 84,216 ha and details are furnished in **Table 5.1.**

**Table 5.1**  
**Sourcewise irrigation within command in ha (2009-10)**

Sl. No.	Source	Sourcewise irrigated area							Total	% of source-wise irrigation
		Whole Districts			Within Command Area					
		Sama-stipur	Begu-sarai	Khagar ia	Samasti-pur	Begu-sarai	Khagaria			
1	Canal	0	0	0	0	0	0	0	0%	
2	Tank	0	0	0	0	0	0	0	0%	
3	Wells and Tube wells	127000	89000	76000	42088	41839	289	84216	100%	
4	Other Wells	0	0	0	0	0	0	0	0%	
5	Other Source	0	0	0	0	0	0	0	0%	
6	Total	127000	89000	76000	42088	41839	289	84216	100	

Source: Bihar Statistical Hand Book 2012, Government of Bihar

### 5.3 Existing cropping pattern

Rice, wheat and maize are the prominent crops of this area followed by sugarcane and potato. Rice occupies 30%, wheat 31% and maize 32% of the total cropped area. High yielding varieties of rice are popular but in the low lands mainly the traditional varieties predominate. Both kharif and rabi maize are grown by a large numbers of progressive farmers. Under un-irrigated situations, mixed cropping of maize and arahar in uplands is a common feature. Amongst the cash crops, tobacco is the most important crops. Fields put under tobacco, pea and arahar are mostly kept fallow during early kharif period and the transplanting of these crops is done in the month of September. The details of existing cropping pattern within command area for the year 2009-10 are given in **Table 5.2**.

**Table 5.2**  
**Existing cropping pattern**

Unit : Area in ha

Sl. No.	Crops	Whole Districts			Within Command Area				% of crop area w.r.t. total area
		Samasti -pur	Begu-sarai	Khaga-ria	Samasti -pur	Begu-sarai	Khag-ria	Total	
1	Rice	94000	30000	24000	21808	9870	65	31743	29.63
2	Wheat	60000	57000	33000	13920	18753	89	32762	30.58
3	Maize	58000	62000	56000	13456	20398	151	34005	31.74
4	Massoor	2000	1000	1000	464	329	3	796	0.74
5	Arahar	1000	1000	0	232	329	0	561	0.52
6	Peas	1000	1000	1000	232	329	3	564	0.53
7	Sugarcan e	3000	1000	-	696	329	-	1025	0.96
8	Potato	12000	6000	1000	2784	1974	3	4761	4.44
9	Tobacco	4000	-	-	928	-	-	928	0.86
	Total				54520	52311	314	107145	100.00

Source: Bihar Statistical Hand Book 2012, Government of Bihar

#### 5.4 Land use

From the latest five years (2005-06 to 2009-10) land use particular data, the maximum culturable command area works out to 1, 26,034 ha in the year 2005-06. The land use particulars within command area for the period from 2005-06 to 2009-10 are given in **Annexure –5.1**. The culturable area is considered to be the total of the land under miscellaneous trees, crops and groves, culturable waste lands, other fallows, current fallows and net area sown. The yearwise culturable area within command of link canal is given in **Table 5.3**.

**Table – 5.3**  
**GCA and CCA in the command of BG-N-B-G link project**

Year	GCA (ha)	CCA (ha)
2005-06	175820	<b>126034</b>
2006-07	175820	126033
2007-08	175820	126004
2008-09	175820	125576
2009-10	175820	125404

The maximum culturable area 1,26,034 ha for the year 2005-06 has been adopted. The land use particulars of command area for the year 2005-06 are presented in **Table 5.4**.

**Table 5.4**

**Districtwise land use particulars for the year 2005-06 within command area** **Unit: ha**

Sl No	Land use	Area of districts falling in command			
		Samastipur	Begusarai	Khagaria	Total
1	Geographical area	86956	88297	567	175820
2	Forests	0	0	0	0
3	Land put to non-agriculture use	3043	5496	45	8584
4	Barren and unculturable land	1302	8520	52	9874
5	Permanent pastures and other grazing land	23	8	1	32
6	Land under miscellaneous trees, crop and groves not included in net area sown	2718	1664	11	4393
7	Culturable waste	0	19	2	22
8	Other fallow land	384	462	28	874
9	Current fallow	938	3415	43	4397
10	Net sown area	60998	55038	313	116348
11	Area sown more than once	22529	23430	175	46134
12	Total cropped area	83526	78468	487	162482
13	Culturable area (6 to 10)	65038	60598	398	126034

Source : Bihar Statistical Hand Book, 2012, Government of Bihar.

