THE PEOPLE'S REPUBLIC OF BANGLADESH

BANGLADESH WATER DEVELOPMENT BOARD

FEASIBILITY STUDY
ON
THE KURIGRAM
IRRIGATION AND FLOOD CONTROL PROJECT
— NORTH UNIT —

VOLUME 1
MAIN REPORT

OCTOBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Japanese Government decided to conduct a Feasibility Study on the Kurigram Irrigation and Flood Control Project (North Unit) and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team headed by Mr. Toshihisa MURATA, Taiyo Consultants Co., Ltd., from August, 1989 to March, 1990.

The team held discussions with the officials concerned of the Government of Bangladesh and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the development of the project and to the promotion of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for their close cooperation extended to the team.

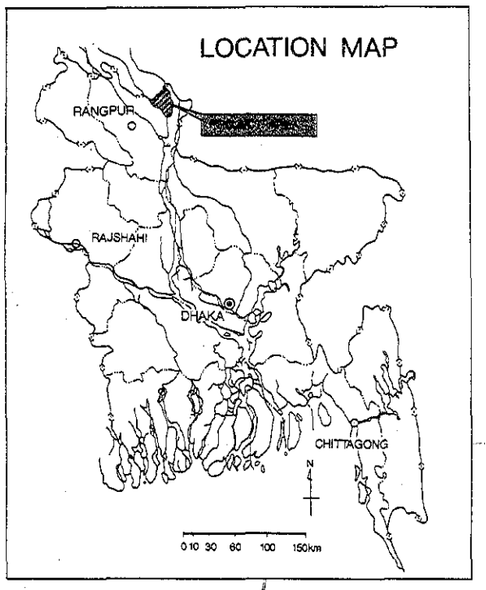
October, 1990

Kensuke Yanagiya

Kensuke YANAGIYA
President
Japan International Cooperation Agency

PROJECT MAP

KURIGRAM IRRIGATION AND FLOOD CONTROL PROJECT
– NORTH UNIT –



N

BURUNGMARI

PATESWARI

PATESWARI PUMPING STATION

(INDIA)

PHULKUMAR RIVER

DUDHKUMAR RIVER

HILKAMAL RIVER

GIRAI RIVER

NAGESWARI

PHULBARI

DHARLA RIVER

TANGONMARI PUMPING STATION

BRAHMAPUTRA RIVER

BEGOMGANJ PUMPING STATION (DRAINAGE)

SCALE 1 : 50,000

LEGEND

- INTERNATIONAL BOUNDARY
- PROJECT AREA (PATESWARI PUMP AREA)
- PROJECT AREA (TANGONMARI PUMP AREA
- PUMPING STATION
- MAIN IRRIGATION CANAL
- SECONDARY IRRIGATION CANAL
- TERTIARY IRRIGATION CANAL
- DRAINAGE REGULATOR
- RIVER & WATER BODY
- FLOOD EMBANKMENT & EXISTING REGULATOR
- ROAD

SUMMARY

INTRODUCTION

1. In response to the request made by the Government of Bangladesh, the Japan International Cooperation Agency ("JICA") concluded the Scope of Work ("S/W") with the Bangladesh Water Development Board ("BWDB") for the implementation of a Feasibility Study on the Kurigram Irrigation and Flood Control Project-North Unit ("the Study") in February, 1989. Based on the S/W, a Feasibility Study Team ("the Team") conducted the field works in Bangladesh from August through October in 1989 and from January through March in 1990. The Team studied in Japan to formulate a development plan based on all the results which had been collected and analyzed through the field works. A draft final report was prepared to present these study results and a meeting was held between the BWDB and the Team for explanation and discussion on the draft final report in August, 1990. Taking into consideration the discussion results and the comments from the BWDB, this final report was completed.

2. In 1969, a feasibility study was conducted for an irrigation, drainage and flood control project for the Kurigram Area including the Study area as its part. The project was started in 1973 and some works including a part of embankment and drainage regulators have been constructed up to now. However, the progress is at a very slow pace mainly due to financial constraint.

On the Third National Five-Year Development Plan, the Government of Bangladesh has put emphasis on accomplishment of food self-sufficiency and improvement of productive employment. Following this policy, the Government decided to accelerate the Kurigram Irrigation and Flood Control Project. The Project area was divided into two units, of which the North Unit was proposed for first implementation of a feasibility study based on updated natural, social and technical aspects.

THE PROJECT AREA

3. From administrative point of view, the Study area is located in four upazilas ; namely Kurigram, Bhurangamari, Fulbari and Nageswari which are included in the Kurigram District, adjoining the West Bengal of India. The gross extent

of the Study area is approximately 42,800 hectares. The land of the study area displays a typical type of alluvial plain in the Teesta delta, bordered by the Dudhkumar, Brahmaputra and Dharla rivers, and is about between 65-128 ft (EL.20-39 m) above the sea level. The land is flat and has inundation problem. The soil varies from loam to clay and has low to moderate fertility.

4. The average annual rainfall in the Study area falls between 2,300 and 3,200 mm. This amount is generally supposed to be no less than sufficient for cultivation. However, the precipitation is not distributed enough for crop cultivation during the dry period from
December to May, while 80% of that is concentrated in the monsoon period from June to October.

5. The population of the Study area is approximately 350 thousands and the estimated annual population growth rate is about 2.5%. 90% of the population lives on agriculture. 52% of the total farmers are independent farmers, 48% landless farmers. Most farmers are of small scale. The average farm size is approximately 0.9 hectares.

6. Of 42,800 hectares of the Study area, the net cultivated area is about 35,100 hectares. Most of the available land, or 82 % of the total area, has been exploited for cultivation.

As for cropping in the study area,paddy production is dominsnt.Other than paddy, jute, wheat and minor crops such as small grains(kaun, cheena, etc.), pulses, vegetables, potato, mustard and other crops are grown.

The present cropping intensity of the study area is about 177 %, which is relatively high as compared with the national average rate of 154 %. This high rate is mainly attributed to double cropping, owing to rain-fed cultivation in the pre-monsoon and to irrigated cultivation by small scale shemes in a part of the area in the dry period in addition to cultivation in the monsoon period.

DEVELOPMENT STRATEGY

7. Under the above-mentioned natural and social conditions, the agriculture in the Study area has stagnated at a relatively low productivity level, lagging

Fig. S-1 Present Cropping Patterns

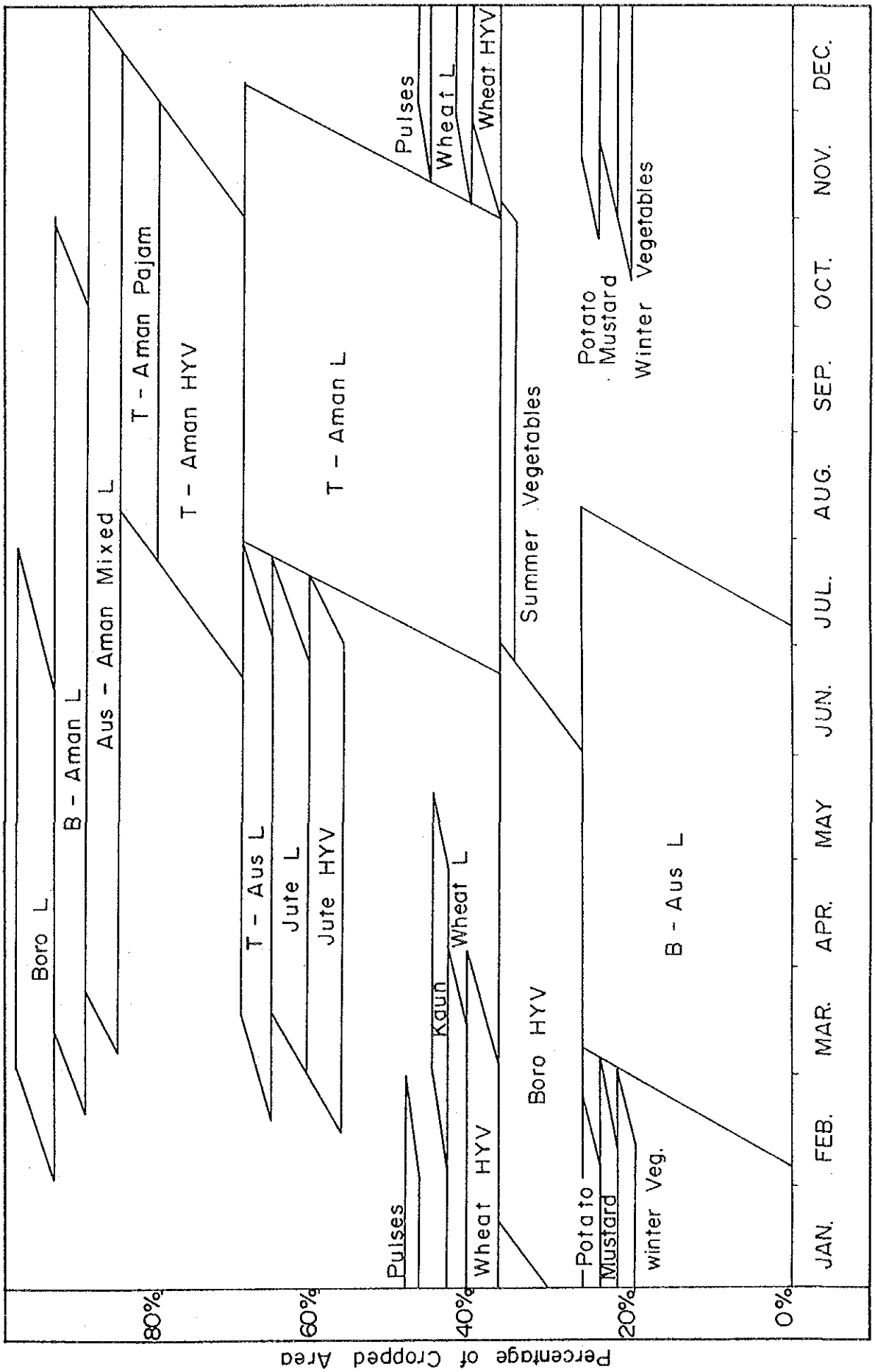


Table S-1 Estimated Crop Prpoduction in the Project Area (Major Crops Only)

unit: ton, ha.

