8-3-2. Inland Fishery Benefits

Benefits of inland fisheries are realised by increased inland fisheries of which representative is silver carp by supplying fresh water into scattered ponds all over the Project area and by inhabitable fisheries for preservation of water quantity and quality in Beels along Sibu River which catches proposed irrigation water in dry season. The surface water area of ponds is about 630 ha and that of Sibu River which dries up completely in the dry season.

8-3-3. Rural Road Network Benefits

Agricultural products are transported from the Project area to the markets through the main road. It is considered that the distance of connected roads from the villages to the main road in the area is about 6 km on an average. When a new road network is constructed, the distance from the villages to the new road would become about 2 km.

Road benefits have been estimated based on the difference of transportation costs between "with" and "without project" to transport marketing quantities of proposed output and quantities of agricultural inputs.

8-3-4. Total Benefits

The total benefits of the Project are as follows:

(Unit: '000 TK.)

	Crops	Fisheries	Rural Road Network	Total
Financial	1,024,521	48,867	28,854	1,102,242
Economic	961,547	38,845	23,087	1,023,479

Note: See Appendix XI-2.

8-3-5. Intangible Benefit

In addition to the above-mentioned tangible economic benefits, the Project will be a considerable socio-economic impact on the Project area and on the country, as follows:

(1) Socio-economic benefits on the Project Area

a) Socio-economic multiplier effect, such as activation of industries related to improvement of living standards of farm households and increase of employment opportunities in those industries;

b) Improvement of cultivation techniques and farm management;

c) Introduction of fresh and inexpensive farm products throughout the year;

d) Improvement of nutrition via increased intake of food grains, vegetables, and fish;

e) Establishment of irrigators' association managed by farmers and communication with BWDB through those associations;

f) Expansion of radius of interaction and close communication among the villagers of the area via improved rural road network;

g) Improved consciousness of farmers with regard to agricultural cooperatives;

h) Deepening of mutual communication among beneficiaries;

i) Continued employment opportunities required for Project construction and operation and maintenance thereafter.

(2) Socio-economic benefits on the country

a) Enhancement of self-sufficient rice production and contribution to improved foreign currencies balance.

8-4. Project Justification

8-4-1. Economic Efficiency

The comparison between project cost and benefits is shown in the following Table 8-4.

The overall FIRR and EIRR are 13.6% and 18.4%, respectively. In case of Barind, FIRR and FIRR are 14.4% and 19.7% and in case of Paba Flood. Plain, FIRR and EIRR are 10.2% and 13.0%, respectively. Benefit cost Ratio (B/C ratio) with discount rate of 15% of the overall is 1.26. The overall EIRR and B/C Ratio appears justifiable for an irrigation improvement scheme which aims at production improvement in the agricultural sector together with inland fisheries sector and rural road network sector.

TABLE 8-4. COMPARISON OF PROJECT COST AND BENEFITS

	Barind	Paba Flood Plain	Overall
A. Financial Indicator			
1. Construction Cost (000TK)	3,953,547	1,029,594	4,983,141
15% Discount Rate	2,535,640	674,830	3,210,440
2. Benefit (000TK)			
- Annual Benefit	960,100	142,100	1,102,200
- Present Worth Value (15% Discount Rate)	2,415,050	464,520	2,879,570
3. Benefit Cost Ratio			
- 10% Discount Rale	1.44	1.01	1.36
- 15% - do -	0.95	0.69	0.90
- 20% - do -	0.67	0.50	0.63
4. Internal Rate of Return (%)	14.4	10.2	13.6
B. Economic Indicator			
1. Construction Cost (000TK)	2,450,119	713,881	3,164,000
15% Discount Rate	1,631,940	473,580	2,105,480
2. Benefit (000TK)			
- Annual Benefit	896,700	126,800	1,023,500
- Present Worth Value (15% Discount Rate)	2,250,270	411,100	2,661,450
3. Benefit Cost Ratio			
- 10% Discount Rate	2.05	1.28	1.89
- 15% - do -	1.38	0.87	1.26
- 20% - do -	0.98	0.64	0.90
4. Internal Rate of Return (%)			
- Proto - type (Sensitivity Test)	19.7	13.0	18.4
a)10% increases in Construction Cost	18.4	12.0	17.1
b) 10% reduction in benefit	18.1	11.7	16.8
c) Two year delay in benefits	18.1	12.0	16.9
d) Combination of (a) and (b)	16.9	10.7	15.7
e) Combination of (a) and (c)	17.0	11.1	15.8
f) Combination of (b) and (c)	16.7	10.8	15.5
g) Combination of (a), (b) & (c)	15.6	9.9	14.5