## 5.5 Command area

The proposed command area lies in Samastipur, Begusarai and Khagaria districts of Bihar. The total gross command area and culturable command area are 175820 ha and 126034 ha respectively. The districtwise breakup of the command area is given at **Table 5.5**. Map showing command area is appended as **Plate 5.1** in the Drawing Volume.

**Table 5.5****District wise break up of command area of the project**

S.N.	District	Whole district		Within command	
		Geographical area (ha)	Culturable area (ha)	Gross command area (ha)	Culturable command area (ha)
1	Samastipur	2,62,390	1,96,253	86,956	65,038
2	Begusarai	1, 87,828	1,28,906	88,297	60,598
3	Khagaria	1,49,342	1,047,76	567	398
		Total		<b>1,75,820</b>	<b>1,26,034</b>

**5.5.1 Rainfall**

As per Statistical Hand Book of Bihar 2012, the normal annual rainfall in the districts of Samastipur, Begusarai and Khagaria for the period 2007-11 varies from 1004 mm to 1160 mm and during monsoon, the average annual rainfall ranges from 936 mm to 1077 mm in these districts. The average numbers of rainy days are 42 in Begusarai and Khagaria districts and 44 in Samastipur districts. Maximum rainfall of 313.3 mm occurs in the month of August and minimum of the order of 1.7 mm in the month of December in the districts under project area.

**5.5.2 Physiography**

The lands of this zone are alluvial plains that slope towards the south east direction with a very low gradient as evident by the stream flow direction along the natural level before they finally meet the Ganga. As a result, there are vast areas that get flooded and become waterlogged during monsoon. Except for the northern portion and portion in west of the zone under the influence of Adhwara system of rivers, the entire zone is under the influence of rivers Gandak, Burhi Gandak and Ghaghara, all of which originate in the lime rich foot hills of the Himalayas. Thus, the soils under the influence of Gandak, Burhi Gandak and Ghaghara are mostly calcareous having different amounts of lime in them. The soils of Siwan and Gopalganj districts with less rainfall and more pronounced dry seasons have developed

salinity as well as alkalinity. Similarly, the soils of the northern part, under the influence of Adhwara group of rivers are neutral, acidic or saline depending on the local physiography.

### **5.5.3 Climate**

The climate of the districts under the command is described in the following paragraphs:

#### **Samastipur**

The climatic conditions can be classified as semi arid and sub tropical. The summers are dry and conditions are extreme during this season. The monsoon season brings relief from the heat and tropical conditions can be experienced during this period. The winters can be cold and harsh conditions prevail during this season. The months of March, April and May constitute the summer season. Temperatures can raise upto a maximum of around 45<sup>0</sup> C during the summer season. The month of May experiences the highest temperatures. The lowest expected temperature is around 20<sup>0</sup> C. The monsoon season is during the months from June to September. Rainfall is abundant during the monsoon season. The post monsoon months of October and November are milder and temperatures can be much lower during this period. The winter season starts in the months of December and extends till the end of February. Temperatures can drop to around 6 degree Celsius during this time. The conditions are usually dry during the winter.

#### **Begusarai**

Being part of the Gangetic plains of the Indian subcontinent, the district experiences three climatic seasons – the summer season from March to mid June, the monsoon season from mid June to October and the winter season from November to February. The month of February and March fall in the transitional season from winter to summer described as Spring . Similarly the months of September and October fall in the transitional season from the monsoon season to the winter season. The maximum and minimum temperatures range from 26° C to 35 °C and humidity levels are of around 73%.

## **Khagaria**

The climate of the district may be said to form a medium between the dry, parching heat of the up country and the close moist atmosphere of the south valley of Bengal. The heat is often intense but is pleasing during the rains because of low humidity. The summer begins towards the middle of March and continues upto the end of June, when the rainy season begins. The months of April and May combine heat with high humidity relieved by intermittent rainfalls. The rainy season continues upto October, while the water logging due to rain water continues in some areas upto the end of December.

The districtwise average annual rainfall for the period 2007-2011 in the command is given in **Table 5.6**.

**Table 5.6**

**Districtwise average annual rainfall for the period 2007-2011 in command**

<b>S. No.</b>	<b>Name of the district</b>	<b>Average annual rainfall in mm</b>
1.	Samastipur	1077
2.	Begusarai	936
3.	Khagaria	990

### **5.5.4 Soils**

The command area of the link canal falls under the districts of Samastipur, Begusarai and Khagaria districts of Bihar state. The district wise soil types, soil taxonomy of the command are described below:

#### **Samastipur**

The soils of Samastipur portion of the command area are very deep, moderately well drained calcareous fine silty soils on very gently

sloping plain with loamy surface texture, slight erosion, severe flooding and slight sodicity; associated with the deep imperfectly drained, fine-loamy soils with loamy surface texture, slight erosion and slight sodicity. The taxonomy of the soil is fine loamy and typic ustorthents.