Crops	Planted Area	Average Production	Total Yield
B-Aus L	14,239	0.79	11,361
T-Aus L	391	2.12	830
T-Aus HYV	2,115	1.68	3,561
B-Aman L	477	1.15	550
T-Aman L	17,930	1.44	25,898
T-Aman P	2,787	2.12	5,886
T-Aman HYV	5,814	2.41	14,037
Boro HYV	5,871	2.81	16,525
Aus Aman Mx	1,364	1.69	2,310
Paddy	50,988	1.59	80,958
Jute L	2,802	1.38	3,869
Jute HYV	2,052	1.50	3,083
Mustard	620	0.84	521
Kaun	1,237	0.63	786
Wheat L	1,082	1.33	1,444
Wheat HYV	2,281	1.78	4,058
Sw. potato	211	7.75	1,636
Potato	600	8.89	5,338
Vegetable	349	-	4,339

Source: estimated from the data by BBS Rangpur Office (five year 1984 - 1989)

behind on the introduction of improved cultivation technologies such as high yielding rice varieties and fertilizer applications.

The most significant and fundamental factor which restricts the development of agriculture in the Study area seems to be its unfavorable water conditions. Flood water levels in the three outer rivers along the Study area are so high above the lands in the lower reaches of the Study area as to cause annual inland flooding. This not only brings about damages to crop production but also hinders the practice of improved technologies, which includes new varieties and fertilizer applications, requiring stable water conditions.
In the rainy season, crops are grown in principle by rain-fed water, while, in the dry season, the cropping area is limited to only about 28 % of the total cultivable land, which is equipped with small scale irrigation pumps. In this situation, the basic way to develop agriculture seems to be to increase productivity in the rainy season and/or to expand the cropping area in the dry season. And, the most fundamental measure to be taken for that purpose is considered to be irrigation.

Among the other restricting factors are the lack of technical know-how and resources of farmers as well as insufficient infrastructures for transportation and marketing. The countermeasures would be strengthening the extension activities for improved technologies, promoting cooperative activities, improving and constructing roads and warehouses, etc..

8. The objectives of the proposed development plan are to increase agricultural production and to raise farmers' incomes and thus to contribute to increase of employment opportunities, regional economical development and improvement of people's living standards, through comprehensive implementation of countermeasures to sweepingly eliminate the above-mentioned constraints on agricultural development. For these objectives, the proposed development plan contains construction of irrigation and drainage systems and flood protecting embankment together with related measures including road network improvement and agricultural supporting services strengthening.

9. At present, a large number of depressions and meandering channels existing in the Study area function as natural flood control reservoirs. Therefore, in principle, the current natural drainage system from farm to main channel level is to be left as it is. Approximately 80 % of the embankment for the

Study area has been already constructed. The unfinished sections of the embankment are to be built and the existing sections to be rehabilitated.

10. Irrigation water is planned to be taken in mainly by pumping up from the Duhdkumar river. Supplementary water intake by installing a reversible pump station for the southern part of the Study area is to be studied for an efficient drainage plan. The irrigation system is to be studied taking into consideration minimizing banking hight, crossing points with settlements and drainage channels and the total pumping energy cost.

11. The proposed development plan aims at making it possible to significantly expand cropping area in the dry period and to raise productivity in the monsoon period. Introduction of high yield varieties and profitable crops as well as application of improved technologies are to be studied so that they will be of optimum level for farmers in the Study area.

12. It is important for successful and effective implementation of irrigation and drainage development to be incorporated with indispensable measures for supporting farmers' cultivation. In this respect, the construction of roads and warehouses for input supply and marketing as well as strengthening extension services are to be studied comprehensively.

13. In the planning, emphasis is to be placed on lowering the construction cost as well as the future operation and maintenance cost by employing appropriate technology.

The implementation schedule is to be discussed as to asure the development investments to bear fruit as soon as possible. Considering this aspect, a step-by-step development method will be studied.

AGRICULTURAL PRODUCTION PLAN

14. The proposed land use for every category is shown in Table S-2, in which the land category distribution is to be in principle as it is at present. Based on the studies on the available river discharge and layout of the irrigation system, it is proposed that the present cultivated land area will be irrigated in the "with project" except for the area used for the planned canal sites.

Table S-2 Proposed Land Use for different categories

Land Use	Area (ha)	(%)
Gross area	42,800	100
Settlements	5,290	12.3
Grass land	350	0.8
Char land	120	0.3
Water bodies	1,940	4.6
Proposed canals	2,300	5.4
Cultivated land	32,800	76.6

15. Taking into consideration mainly staple food self sufficiency in the Kurigram district including the Study area, crop diversification under the rather unfavorable marketing condition of this area and crop suitability to land and climatical conditions, a limited number of crops were selected for the proposed cropping patterns. They are staple food crops i.e. paddy and wheat which are suitable crops for irrigation, jute to maintain present share, oil crops, pulses and other comparatively storable vegetables and potatoes. High yield varieties of these crops should be adopted as far as possible to elevate yield levels, for they are the only input responsive ones. Under the proposed cropping patterns, high yielding paddy again inevitably play a major role in so far as it is the most suitable and safest crop assuming that the flood submersion condition will to some extent remain even with the flood control measures by the project.

16. The proposed cropping patterns were figured out as shown in Fig. S-2, considering the following points:

- To be optimum for different land drainage conditions improved by the project.
- To increase crop production mainly by means of crop intensification during the dry peiod and the replacement of local varieties with high yield varieties.
- Economized use of the limited available water.
- To preserve soil fertility.

Through the implementation of the proposed cropping patterns, the cropping development shown in Table S-3 and the crop production shown in Table S-4 will be expected.