8-4-2. Sensitivity Analysis

Sensitivity analysis has been made on the basis of seven alternative assumptions, the results of which are shown in Table 8-4.

From the sensitivity analysis, it appears that without extraordinary setbacks the North Rajshahi Irrigation Project would be a viable project.

8-4-3. Analysis of Farm Household Income

Farm households (including landless farmers) in the Project area depend mainly on paddy culture with an average area of 1.0 ha (1.5 ha in case of excluding landless farmers). According to the Farm Economic Survey, the income of a farm household with an average operated area of 1.7 ha of medium farm is assumed to be TK20,991 per year at present. Upon implementation of the Project, however, income will become TK 58,073 per year out of which agricultural income is TK45,184 per year and non-agricultural income is TK 12,827 per year, with a disposable income of TK57,174 per year due to the enhancement and upgrading of cropping ratio, and increases in yield (Table 8-5).

Assuming that water charge of this Project is equal to operation and maintenance cost with project, the farm household economic surplus will become TK. 33,178, after deducting the O/M cost with project of TK. 4,772 and household expenditures of TK. 19,224 from disposable income (Table 8-5 refers).

TABLE 8-5. FARM BUDGETS

Item	Small Farm (0.6ha)		Medium Farm (1.7ha)		Large Farm (4.8ha)		Average Farm (1.8ha)	
	Present (TK)	W.P. (TK)	Present (TK)	W.P. (TK)	Present (TK)	W.P. (TK)	Present (TK)	W.P. (TK)
Agricultural Income	3,219	15,947	8,142	45,184	29,028	127,579	7,619	47,842
Non-agricultured Income	9,564	9,564	12,227	12,227	52,732	52,738	15,683	15,683
Gifts etc	161	161	622	662	438	438	335	335
Farm household Income	12,944	25,672	20,991	58,073	82,204	180,755	23,637	63,860
Tax etc	349	349	899	899	3,584	3,584	935	935
Disposable Income	12,595	25,323	20,092	57,174	78,620	177,171	23,702	62,925
Household Expenditures	11,887	11,887	19,224	19,224	33,775	33,775	16,424	16,424
Operation and Maintenance Cost with Project Per Year	-	1,684	-	4,772	-	13,474	-	5,053
Farm household Economic Surplus	708	11,752	868	33,178	44,845	129,922	7,278	41,448

Source: 1) Present --- Farm Economic Survey
2) With Project --- Project Benefits (see Main Report, Table 8-3-1, Volume 1).
3) O/M Cost with Project Per Year --- Estimated O/M Cost with Project (see Main Report, Table 8-2-1, Vol.1)

Note: Agricultural income at present is figure which water charge has been already reduced.

CHAPTER 9
STAGE DEVELOPMENT PLAN

CHAPTER 9. STAGE DEVELOPMENT PLAN

9-1. Staging of the Project

9-1-1. Basic Concept

The Project, which covers an irrigable area of 51,200 ha, would cost TK. 4,983 million in total with a 6-year construction period. The Project is widely diffused and costly that alternative stage development plans should be studied based on the following basic concepts.

(1) High Priority for Flood Plain Area

The construction works in the Flood Plain area have higher priority over the Barind area because of;

1) The Project should be integrated with the other on-going projects such as Chalan Beel Project, Barnai Project and so forth.

2) The Flood Plain area, which is part of Kalnahal Bara Beel, has no irrigation system.

3) The Kasba pumping station can be operated by the present power supply capacity.

(2) Phasing of the Barind Area

The construction works in the Barind area can be phased because of:

1) The works can be carried out from the pumping station to the on-farm.

2) On Phase I, intake canal, pumping station and secondary canal can be constructed in full-scale, however, pumps can be installed in the pumping station with the same capacity as in the secondary canal.