### **Begusarai**

The soils in Begusarai portion of the command area are very deep, well drained, moderately well drained, coarse-loamy soils on very gently sloping plain with loamy surface texture and slight erosion; associated with very deep, imperfectly drained, fine-loamy soils with loamy surface texture and slight erosion, flooding and slight salinity/ sodicity. The taxonomy of the soils of the area is coarse –loamy, Fine- loamy, typic ustifluvents.

### **Khagaria**

The soils in Khagaria portion of the command area are very deep, well drained, calcareous fine-loamy soils on very gently sloping plain with loamy surface texture, slight erosion, severe flooding and slight salinity / sodicity; associated with very deep imperfectly drained, calcareous fine-loamy soils with loamy surface texture slight erosion, severe flooding and slight salinity/ sodicity. The taxonomy of the soils are fine –loamy, typic ustifluvents.

## **5.5.5 Agriculture status in the command**

The main occupation of the people in the area is agriculture and about 85% of the population depends on agriculture based economy. The main crops grown in the area are rice, wheat, pulses, oilseed, tobacco, potato, red chilies, tomato and arandi. In addition to the agriculture, rearing of milk cattle has also been a traditional occupation.

## **5.5.6 Socio economic aspects**

### **5.5.6.1 Agriculture**

Agriculture being the back bone of the project area since a long time inspite of the fact that project area has a rugged topography. The project area has two agricultural seasons viz . kharif and rabi. The kharif



season starts from the month of June and lasts upto October and rabi season starts from November and lasts upto April. The important crops and vegetables grown in the area are rice, paddy, wheat, maize, oilseeds, sugarcane, potato, barley, cauliflower, cabbage, tomato, radish and carrot.

#### **5.5.6.2 Marketing facilities**

The Samastipur, Dalsinghsarai, Begusarai and Barauni are important towns where all marketing facilities for agricultural products are available in the vicinity of the project. These towns are well connected with highways and railway network.

#### **5.5.6.3 Infrastructure facilities**

The project area is well connected with all infrastructure facilities required for agro based industries. The NH-28 and NH-31 are passing through and nearby the command area. Railway network in the project area connects all important towns of state and country.

#### **5.5.6.4 Agro climatic condition**

The soils of Samastipur, Begusarai and Khagaria districts are rich alluvial and excellent for rabi and kharif crops. The agro climatic conditions of the area are favourable for maize, tobacco, rice, wheat, chillies, pulses, oilseeds and vegetables.

#### **5.5.7 Method of irrigation followed**

Electric/diesel pump sets are used to lift water from the wells, tube wells and rivers for irrigation.

#### **5.5.8 Ground water**

The districtwise ground water resources for the districts falling in the command area are given in **Table 5.7**.

**Table 5.7****Districtwise ground water resources**

Sl. No.	District	Total ground water resource (ham)	Ground water resource form drinking and industrial use (ham)	Available ground water resource for irrigation (ham)	Ultimate ground water resource for irrigation (ham)	Irrigation potential created (ha)	Ultimate irrigation potential (ha)	% of potential created to ultimate potential
1	2	3	4	5	6	7	8	9
1	Samastipur	81394	12208	69186	62265	53257	95795	55.69
2	Begusarai	63479	9523	53962	48563	45878	74709	61.41
3	Khagaria	45530	6829	38701	34831	24266	53585	45.29

Source : Central Ground Water Board , Government of India.

**5.6 Proposed cropping pattern**

The proposed link canal is basically meant for diversion of flood water of river Burhi Gandak. In view of reclamation of land due to reduction in inundation and availability of fertile land enroute the proposed link canal, irrigation in the area has been proposed in kharif season. The proposed cropping pattern as per Government of Bihar for the link project has been adopted in the study and is given in **Table 5.8**.