Fig. S-2 Proposed Cropping Patterns

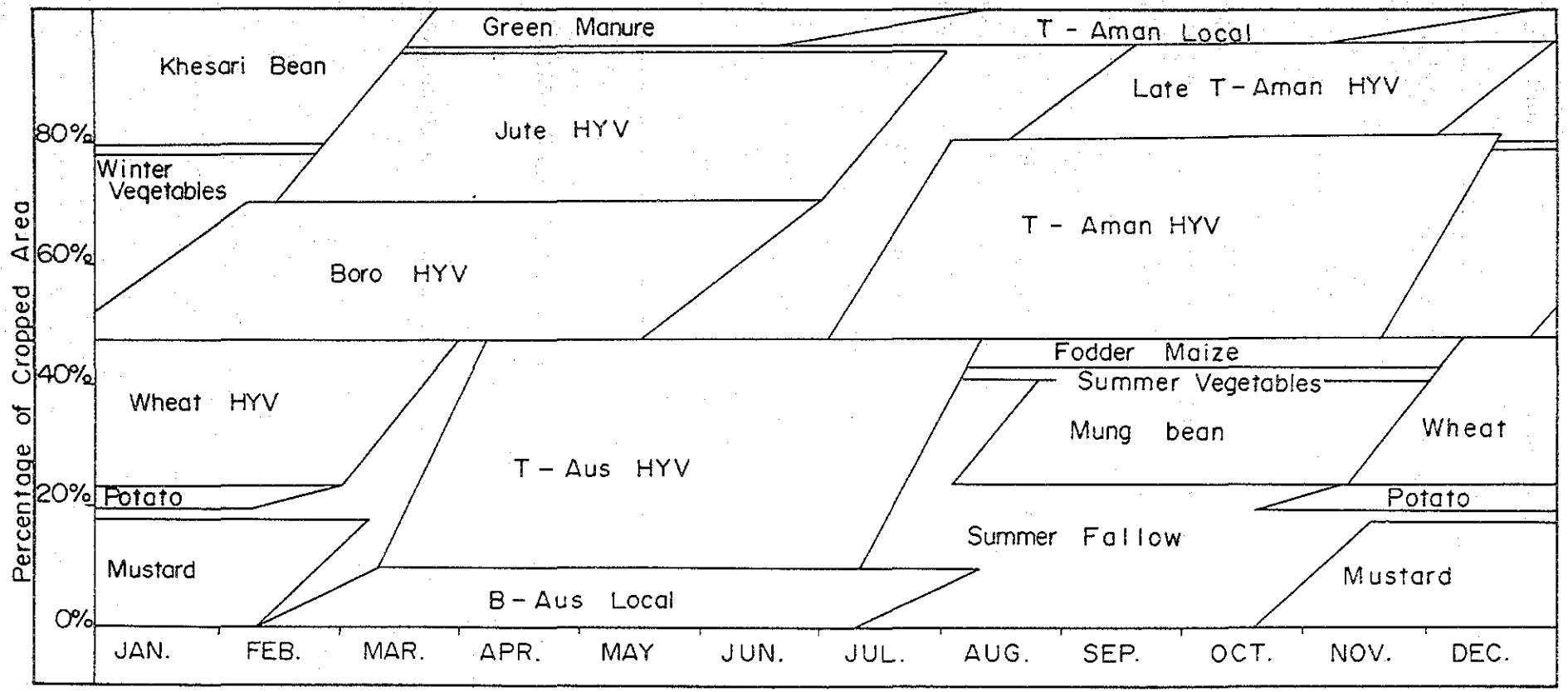


Table S-3 Cropping Development unit : ha. %

Season/Crop	Current Land Use		Without- Project		With- Project	
	Area	%*	Area	%*	Area	%*
Kharif						
Total Crops	49,971	142	48,123	137	43,050	131
Food-grains	45,117	128	43,166	123	32,775	100
Cash Crops	4,854	14	4,957	14	8,750	27
Other Crops	0	0	0	0	1,525	4
Rabi						
Total Crops	12,251	35	14,099	40	37,050	113
Food-Grains**	10,471	30	12,088	34	27,750	85
Cash Crops	1,569	4	1,561	4	9,300	28
Other Crops	211	1	1,450	2	0	0
Crop Coverage		177		177		244
Share of Kharif***		80		77		54
Share of Rabi***		20		23		46

Note: * percentages to the cropping land area (without P =35100 ha. with-P =32800 ha.).

** including pulses

*** percentage to the total annual crop coverage excluding G.M.

Table S-4 Planned Crop Production (With Project) unit : ha. ton/ha. ton

Crops	Area under Crop(ha.)	Yield (ton/ha.)	Production (ton)	Difference (with-P - without-P) Area(ha.)	Yield	Production (ton)
B-Aus Local	3,075	2.0	6,150	-10,167	+1.17	- 4,840
T-Aus HYV	12,450	3.0	37,350	+ 9,694	+0.87	+31,480
T-Aman HYV	10,475	4.0	41,900	- 470	+1.25	+12,629
T-Aman Local	1,975	2.8	5,530	-12,499	+1.23	-17,194
Late T-Aman H	4,800	3.0	14,400	+4,800	+0.52	+14,400
Boro HYV	7,100	4.5	31,950	+ 1,355	+1.41	+14 198
Other Paddy	-	-	-	- 3,621	-	-5 313
Paddy	39,875	3.4	137,280	-11,358	+1.6	+45,360
Wheat HYV	7,875	3.5	27,562	+4,579*	+1.25	+20,841
Jute HYV	7,875	2.3	18,112	+ 3,118*	+0.61	+10,743
Potato HYV	1,425	20.0	28,500	+ 765	+9.78	+21,755
Mustard HYV	7,650	1.3	9,945	+ 7,049*	+0.44	+ 9,428
Khesari(Pulses)	7,100	1.0	7,100	+ 6,850	+0.10	+ 6,875
Mungbean	5,675	0.9	5,107	+ 5,675	-	+ 5,675
S.Vegetables	875	25.0	21,875	+ 675	+15.00	+19,875
W.Vegetbls	225	40.0	9,000	- 75	+25.00	+ 3,600
Fodder Crop	1,525	90.0	137,250	+ 1,525	-	+ 137,250
Kaun	-	-	-	- 1,175	-	- 928
Sweet Potato	-	-	-	- 200	-	1,550
Cropped T.	80,100	-	-	+17,878	-	-
Dhoincha	1,975	30.0	59,250	-	-	-

IRRIGATION PLAN

17. Criteria for irrigation water requirements are as follows:

- Consumptive use; calculation based on the modified Penman's method.
- Irrigation lossese;
  The coveyance efficiency for canals 0.85,
  The field efficiency for upland crops 0.70,
  The field efficiency for paddy 0.85, besides, the percolation rate of 6 mm/day is added.
- Puddling watwer for paddy; 150 mm depth of water is supplied during 30 days.
- Effective rainfall ; 80% of daily rainfall depth exceeding 5mm is effective. Only in the case of paddy, 80 mm per day exceeding the water requirements can be stored.

Based on the above criteria,the proposed cropping patterns and the planned land use, diversion water requirements were obtained. The maximum diversion water requirements for the proposed two intakes for 10 years from 1979 to 1988 are given as shown in Table S-5.

For irrigation canals, the design unit water requirements are given bellow.

Canals	Unit design water requirements
Main canals	1.453 l/s/ha
Secondary canals	1.453 l/s/ha

18. The existing small scale irrigation facilities might be kept to supplement the planned irrigation system which is to utilize the nearby river water. However, it is proposed that the irrigation system fully depend on surface water from rivers based on the following points:

- The wster diversification from the Dudhkumar and Brahmaputra rivers is available to cover the whole cultivated area.

- It will be efficient from investment cost, operation and maintenance viewpoints that the planned irrigation system covers the whole project area incorporating the existing irrigated area by small scale pumps. It is also advantageous for better specifying and administration of beneficiaries.

19. Among available three rivers around the project area, the Dharla river is supposed to be reserved for irrigation for Kuriguram South Unit area in accordance to the the BWDB's basic development strategy for the whole Kurigram area. Following this strategy, the proposed irrigation system is to mainly take water from the Dudhkumar river.

To take irrigation water from the Dudhkumar River, a main pump station is planned for installation at Pateswari, on the downstream side of the abolished railway bridge. The proposed site is considered to be the most suitable situation, since it commands the most upstream and highest position to the irrigated area as well as it faces the relatively stable river bank.

The justifiability for installing a reversible pump station for the dual usage of drainage and supplementary irrigation for the southern part of the project area was studied from the following viewpoints:

- To reduce the total cost of irrigation and drainage pumps.
- To decrease the intake water from the Dudhkumar river which has a limited available discharge in the drought period, by taking a part of the total required water from the Brahmaputra river.

As a result, a reversible pump station which commands 3,350 ha for irrigation is proposed for installation at the Tangonmari regulator. Basic design features for the two pump stations are given in Table S-5.

Table S-5 Irrigation Facilities

(a) Pumping Stations

Items	Pateswati Pump Station	Tangonmari Pump Station
1) Design Discharge	42.78 m^3/sec	4.87 m^3 / s
2) Pump Type	Vertical Mixed Flow Pump	-do-
3) Pump Bore	ø 2,200 mm	ø 900 mm
4) Pump Numbers	4 Nos	3 Nos
5) Pump Capacity	10.70 m^3 / sec / unit	1.63 m^3 / s
6) Pump Head	8.6 m	8.0 m
7) Moter Pawer	1,220 kw / unit	200 kw /unit
8) Total Moter Power	4,880 kw	600 kw

(b) Canals

Canals	T. Length(km)	Discharge(m^3 /s)	Slope	Type
1) Main Canals	47.4	42.8~4.5	1/12,000 ~1/5,000	Unlined
2) Secondary Canals	156.3	4.4~0.5	1/7,000 ~1/3,000	-do-
3) Tertiary Canals	354.0	0.4~0.1	1/1,000~	-do-

(c) Major Appurtenant Structures

Structures	Number
1) Diversion Structure	215 nos.
2) Escape	39 nos.
3) Syphon	3 nos.
4) Aqueduct	26 nos.
5) Drainage Culvert	244 nos.
6) Road Cross Structures	721 nos.

20. The layout of the irrigation canal routes was studied so as to minimize banking height and to avoide crossings with settlements, rivers and roads as far as possible.

Further studies for water conveyance systems were done based on results of the route survey, while focusing on the stability of earth structures as well as on the minimization of construction costs and land acquisition. As for the western part of the study area, whose altitude is relatively high, alternative plans to supply water from the Pateswari intake were discussed to lower canal banking and to decrease the total pumping energy cost for the whole system. Consequently, an optimum plan of water conveyance system was worked out.

DRAINAGE AND FLOOD CONTROL PLAN

21. Criteria for drainage planning are as follows:

- Design rainfall for inland runoff; 5-year return period, 5-day consecutive rainfall.
- Allowable submergence for crops; over 0.30 m standing water over the datum field level for no more than 5 days.
- Beneficial area by flood protection and drainage improvement; submerge area, except depressions and river courses, caused by a one-in-5-year flood in the outer rivers in the present conditions with embankment gaps and therefore receive less submergence by some improvement measures.