3) On Phase II and III, the canals, facilities to be constructed, and pumping stations are to be installed according to the water requirement in the phased area.

9-1-2. Stages of the Project

The Project will be constructed by the following stage development plans:

	Flood	Barind Area		
	Plain Area	Phase I	Phase II	Phase III
I. Benefit Area (ha)	9,000	7,942	17,247	17,011
II. Discharge	9,436	9,804	18,082	17,834

9-2. Facility Planing

Facility Planning by stage development is summarized in Table 9-1.

9-3. Implementation and Disbursement Schedule

9-3-1. Implementation Schedule

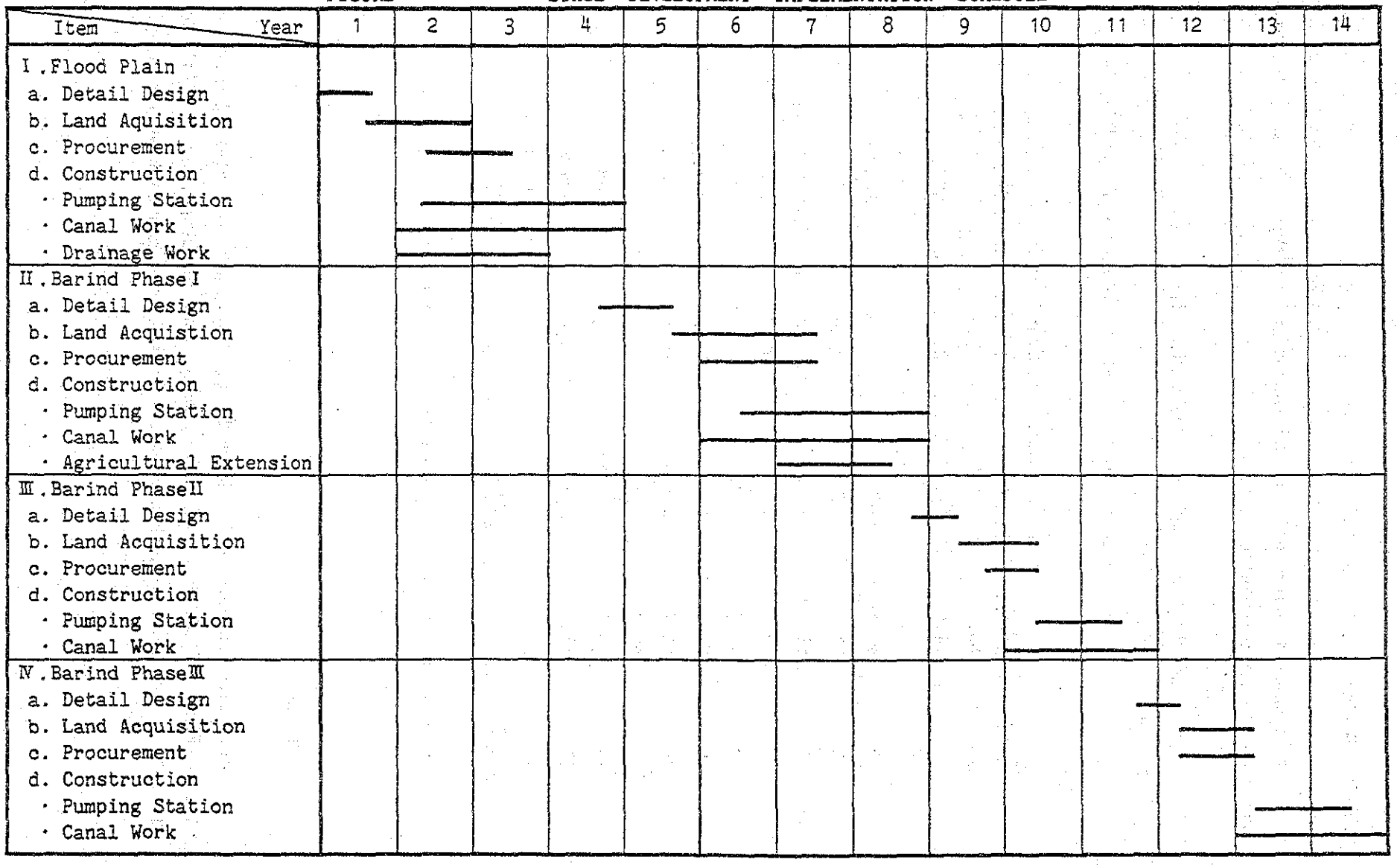
According to the stage development plan, the construction works would have a total construction period of about 14 years including 4 years for the Flood Plain area; about 4 years in Phase I, and about 3 years each in Phases II and III, respectively for the Barind Area. The implementation schedule by stage development is shown in Fig. 9-1.