**Table-5.8****Proposed cropping pattern as per Government of Bihar**

Sl. No.	Name of Crops	% of CCA	Area under crop (ha)
1	Paddy	36	45,372
2	Maize	54	68,059
3	Pulses	9	11,343
4	Oilseeds	1	1,260
Total		100	1,26,034

## 5.7 Crop water requirement

Net irrigation requirement (NIR) for paddy and maize has been worked out by NIH using potential evapotranspiration (ET<sub>o</sub>) data of Muzaffarpur IMD observatory which is situated near the project area. The pulses and oilseeds are purely rainfed crops and therefore do not require irrigation. The gross irrigation requirement (GIR) of the crops has been worked out considering an irrigation efficiency of 65% for paddy and 55% for maize. The total crop water requirement works out to 450MCM. The details of cropwise requirement, monthwise delta and monthly cropwater requirement for proposed crops are given in **Table 5.9** to **Table 5.11** respectively.

**Table 5.9**  
**Crop water requirement**

Sl No.	Name of crops	Area under each crop (ha)	Delta (mm)	Water requirement (MCM)
1	Paddy	45,372	580.03	263
2	Maize	68,059	274.44	187
Total				450

**Table-5.10**  
**Monthwise delta in mm**

Name of Crops	Months						
	June	July	Aug.	Sept	Oct	Nov	Total
<b>Paddy</b>	-	-	-	186.83	315.38	77.82	<b>580.03</b>
<b>Maize</b>	96.78	42.55	55.49	25.31	54.31	-	<b>274.44</b>
<b>Total</b>	<b>96.78</b>	<b>42.55</b>	<b>55.49</b>	<b>212.14</b>	<b>369.69</b>	<b>77.82</b>	<b>854.47</b>

Source: NIH study

**Table No, 5.11****Monthwise crop water requirement**

Sl. No	Month	Name of Crops				Total water requirement	
		Paddy (45,372 ha)		Maize (68,059 ha)		in	
		Delta (mm)	Water requ- irement (MCM)	Delta (mm)	Water requ- irement (MCM)	MCM	cumec
1	Jun	0	0	96.78	66	66	25.46
2	Jul	0	0	42.55	29	29	10.83
3	Aug	0	0	55.49	38	38	14.19
4	Sep	186.83	85	25.31	17	102	39.35
5	Oct	315.38	143	54.31	37	180	67.20
6	Nov	77.82	35	0	0	35	13.50
	<b>Total</b>	<b>580.03</b>	<b>263</b>	<b>274.44</b>	<b>187</b>	<b>450</b>	

**5.8 Water planning****5.8.1 Total demand**

It is proposed to provide irrigation in the enroute command during kharif season. The monthwise demand of water for irrigation during kharif season is given table in **Table 5.12**.

**Table 5.12****Monthly demand of water for irrigation**

Sl. No	Month	Total demand in	
		MCM	cumec
1	Jun(1-30)	66	25.46
2	Jul(1-31)	29	10.83
3	Aug(1-31)	38	14.19
4	Sep(1-30)	102	39.35
5	Oct(1-31)	180	67.20
6	Nov(1-30)	35	13.50
	<b>Total</b>	<b>450</b>	

**5.8.2 Working table**

The hydrological studies of the project have been carried out by NIH. According to the study, the 75% dependable flow in river Burhi Gandak at Sikandarpur G&D site is 63.15 cumec. A flow duration curve (FDC) of river Burhi Gandak at Sikandarpur G&D has been plotted using daily discharge data from 1<sup>st</sup> June 2000 to 31<sup>st</sup> May 2006. From the FDC, it is apparent that 650 cumec of discharge is available in Burhi Gandak 10% of the time. It means, in a year, flow of 650 cumec would be available for around 37 days out of which a part can be diverted through the canal which can be utilized for meeting the crop water requirement. Similarly, if we consider 20% dependable flow of 315.2 cumec, the diversion of water through the canal is possible for a period of 73 days in a year. The possible dependable flows in the canal with intention to ensure irrigation benefits are tabulated below. It may be kept in mind that the dependable flow for the number of days of availability in a year is with mid July as the median.

The working table has also been prepared to evaluate the irrigation success rate for the proposed crops for the period June to November by using data of Sikandarpur G& D site on river Burhi Gandak for the period from 1994 to 2010. From the working table, it is revealed that out of 102 months, success achieved for 100 months which is 98% success and only 2% failure. The details are furnished at **Annexure 5.2**.

The dependable flows and number of days of its availability in a year as computed by NIH, Roorkee is given in **Table 5.13**.

**Table 5.13**

**Dependable flows and number of days of its availability in a year**

Sl. No.	Probability of exceedance (%)	Dependable discharge (cumec)	Days of availability in a year (days)
1.	10	650.00	37
2.	20	315.20	73
3.	25	243.40	91
4.	50	83.38	183
5.	75	63.15	274