22. A mathematical simulation model, in which inland runoff was calculated with the "Integrated Unit-hydrograph Method", has been employed for drainage analysis. The results from the various alternative studies have finally been compiled into Table S-6, in which the case for protection of 80 % of beneficial area is proposed as a economically acceptable plan.

Table S-6 Results from Drainage Analysis

(Regulators and Pumps needed for Drainage Improvement)

Protected Area	over 80% of area		over 90% of area	
Allowable Submerge Criteria	< 5-day	< 3-day	< 5-day	< 3-day
No. of vents of regulator	89	90	89	89
Total pumping capacity (cms)	10	18	28	37
No. of pumping plant	2	3	3	3

23. Some basic policies for plan formulation has to be established in order to meet technical, social, economic and local requirements as follows:

- The existing drainage systems including natural depressions and meandering channels will be left as they are at present.This is because the improvement of drainage channel networks would bring about worse drainage in the lower reaches of the project area.
- Drainage by pumping is the most costly measures that a pumping plant of 5 m^3/sec for both irrigation and drainage, which can be much advantageous in cost allocation, is proposed to be installed in the Tangonmari-Old Girai Block. Another pump station of 5 m^3/sec will be constructed in the South Tail Block.

24. Criteria for Planning of Embankment are as follows:

Rivers	Design water level	Freeboard
Dharla River	of one-in-50-year flood	1.20 m
Dudhkumar River	of one-in-50-year flood	1.20 m
Brahmaputra River	of one-in-100-year flood	1.50 m

(N.B. For the Dharla and Dudhkumar, 0.30 m freeboard for future rise of river bed is included)

25. As of date 61.9 km out of 84 km of the planned embankment has been built. The completion of the unfinished embankment of 22.1 km length is accordingly the first priority.

The embankment shall be planned to be durable against ordinary intensive rainfall, wind, water table, traffic etc.. The embankment may be located 300 - 500 m apart from river water ridges to escape flood flow so as to avoid expensive long river bed and slope protection works.

Neccessary reconstruction and repairs for the completed embankment will be implemented.

MARKETING AND AGRICULTURAL SUPPORTING SERVICES

26. When farming aiming at high harvesting of crops according to the proposed cropping patterns and farming criteria under irrigation is realized, a lot of fertilizers, pesticides and improved crop seeds will be needed. In order to respond to these increasing demands smoothly, it is necessary to strengthen the distribution system for crop production materials. For this purpose, it is considered to be most appropriate to expand the organization of UCCA/KSS/BSS/MBSS system in the project area under the full cooperation of the BRDB and to encourage immediate participation of those cooperatives in both the wholesale and retail sectors. Moreover, as a part of the UCCAs' economic activities, the stationing of proper godowns and primary distribution centers with proper storage capacities should be promoted. At the same time, it is necessary to improve transportation and communication facilities.

27. As long as the Government's policy for its foodgrain procurement remains unchanged, the considerable portion of the increased paddy production brought about by the project implementation is expected to be marketed in the open market. Besides, as a result of expanded irrigation, the production of cash crops such as vegetables is also expected to increase and to be marketed in the open market. In order to meet this situation, it is necessary to set up or improve marketing facilities for farmers, including rice and wheat mills with large capacities which can deal with increased products, godowns which can keep increased products in high quality, transporting means such as boats, trucks etc., and marketing information networks.

It is necessary that the UCCA/KSS/BSS/MBSS systemswill be organized for small scale farmers, who have been left unfavorable for marketing, to obtain stronger stance for profitable marketing.

At the same time, it is necessary to provide or to improve the social infrastructure including the municipally-run markets in urban areas, the road network and the transportation facilities for crossing the Dharla River.A construction plan of roads is to be proposed on the basis of studies focusing on the usage for operation of the irrigation and dranage systems as well as considering the usage for the agricultural material supply and marketing.

28. In order to achieve agricultural target production after the implementation of the project, it is important to formulate the adaptable irrigated cultivation methods of paddy and upland crops based on accumulated research results and to transfer them to farmers in the project area. For this purpose, it is proposed to establish a model farm situated at a representative point in the project area as follows:

- Land area: 7ha (leased land system)
- Farm: divided into 3(three) blocks (irrigated);
  1) First block (2ha) --- for experiments.
  2) Second block (3ha) --- for demonstration.
  3) Third block (1ha) --- for training of farmers.
- Buildings; an office (including experimentation room, working room and training room) and a warehouse.
- Organization

	Number of staff
1) Chief (an agronomist)	1
2) Subject matter specialist (plant protection, water management)	2
3) Extension overseer (additional of training officer)	1
4) Assistant	2
5) Junior	2
6) Farm labourers	20-22

29. In order to practice satisfactory extension service activities responding to the expansion of the cropped area, the diversification of crops and the introduction of improved irrigated farming techniques after the implementation of the project, it is evident that staff and equipment for extension services will have to be strengthened from their present status. It is proposed to train and newly assign the personnel concerned, and to provide equipmentand facilities including vehicles.

THE PROJECT COST

30. The project cost is estimated under the following conditions.

- The project cost is estimated on the basis of the market price as of March, 1990.
- Civil works are to be done on the local contract basis,mechanical and electrical works in the pumping stations are on the foreign contract basis.
- The unit prices of materials, labours and civil works are mainly based on "Schedule of Rates for Project-IV, BWDB,Rangpur(Oct. 1989)".
- Data on taxes and inland transportation charges on the imported materials and equipment are quoted from "Customs and Sales Tax, 1989, Ministry of Finance" and "Schedule of Rates for Transportation, 1989-90, Ministry of Food".
- The price of the land acquisition is based on the actual rates in the works of BWDB, Kurigram 1988 to 1989.
- The physical contingency is set at 10 % to the construction and associated costs.
- The price escalation rate is predicted at 10 % for local portion and 7.0 % for foreign portion considering the recent tendency.
- The exchange rate between Bangladesh Taka and US dollar is adopted at US$1.00 = Taka 33.0.

31. The summary of the project cost is shown in Table S-7.

32. The summary of the annual operation and maintenance cost is shown in Table S-8.

PROJECT IMPLEMENTATION SCHEDULE

33. The project implementation schedule is proposed as shown in Fig. S-3.

Table S-7 Summary of Project Cost

(Unit; × 1,000 Tk)

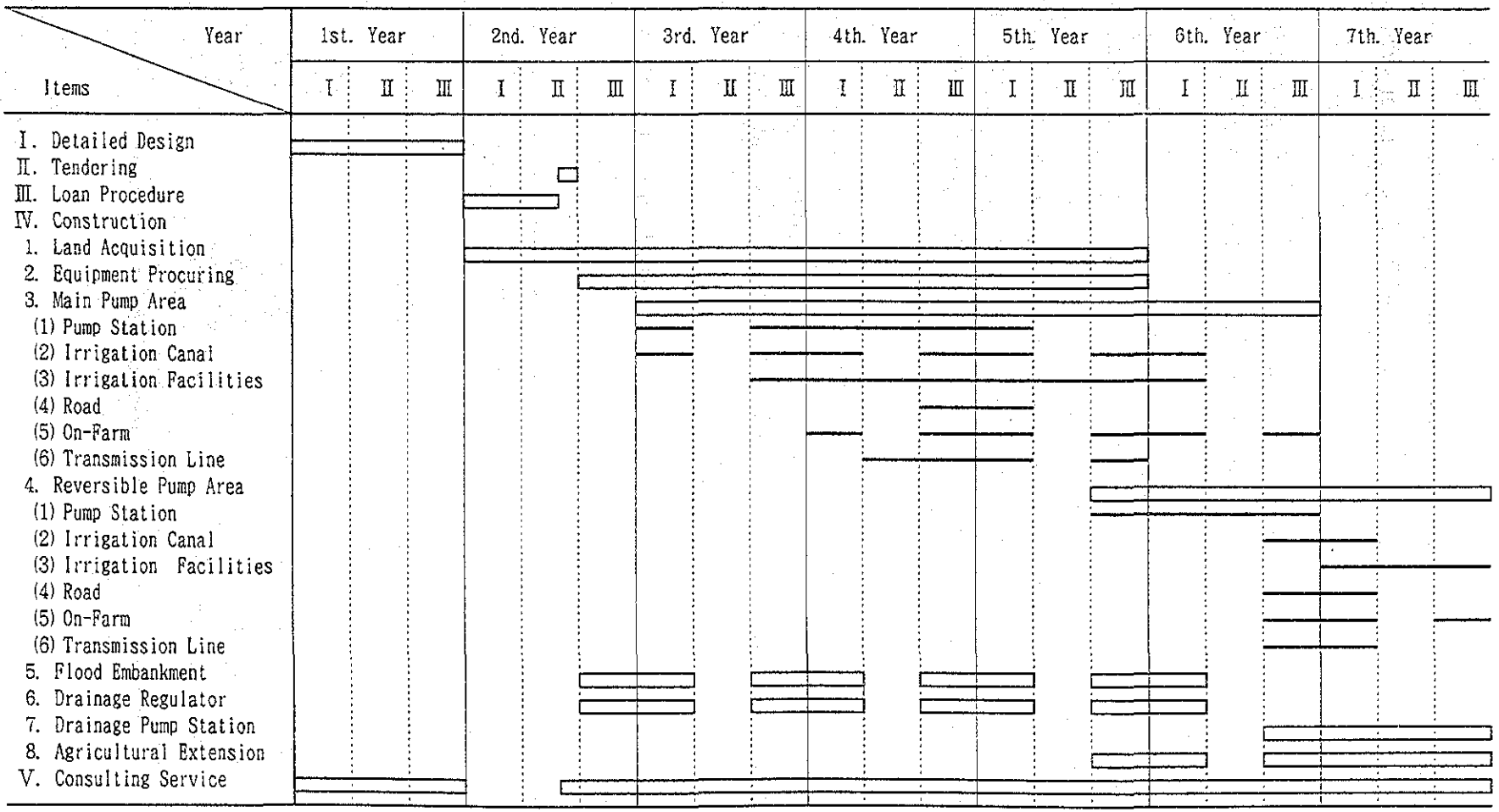
Item	L/C	F/C	Tax	Total
1. Construction cost				
a. Pump stations	241,176	685,026	260,830	1,187,032
b. Irrigation canals	146,559	-	-	146,559
c. Irrigation facilities	190,890	74,673	-	265,563
d. Flood embankments	51,100	-	-	51,100
e. Drainage regulators	37,750	24,449	-	62,199
f. Roads	8,078	-	-	8,078
g. On-farm facilities	105,287	14,169	-	119,456
h. Transmission and telephone lines	4,805	17,530	7,997	30,332
Sub-total	785,645	815,847	268,827	1,870,319
2. Associated cost				
a. Construction machines	3,201	57,258	27,519	87,978
b. Agricultural extension facilities	12,765	6,605	1,865	21,235
c. Land acquisition	146,674	-	-	146,674
d. Consulting service	36,608	199,207	-	235,815
e. Project administration	87,986	11,552	1,630	101,168
Sub-total	287,234	274,622	31,014	592,870
Total(1+2)	1,072,879	1,090,469	299,841	2,463,189
3. Physical contingency	78,884	87,311	29,635	195,830
4. Price escalation	354,844	194,703	52,651	602,198
Grand total	1,506,607	1,372,483	382,127	3,261,217