TABLE 9-1 STAGE DEVELOPMENT PLAN

Area		Flood Plain	Barind			
Item		Stage-1	Stage-2	Stage-3	Stage-4	Total
I. Benefit Area	ha	9,000	7,942	17,247	17,011	42,200
II. Discharge	m^3/s	9,436	9,804	18,082	17,834	44,242
III. Pump		1,350×1 1,000×2	1,650×1 1,350×1	1,650×3	1,350×2	1,650×4 1,350×4
IV. Canal						
a. Main	m	13,908	-	32,400	16,370	48,770
b. Secondary	m	62,800	19,500	96,100	44,060	159,660
c. Sub-Secondary	m	18,790	100,470	116,470	68,530	285,470
V. Irrigation Facilities						
a. Bifurcation	nos	15	46	69	24	139
b. Check Gate	nos	1	-	2	-	2
c. Siphon	m	300	-	160	200	360
d. Acueduct	nos	3	-	-	-	-
e. Chute	nos	-	-	2	-	2
f. Vertical Drop		1	78	61	7	146
g. Culvert		-	-	2	1	3
h. Overchute		-	-	7	4	10
i. Double Orfice		-	-	4	1	5

Area		Flood Plain	Barind			
Item		Stage-1	Stage-2	Stage-3	Stage-4	Total
VI. Drainage						
a. Excavation		2,001,395	-	-	-	-
b. Regulator		4	-	-	-	-
VII. Road and Bridge						
a. Road						
· Trunk		5,000	4,000	3,000	3,000	10,000
· Maintenance		76,708	19,500	128,500	60,430	208,430
b. Bridge		6	-	20	7	27
VIII. On-Farm		9,000	7,942	17,247	17,011	42,200
IX. Transmission Line	set	1	1	-	-	-
X. Telephone Line	set	1	1	-	-	-
XI. Construction Machine	set	1	1	-	-	-
XII. Land Acquisition	ha	281.1	246.7	523	517	1,286.7
XIII. Consulting Service	set	1	1	1	1	-

FIGURE 9-1 STAGE DEVELOPMENT IMPLEMENTATION SCHEDULE



9-3-2. Disbursement Schedule

The annual disbursement schedule as shown in Table 9-2 was calculated based on the implementation schedule.

TABLE 9-2. ANNUAL DISBURSEMENT SCHEDULE

(Unit: Million TK)

	Project Cost			
Year	F/C	L/C	Tax	Total
1	60.7	41.4	17.4	119.5
2	311.2	133.5	107.6	552.3
3	159.5	191.3	55.0	405.8
4	98.1	102.8	-	200.9
5	91.1	44.1	30.4	165.6
6	466.5	142.3	186.8	795.6
7	239.0	203.9	95.7	538.6
8	141.3	90.9	-	232.2
9	71.5	158.7	97.6	327.8
10	364.2	416.5	149.4	930.1
11	222.9	262.4	-	485.3
12	35.6	108.3	48.8	192.7
13	218.2	284.4	74.8	577.4
14	111.2	179.2	-	290.4
Total	2,591.0	2,359.7	863.5	5,814.2

The details of annual disbursement schedule are given in Table XII-1-1 of Appendix XII.

9-4. Evaluation

Evaluation is made on the basis of the economic internal rate of return (EIRR) of which benefits are only that of crops, as benefits of aquaculture and road network are extremely smaller than that of the crops.