Table S-8 Summary of Annual Operation and Maintenance Cost

(Unit; × 1,000 Tk)

Description	Pateswari Pump Station Area	Tangonmari &Begomganj Pump Station Area	Total
1. Pump stations			
a. Mechanical	8,144	3,320	11,464
b. Electricity	42,041	6,867	48,908
c. Civil work	120	240	360
d. Dredging	252	362	614
Sub-total	50,557	10,789	61,346
2. Irrigation and drainage facilities			
a. Canals	4,300	385	4,685
b. On-farm	2,654	294	2,948
c. Hydraulic structures	1,392	132	1,524
d. Embankment	1,260	141	1,401
e. Regulators	72	30	102
Sub-total	9,678	982	10,660
3. Miscellaneous	3,011	588	3,599
4. Administration	4,584	-	4,584
Total	67,830	12,359	80,189

Fig. S-3 Project Implementation Schedule



PROJECT JUSTIFICATION

34. The evaluation of this project is proposed to be conducted as per a widely accepted cost-benefit analysis based on market prices for financial analysis and on economic prices for economic analysis.

Prerequisites for cost estimation are in principle the same as those mentioned regarding the project cost in the section 30 except for the economic prices for economic analysis.

The economic prices are given as border prices for traded commodities. The conversion factor of 0.82 is used to obtain economic prices for non-traded commodities. The opportunity costs of unskilled labor are supposed to be 75 % of market wages. Economic costs exclude transfer items such as taxes, financial interest, water charges, subsidies, imputed capital costs and land acquisition expenses.

35. For both financial and economic bases, the investment costs, the annual operation/recurring expenditures and the benefits were calculated. The distribution of annual investment and that of net benefits were supposed based on the project implementation schedule.

On the basis of the above-mentioned conditions, the following indicaters were finally obtained.

Indicaters	Financial	Economic
Net present value (NPV) Mil.Taka (15 % discount rate)	△ 659.8	456.5
Benefit-cost ratio (BCR)		
(10 % discount rate)	0.953	1.785
(15 % discount rate)	0.685	1.286
Internal rate of return (IRR) %	9.6	19.7

△ ;minus

36. Among various socio-economical secondary and intangible benefits which are expected from the project implementation, the most important is the increase of employment opportunities shown below.

- *Labor requirement (thousand man-days)*
  - for the project implementation (for 7 years); 7,403
  - for the operation and maintenance ; annually 330
  - for crop cultivation ; annual increase 4,090

RECOMMENDATION

37. On the basis of the results from the Study for the Kurigaram Irrigation and Flood Control Project - North Unit, its economic feasibility and technical soundness was ascertained in this report.

This project not only has relatively high investment efficiency as shown in the above-mentioned indicaters but also is expected to extend a significant regional development impact to the surrounding area, which has rather lagged behind in implementation of various development shemes, being situated in a remote region in Bangladesh.

Accordingly, early implementation of the project is strongly recommended.

38. For detailed design and implementation, the latest topographical maps of 1:10,000 scale will be required to cover the whole project area. Detailed geological surveys will also be needed at the proposed pump station sites and at other major structure sites.

39. Surveys to know river bank and cross section shifting will be needed peoriodically at the proposed sites for Pateswari Pump Station and Tangonmari Pump Station.

40. It is important for successful and effective implementation to be incorporated with indispensable measures regarding agricultural extension services, input supply, marketing, communication and so on for supporting farmers' cultivation. In this respect, it is recommended that the BWDB discuss the project implementation with concerned agencies in order to gain their full cooperation.

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GLOSSARY

Aman	:	The main rice crop. Generally, broadcast Aman is sown in March -April and harvested in Novemberg-December. Transplanted Aman is transplanted in mid-July -early September and harvested in Novembere-December.
Aus	:	The pre-monsoon rice, generally sown or transplanted in March -April and harvested in November -December.
Boro	:	The winter rice crop, generally transplanted in December-February and harvested in April -June.
Kharif	:	The monsoon season.
Rabi	:	The dry (winter) season.
Taka	:	The bangladesh currency unit (Us 1 dollar = 33 Taka).
Upazila	:	A basic local government in Bangladesh.

ABBREVIATIONS

BADC	:	Bangladesh Agriculture Development Corporation
BARC	:	BangladeshAgriculture Research Council
BARI	:	Bangladesh Agricultural Reserch Institute
BB	:	Bangladesh Bank
BBS	:	Bangladesh Bureau of Statistics
BJRI	:	Bangladesh Jute Research Institute
BKB	:	Bangladesh Krishi Bank
BRDB	:	Bangladesh Rural Development Board
BRRI	:	Bangladesh Rice Research Institute
BS	:	Block superviser
BSRIT	:	Bangladesh Sugarcane Research and Training Institute
BSS	:	Bhumiheen-bityaheen samabaya samity (Landless/assetless cooperative society)
BWDB	:	BangladeshWater Development Board
B. Aus	:	Broadcast Aus
CF	:	Contact farmers
DAE	:	Department of Agriculture Extension
DTW	:	Deep tube-well
HYV	:	High-yielding variety
IRDP	:	Integrated Rural Development Program
JICA	:	Japan International Cooperation Agency
KSS	:	Krishak samabaya samity (Farmers' cooperative society)
LLP	:	Low-lift pump
MBSS	:	Mahila bhumiheen-bityaheen samabaya samity (Women's Cooperative Society)
MOA	:	Ministry of Agriculture
MOF	:	Ministry of Food
MLGRDC	:	Ministry of Local Government, Rural Development and Cooperatives
NLRI	:	National Livestock Research Institute
SB	:	Sonali Bank
SMS	:	Subject matter specialist
SRDI	:	Soil Resources Development Institute
SRTI	:	Sugarcane Research and Training Institute
STW	:	Shallow tube-well
TCCA	:	Thana central cooperative association
TFYP	:	Third Five Year Plan
TK	:	Taka (Bangladesh currency unit)
T. Aman	:	Transplanted Aman
UCCA	:	Upazila central cooperative association
UAO	:	Upazila Agriculture Officer

ABBREVIATIONS OF MEASUREMENTS

Length

mm	=	millimeter		
cm	=	centimeter		
	=	0.39 in.		
m	=	meter	=	1.09yd.
	=	3.28 ft.		
km	=	kilometer	=	0.62ml.
in.	=	inch	=	2.54cm
ft.	=	foot	=	30.48cm
yd.	=	yard	=	91.44cm
ml.	=	mile	=	1.61km

Area

cm^2	=	square centimeter		
m^2	=	square meter		
km^2	=	square kilometer		
	=	100ha		
ha	=	hectare	=	0.01 km^2
	=	2.5ac		
ac	=	acre	=	0.41 ha
	=	4,050 m^2		
ft^2	=	square feet		
	=	0.03 m^2		
$mile^2$	=	square mile	=	2.59 km^2

Electrical Measures

KW	=	kilowatt	=	1,000 watt
MW	=	megawatt	=	1,000 KW
GW	=	gigawatt	=	1,000 MW
KV	=	kilovolt	=	1,000 volt

Other Measures

%	=	percent
°	=	degree
'	=	minute
"	=	second
°C	=	degree in centigrade
crore	=	10 million
lakh	=	0.1 million

Volume

lit.	=	liter		
cm^3	=	cubic centimeter		
m^3	=	cubic meter		
	=	1,000 lit.		
MCM	=	million m^3		
	=	$1 \times 10^3 m^3$		
ft^3	=	cubic feet	=	0.028 m^3
	=	28.32 lit.		
ac-in.	=	acre inch	=	88.05 m^3
ac-ft.	=	acre feet	=	1,234 m^3

Weight

g	=	gram		
kg	=	kilogram		
t	=	metric ton	=	1,000kg
lb	=	pound	=	375g

Time

sec	=	second		
min	=	minute	=	60 seconds
hr	=	hour	=	60 minuits
	=	3,600 seconds		
day	=	24hrs	=	1,440 minutes
	=	86,400 seconds		
yr	=	year		

Derived Measures

m^3/sec	=	cubic meter per second (Cumec)
ft^3/sec	=	cubic foot per second (Cusec)

Monetary

US$	=	US dollar		
¥	=	Japanese yen		
TK	=	Taka		
US$1	=	Tk 33.0	=	¥ 148.5

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1-1. General

In response to the request made by he Government of the People's Republic of Bangladesh (hereinafter referred to as "the Government of Bangladesh"), the Government of Japan entrusted the implementation of a Feasibility Study on the Kurigram Irrigation and Flood Control Project-North Unit (hereinafter referred to as "the Study") to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). From the 3rd to the 15th of February 1989, JICA dispatched a Preliminary Survey Team to Bangladesh and concluded the Scope of Work (S/W) for the Study with the Bangladesh Water Development Board (hereinafter referred to as "BWDB").

Based on the S/W, a Feasibility Study Team (hereinafter referred to as "the Team") conducted the field work in Bangladesh for the Phase I Study from July the 31st through October the 28th in 1989, and afterwards the home office work to analyze the collected data and to formulate basic concept for a development plan. These results were incorporated in the Interim Report.

The Team again visited Bangladesh to conduct the field work for the Phase II Study from January 10th through March 30th, 1990. Upon returning to Japan, the Team studied to formulate a development plan based on all the results which had been collected and analyzed through the previous works. The Draft Final Report was prepared to present these study results, which was explained and discussed at a meeting between the BWDB and the Team in August, 1990. Taking the discussion results into consideration, the Draft Final Report was rivised and elaborated. As a result this Final Report was completed.

1-2. Background

From administrative point of view, the Study area is located in four upazilas; namely Kurigram, Bhurangamari, Fulbari and Nageswari which are included in the Kurigram District, adjoining the West Bengal of India.

The land of the study area displays a typical type of alluvial plain in the Tista delta, bordered by the Dudhkumar, Brahmaputra and Dharla rivers, and is about

between 65-128 ft (EL.20-39 m) above the sea level. The land is flat and has inundation problem.

The gross extent of the Study area is approximately 42,800 hectares, of which the net cultivated area is about 35,100 hectares. Most of the available land has been exploited for cultivation.

The population of the Study area is approximately 350 thousands and the estimated annual population growth rate is about 2.5%. 90% of the population lives on agriculture. 52% of the total farmers are independent farmers, 48% landless farmers.

The average annual rainfall in the Study area falls between 2,300 and 3,200 mm. This amount is generally supposed to be no less than sufficient for cultivation. However, the precipitation is not distributed enough for crop cultivation during the dry period from December to May, while 80% of that is concentrated in the monsoon period from June to October.

The present cropping intensity of the study area is about 177 %, which is relatively high as compared with the national average rate of 154 %. This igh ate is mainly attributed to double cropping, in addition to cultivation in the monsoon period, owing to rain-fed cultivation in the pre-monsoon and to irrigated cultivation in the dry period. Approximately 28 % of the total culitivable land is cropped under irrigation either by pumping from beels, creeks and wells or by manual labor.

Under the above-mentioned natural and social conditions, the agriculture in the Study area has stagnated in relatively low productivity, lagging behind on introduction of improved cultivation technology such as high yield rice varieties and fertilizer application. The most fundamental and significant factor which constrains agricutural development in the Study area seems to be its unfavorable water conditions.

Being aimed at complete improvement of the water conditions in the Kuriguram area including the Study area, a feasibility study was conducted for an irrigation and drainage project under the initiative and administration of the East Pakistan Water & Power Development Authority. The project was started in 1973 and some works including a part of embankment and drainage regulators

have been constructed until now. However, the progress is at a very slow pace mainly due to financial constraint.

On the Third National Five-Year Development Plan, the Government of Bangladesh has put emphasis on accomplishment of food self-sufficiency and improvement of productive employment. Following this policy, the Government decided to accelerate the Kurigram Irrigation and Flood Control Project. The Project area was divided into two units, of which the North Unit was proposed for first implementation of a feasibility study based on updated natural, social and technical aspects.

1-3. Objectives of the Study

The objectives of the Study are to formulate plans for irrigation and drainage development as well as flood control for the Kurigram North Unit, which will be justified from technical feasibility, economic viability and socio-economic acceptability viewpoints, toward the increase and improvement of agricultural productions.

1-4. Activities of the Study Team

(a) Activities

The Study were implemented in two phases, namely, the Phase I Study (July 1989 to December 1989, approximately 6 months) and the Phase II Study (January 1990 to August 1990, approximately 8 months).

1) Phase I Study (Study in the rainy season)

The Phase I Study consisted of preliminary home office work, field work for data collection and survey (July to October, 1989), and home office work for data analyses and the formulation of a basic concept for a development plan (November to December, 1989).

At the beginning of the Study, on August the 5th, a meeting was held between the BWDB and the Team in the presence of JICA's advisory committee for explanations and discussions on the Inception Report, which had been prepared by the Team to present the basic concept, plan of operation and schedules of the

Study. Both the parties agreed that the Study be conducted as per the laid down program in the Inception Report.

Data and information, including maps, aerial photographs, the existing feasibility study reports (Kurigram Flood Control and Irrigation Project, initially worked out in 1969 and revised in 1975) and statistics, necessary for grasping the present situation of the Study Area and for studying the development plan, were collected successfully as scheduled in the Inception Report. Field investigations, including a reconnaissance survey on major facilities, a water requirement test, surveys on present conditions of land use, farming, irrigation and drainage and an inquiry-survey with farmers, were carried out. In addition, a boring survey and a topographical survey at the proposed site for a main pumping station, as well as topographical surveys for the main irrigation canals and four sampled areas of 40 ~50 ha each, were conducted, which had initially been scheduled in the Phase II Study.

On October the 24th, a meeting was held between the BWDB and the Team for explanations and discussions of the Progress Report (I).

After having returned to Japan, the Team analyzed the collected data and the surveyed results through the field work in Bangladesh. In addition, based on the analyses, the Team formulated a basic concept for agricultural production, irrigation, drainage and flood control plans. These results were incorporated in the Interim Report.

2) Phase II Study (Study in the dry season)

The Phase II Study comprised field work for supplementary surveys and additional data collections (January to March, 1990),home office work for data analyses and the formulation of plans (May to July, 1990).

On the 13th and 14th in January, a meeting was held between BWDB and the Study Team for the explanation and discussions on the Interim Report.

Field surveys and data collection were conducted. Major works were soil survey and analyses, additional investigation on the existing tube well irrigation to know the present condition of irrigation and the actual water consumption, topographical surveys for the Dudhkumar river's cross sections and for major structures, analysis of the results from the interview survey of sampled farmers,

measurement of the river discharge to examine the availability of irrigation water intake as well as data collection on agronomy, agro-economy, drainage, Preliminary design of major structures, construction cost estimation and project evaluation.

Meetings were held between the concerned experts from the Bangladesh side and the Study Team, respectively on irrigation planning on the 29th in January, on cropping patterns on the 3rd in February and on drainage planning on the same day.

On the basis of surveyed results, collected and analyzed data and discussions with the BWDB side concerned officials, the outline of plans for the respective components were studied.

Major results from the Phase II field work and policies for planning were incorporated in the Progress Report (II). A meeting was held for explanation and discussions on this report on the 25th in March.

After having returned to Japan, the Team carried out the home office work including the following items:

- Review of all the previous field work results and data analyses.
- Confirmation of basic plans referring to the previous discussions with the BWDB.
- Completion of plans for irrigation, drainage and flood control systems.
- Estimation of costs and benefits of the development plan.
- Formation of plans for operation and maintenance.
- Evaluation of the development plan in view of economic, financial and sensitivity analyses.
- Formation of the implementation plan and schedule.
- Preparation of recommendations.

The results of the above-mentioned work were incorporated in the Draft Final Report, which was sent to the BWDB at the end of July, 1990. A meeting was held between the BWDB and the Team for the explanation of the Draft Final Report in August, 1990. Taking the discussion results into consideration, the Draft Final Report was rivised and elaborated. As a result this Final Report was completed.