As shown in the following table, EIRR of Overall and Paba Area are 16.1% and 10.1% which are 2% and 3% smaller than those of the original plan respectively, whereas EIRR of Barind Area is 21.4% which is 2% higher than that of the original plan.

However, as EIRR of Overall Area is higher than 15% of Bangladesh Bank's interest rate for long-term on deposits it is economically appropriate to implement stage development of this Project.

ECONOMIC INTERNAL RATE OF RETURN

Area	Paba Flood Plain	Barind				Overall
Phase		Phase I	Phase II	Phase III	sub-total	
EIRR	10.0%	12.8%	28.9%	55.1%	21.4%	16.1%

Details of EIRR Computation are given from Table XII-1-2 to Table XII-1-7 of Appendix XII.

CHAPTER 10
ENVIRONMENTAL IMPACT

CHAPTER 10. ENVIRONMENTAL IMPACT

10.1. Natural Conditions

The following natural conditions will be affected by the project implementation:

1) Modern agricultural practices require more chemicals and fertilizers for irrigated agricultural development. The effect of irrigation and drainage development for water pollution shall be studied.

2) The irrigation during dry season makes it possible to grow aquatic animals in the river and also keeps green plant throughout the year.

3) The irrigation water supply can recharge the ground water.

4) Large amount of water intake for the Project will affect the downstream river conditions such as water level change for G-K Project, etc.

5) According to soil survey and analysis, Barind Tract is covered with acid soil. On the other hand, the water qualities of Ganges River were cleared to be alkali by the laboratory test. Accordingly, after the irrigation, the characteristics of soil shall be gradually improved to neutral side which will be favourable for agricultural production.

10-2. Socio-economic Impact

The large-scale Project will give large impact to the social and economic activities of the regions. The increasing amount of agricultural input and production will affect the marketing, transportation and post-harvest systems.

Comparison of farm input and production between the present and with project conditions are shown in TABLE 10-1.

It will be required to facilitate sufficient social infrastructures along with the Project development.

The implementation of the Project would give impact on many aspects in and around the Project area. They may be social, economical or environmental impact.

The Project will boost the agricultural production mainly to rice at about 4.9 times high. But it will depend on the proper supply of sufficient agricultural input namely good quality seeds and fertilizers. Therefore, to obtain the targeted production, sufficient supply of agricultural input must be assured.

As the production increases, the post-harvest facilities will be developed accordingly. For example, for the increased production a modern marketing facility has to be established. Measures shall have to be taken for a stable price system. Construction of food godown might be necessary to store the farm products.

To ensure a steady flow of the products to the markets or to the doors of the consumers an appropriate transportation system has to be introduced.

For hulling the increased amount of paddy, existing rice mills are not sufficient. Therefore, more rice mills have to be installed either by private sector or by the government sector in order to handle the increased amount of rice.

TABLE 10-1. COMPARISON OF FARM INPUT AND PRODUCTION BETWEEN PRESENT AND WITH PROJECT CONDITIONS

	Present (t)	With Project (t)	Increment (t)	Increased Ratio /*
Farm Input				
1. Seed	19,178	21,708	2,530	1.1
2. Fertilizer	15,328	28,740	13,412	1.9
Production				
1. Rice	77,157	380,570	303,413	4.9
Aus	10,101	48,090	37,989	4.8
T.Aman	59,296	190,400	131,104	3.2
Deepwater Rice	2,524	1,080	-1,444	0.4
Boro	5,236	141,000	135,764	26.9
2. Wheat	7,500	18,550	11,050	2.5
3. Sugarcane	83,392	140,400	57,008	1.7
4. Jute	1,080	2,160	1,080	2.0
5. Pulses	496	6,755	6,259	13.6
6. Oilseed	372	1,173	801	3.2
7. Potatoes & others	26,666	20,682	-5,984	0.8
TOTAL	196,663	570,290	373,627	2.9

/*... Increased ratio is obtained ratio of With Project/Present.

In parallel with the agricultural production, fish culture will also be developed through the use of return-flow. But this development will also depend on the supply of quality fingerlings and proper marketing facility and maintenance of the existing ponds, beels, etc. Construction of cold stores should also be taken into consideration.

Also, the pump stations require large scale of electric supply capacity which will be necessary to strengthen the power supply capacity.

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