(b) Personnel Involved in the Study

During the Feasibility Study period, the following personnel were involved in the Study.

Members of the Feasibility Study Team

Name	Speciality
Mr. MURATA Toshihisa	Team Leader
Mr. IWAI Isao	Irrigation Planning/Co-Leader
Mr. MAHBUB A. K. M. Reza	Hydrology/Meteorology
Mr. BANNO Kiyoshi	Drainage Planning
Mr. OOSAWA Takeshi	Pumping Facilities Planning
Mr. SHIBATA Toshihide	Agriculture
Mr. KOTO Akira	Soil/Land Use
Mr. INADA Sho	Agro-Economy
Mr. HORI Shinwa	Facilities Design
Mr. YAMASHITA Masanobu	Project Evaluation

Advisory Committee

Name	Speciality
Mr. KIMURA Kazuo	Leader, Advisory Committee.
Mr. NAMBA Teruhisa	Member, Avvisory Committee.

BWDB Counterpart Personnel

Name	Designation
Mr. Shamsur Rahman	Member, Planning, BWDB.
Mr. Mabinuddin Chaudhury	Chief Engineer, Planning, BWDB, Dhaka.
Mr. Majidul Islam	Chief Engineer, Planning, BWDB, Dhaka.
Mr. M. A. Razzaque	Chief Engineer, Planning, BWDB, Dhaka.
Mr. Khaliquzzaman	Director,Planning(General), BWDB,Dhaka.
Mr. Md. Lutfur Eahman	Director,Planning(General), BWDB,Dhaka.
Mr. Emam Hossain Khan	Chief and Agricultural Survey Officer, Office of Director, Planning(General), BWDB,Dhaka.
Mr. A. K. M. Anisur Rahman	Superinending Engineer, Canal Circle- II , BWDB, Rangpur.

BWDB Officials Contacted during the Study

Name	Designation
Mr. M. A. Matin	Director, Planning Schemes-I, BWDB, Dhaka.
Mr. A. A. Ansari	Director, Planning Schemes-II, BWDB, Dhaka.
Mr. Syed Shahadat Hossain	Director, Surface Water Hydrology-I,BWDB, Dhaka.
Mr. Md. Alam Mia	Director, Surface Water Hydrology-II,BWDB, Dhaka.
Mr. M. A. Sattar	Director, Land and Water Use, BWDB,Dhaka.
Mr. Md. Hasan Zubair	Executive Engineer, Kurigram W.D. Division-II, BWDB, Kurigram.
Mr. Abu Jaffar Howlader	Executive Engineer, Kurigram W.D. Division-II, BWDB, Kurigram.
Mr. Badiur Rahman	Chief Soil and Agricultural Survey Officer, Office of Chief Engineer, Planning, BWDB, Dhaka.
Mr. M. A. Mannan	Sr.Agril. Planning Officer, BWDB, Dhaka.
Mr. Raihan Ali Miah	Executive Engineer, Design, BWDB, Dhaka.

Mr. N. Chakravarty	Economist, Directorate of Planning Scheme-I, BWDB, Dhaka.
Mr. Md. Abdus Salam	Executive Engineer, Planning Schemes-II, BWDB, Dhaka.
Mr. Md.Obaidul Islam	Executive Engineer, Planning (General), BWDB, Dhaka.
Mr. Shofiuddin Ahmed	Executive Engineer, Planning (General), BWDB, Dhaka.
Mr. A. K. M. Halimur Rahman	Executive Engineer, Design Circle-VII, BWDB, Dhaka.
Mr. M. A. Rashid	Executive Engineer, Office of the Chief Engineer, Design-II, BWDB, Dhaka.
Mr. Syed Manzoor Towheed	Dy. Chief Agronomist, Dte. Land & Water Use, BWDB, Dhaka
Mr. Md. Jamshed Ali	Sub-Divnl, Engineer, Kurigram W.D. Divn-II, BWDB, Kurigram.
Mr. Md.Farook Ahmed	Sub-Divnl, Engineer, Kurigram W.D. Divn-II, BWDB, Kurigram.
Mr. Md.A.Majid	Sub-Divnl, Engineer, Kurigram W.D.

Other Officers Contacted during the Study

Name	Position
Mr. Sk.Amir Ali	Superintending Engineer, MPO, Banani, Dhaka.
Mr. Azizul Haque	Chief Agronomist, MPO, Banani, Dhaka.
Mr. Md.Jahurul Huq	Dy. Director, Directorate of Agril. Extension.
Mr. Md.Shajahan	Former Associate Professor, Department of Economics of Carmichael University Collage, Rangpur.
Mr. Mohd.Idris Ali	Principal Scientific Officer, Regional Office, SRDI.
Mr. Khabir Hossain	Scientific Officer, Regional Office, SRDI.

Mr. Mahtabuddin Ahmed	Deputy Dir., Bangladesh Meteology Dept.
Mr. Wasiuzzaman	Deputy Director, Directorate of Agril. Extention, Kurigram.
Mr. Abdur Rouf	Assistant Statistical Officer, Rangpur.
Mr. Jainal Abedin	Assistant Engineer, BADC, Nageswari.
Mr. Shamsul Haque Choudhury	Chairman, Bhurungamari Upazila Parishad.
Mr. A.S.M. Abdul Hamid	Bhurungamari Upazila Nirbahi Officer.
Mr. Rustam Ali Mondal	Bhurungamari Upazila Agriculture Officer.
Mr. Ismail Hossain	Bhurungamari Upazila Engineer.
Mr. Nurul Islam Choudhury	Bhurungamari Upazila Fishery Officer.
Mr. Rabindranath Deb	Bhurungamari Upazila Cooperative Officer.
Mr. Shaban Ali	Bhurungamari Upazila Statistical Officer.
Mr. Saifur Rahman	Chairman, Nageswari Upazila Parishad.
Mr. Monsin Khan	Nageswari Upazila Nirbahi Officer.
Mr. Abdul Khaleque	Nageswari Upazila Engineer.
Mr. Bhupen Kumar Mondal	Nageswari Upazila Additional Agriculture Officer.
Mr. M.A. Quddus Akanda	Nageswari Upazila Fishery Officer.
Mr. M.A.Rashid	SSAE(IRRI), BADC, Nageswari.
Mr. Abul Asad Miah	Nageswari Project Implementation Officer.
Mr. Abu Tayeb Sarder	Nageswari Upazila Statistical Officer.
Mr. A.k.M. Shamsudoha	Chairman, Kurigram Upazila.
Mr. Md.Muazzem Hossain	Kurigram Upazila Nirbahi Officer.
Mr. Md.Hassan Ali	Kurigram Upazila Agriculture Officer.
Mr. Abdul Maleque Sarker	Kurigram Upazila Engineer.
Mr. Dobiruddin	Kurigram Upazila Statistical Officer.
Mr. Md. Shahadat Hussain	Chairman, Fulbari Upazila.
Mr. Md. Rafiqul Islam	Fulbari Upazila Nirbahi Officer.
Mr. Md. Abdul Karim Mandal	Fulbari Upazila Agricultural Officer.
Mr. Jafor Ali Sorker	Fulbari Upazila Statistical Officer.

CHAPTER 2

AGRICULTURE AND THE GOVERNMENTAL POLICIES IN BANGLADESH

CHAPTER 2 AGRICULTURE AND THE GOVERNMENTAL POLICIES IN BANGLADESH

2-1. Agriculture

The cultivated area in Bangladesh amounts to 63% of the total land area. 85% of the total households as well as 85% of the total population are in rural areas. Agriculture provides the highest portion of employment (61%). Even in the industrial sector, the main industries achieving significant development are those related to agriculture, for example, jute and cotton textile industries which use agricultural crops as raw materials. Although an annual real growth rate in the agricultural sector dropped to 3.8% from 1976 to 1985, the agricultural sector occupied a large portion of the GDP, i.e., 54.3% in 1984/85 as shown in Table 2-1. These facts show that Bangladesh is primarily an agricultural country.

According to the 1983/84 agricultural census, the number of farm households in the country was 10,045,299, which accounted for 73% of the total households. Of them, small scale farmers (less than 1.0 ha) occupied 70%, medium scale farmers (1.0~3.0 ha) 25% and large scale farmers (more than 3.0 ha) 5%. The net cultivated land area was 8,157,786 ha, i.e., 70% of the total land area (excluding reserved forests and river areas). The net cultivated area per farm household was 0.8 ha, while the operated area for that was 0.9 ha.

According to the above census, the landless farmers in the country occupied 49% of the total households. Out of them, the landless I (having no land) occupied 9% of the total, the landless II (having homestead land but no cultivable land) 14% and the landless III (having homestead land and up to 0.2 ha of cultivable land) 26%. These landless farmers form the poor in rural areas and have an important meaning as the dearth of basic human needs, unemployment, social uneasiness in urban areas and the backwardness of agricultural productivity.

In 1986/87, the total cropped area was 14,117,000 ha, of which 4,363,000 ha were single cropped, 3,719,000 ha were double cropped and 772,000 ha were triple cropped as shown in Table 2-2. Accordingly, the cropping intensity was 159% in the country. As for crops, the cropped area of rice was 10,323,000 ha (73.1% of the total cropped area), of wheat 597,000 ha (4.2%), of jute 512,000 ha (3.6%), of pulses 737,000 ha (5.2%), of oilseeds 537,000 ha (3.9%), of condiments and spices 210,000 ha (1.5%) and of tobacco 47,000 ha (0.3%). Crop yields per ha were 1.5 t of rice, 18

t of wheat, 1.7 t of jute and 43 t of sugercane. Accordingly, rice is Predominant in Bangladesh agriculture. The production of food grains (rice and wheat) amounted to 17,039 thousand tons in 1987/88. Besides, the area of rice cropped under irrigation was 1,717,000 ha, which occupied 16.6% of the total cropped area of rice.

On the other hand, the share for agriculture was 39% of the country's GDP in 1987/88. Cereal crops occupied 74.6% of the agriculture GDP , jute 4.6%, fruits 5.5%, beverages 1.9%, oil seeds 2.2%, pulses 2.6%, spices 2.3%, sugercane 3.0% vegetables 2.9% and others 0.3% as shown in Table 2-3.

Table 2-1 Growth and Structure of GDP
(At 1972/73 factor cost)

(Unit: Tk. in crore)

Sectors	GDP of 1972/73	GDP of 1984/85	Annual Growth Rate (%)	Share of GDP of (%)	
				1972/73	1984/85
i) Agriculture	2,722.0	4,248.0	3.8	60.1	54.3
ii) Industries	329.8	676.8	6.2	7.3	8.6
iii) Other sectors	1,478.2	2,903.6	5.8	32.6	37.1
Total	4,530.0	7,829.0	4.7	100.0	100.0

Source: Third Five-Tear Plan, 1985-90

Table 2-2 Cropping Intensity (1986-87)

	Single Cropped Area	Double Cropped Area	Triple Cropped area	Net Cropped Area	Total Cropped Area	Intensity of Cropping
	'000'ha	'000'ha	'000'ha	'000'ha	'000'ha	%
Country	4,363	3,719	772	8,854	14,117	159.4

Source: 1989 Statistical Yearbook of Bangladesh
Note: Intensity of cropping of 1984-85 is 152.2% and 154.5% respectively

Table 2-3 Value Added from Agricultural Crops at Current Prices (1987-88)

	Cereals	Beve-rages	Fi-bers	Frui-ts	Oil-seeds	Pul-ses	Spi-ces	Sugar-cane	Vege-tables	Othe rs	Total
Value Added (Million Taka)	127,002	3,393	7,848	9,318	3,797	4,354	3,979	5,104	4,946	471	170,212
Percen-tage(%)	74.6	2.0	4.6	5.5	2.2	2.6	2.3	3.0	2.9	0.3	100.0

Source: The above

2-2. The Government's Policy

Bangladesh has followed the course of planned development since her independence, and the Government policy was implemented based on that plans.

As a national development plan for the period of 1985 through till 1990, the Third Five Year Plan (TFYP) was enforced. The ultimate object of the TFYP was set to be poverty alleviation as had been in the preceding plans, considering the present social and economic situation. The problem of poverty, however, seemed to be so serious and complicated that it needed comprehensive countermeasures formulated based on a long perspective as well as on relative priorities considering the limit of available resources, administrative capabilities and the cultural characteristics of the society. In line with this aspect, the major objectives of the TFYP were given as follows:

1) Reduction of population growth.
2) Expansion of productive Employment.
3) Universal primary education and human resource development.
4) Development of a technological base for bringing about long term structural changes.
5) Food self-sufficiency.
6) Satisfaction of the minimum basic needs of the people.
7) Acceleration of economic growth.
8) Promotion of self-reliance.

The TFYP aims at an average annual real growth rate in gross domestic products of 5.4%, while the annual population growth rate is projected to decrease from the current 2.4% to 1.8% at the end of the TFYP. For the agricultural sector, a 4.0% annual growth rate is targeted (Table 2-4).

The main objective given to the agricultural sector in the TFYP is to attain self-sufficiency in foodgrain production. For this, foodgrain production needs to grow at a 5.2% annual rate from the bench mark production, 16.1 million tons (1984/85) to 20.7 million tons, the target in the terminal year (1989/90) of the TFYP. This target is set to ensure the food availability of 16 oz, (453 g) per capita per day (Table 2-5).

The employment target of the TFYP is set as 243.8 1ac in the terminal year at a 4.8% growth rate (Table 2-6). This means that 50.9 1ac men-years of fresh employment will be genarated, and it is pointed out that approximately 67.2% of the addtional employment will arise from expanded activities in the agricultural sector during the TFYP.

However , the Government has envisaged serious difficulties for the achievement of the TFYP due to the unprecedented floods in 1987 and 1988, resource constraints and occcasional natural calamities after the TFYP was launched.

In 1987/88, serious damages from severe floods caused a reduction in foodgrain production down to 16.46 million tons (rice 15.4 million tons, wheat 1.05 million tons), which was considerably less than 17.51 million tons of the target production (Table 2-7). As a result, the actual annual growth rate for the first three years of the TFYP has been approximately 0.7% against the target rate of 4.5% (Table 2-8).

In 1988/89, foodgrain production again suffered record damages from natural disasters such as excessive rainfall in May, excessive rain fall and floods in June and July, severe floods in August and September and a cyclone in November. These damages brought about a reduction of food grain production by 3,163 thousand tons (rice 3,135 thousand tons, wheat 28 thousand tons).

To cope with the above serious corcumstances, the Government has been continuing efforts to increase crop production and to attain self-sufficiency in foodgrains. One of the taken measures was a project named "Flood Rehabilitation Program", which was implemented in 1987/88.

Meanwhile , the main development objectives in the agricultural sector in 1987/88 and 1988/89 were given as follows :

1) To attain self-sufficiency in foodgrain production by increasing the per acre yield.
2) To increase the production of various types of crops on the same land per year.
3) To assist in the increase of foodgrain production through the distribution of improved quality seeds.

4) To ensure water and water resources through the utilization of necessary agricultural inputs.
5) To assist with the physical and financial conditions of the farmers to increase foodgrain production in the agricultural sector.

Table 2-4 GDP Composition (constant factor cost of 1984/85)

(Unit: Tk. in crore)

	1984/85		1989/90		Annual Growth Rate (%)
	GDP	Shares of GDP (%)	GDP	Shares of GDP (%)	
1. Agriculture	16,538	50.4	20,052	46.9	4.0
2. Industries	3,125	9.5	5,063	11.9	10.1
3. Gas and Electricity	238	0.7	376	0.9	9.6
4. Construction	761	2.3	965	2.3	4.9
5. Transport & Communication	1,722	5.2	2,407	5.6	6.9
6. Trade & Other Services	7,319	22.4	9,975	23.3	6.4
7. Housing Services	986	3.0	1,182	2.8	3.7
8. Public Services	2,145	6.5	2,690	6.3	4.6
Total	32,834	100	42,710	100	5.4

Source: The Third Five-year Plan, 1985-90

Table 2-5 Major Sectoral Targets of the TFYP

Items	Units	1984/85 (Actual)	1989/90 (Target)
Agriculture			
1. Foodgrains/1	ml. metric tons	16.1	20.7
(a) Rice	-do-	14.6	18.0
(b) Wheat	-do-	1.5	2.6
(c) Others	-do-	-	0.1
2. Jute	ml. bales	4.6	6.0
3. Tea	ml. lb	96.8	115.0
4. Sugarcane	lakh tons	70.0	82.0
5. Pulses/1	-do-	2.0	3.0
6. Oil Seeds	-do-	2.0	3.5
7. Potato	-do-	13.0	17.0
8. Fish/1	'000 tons	774	1000
Industries			
1. Jute Textiles	'000 tons	561	650
2. Cotton Textiles			
(a) Yarn	ml. kg.	59.4	95.0
(b) Cloth	ml. metre	771.0	1215.0
3. Fertilizer	'000 metric tons	806	21.5
4. Paper and Newsprint	-do-	90	105
5. Sugar	-do-	88	225
6. Cement	'000 metric tons	240	850
7. Basic Metals (Steel)	-do-	101	230
Energy			
1. Electricity			
(a) Generation	GWH	4545	899
(b) Sales	GWH	2840	7146
(c) Villages/1	'000 numbers	7.9	22.1
2. Gas			
(a) Output	MMCFD	450	750
(b) Customs Connections	'000 numbers	240	400
(c) Development Wells	Numbers	21	38
Transport and Communication			
1. Paved Roads	Km	4,830	6,118

(to be continued on next page)

Items	Units	1984/85 (Actual)	1989/90 (Target)
PPH			
1. Rural Drinking Water Supply/1	'000 of hand tubewells/*	618.8	792.8
Education			
1. Primary School Enrolment/1	1akh students	89.2	116
2. Secondary Education Enrolment	-do-	24.8	27.5
3. College Education Enrolment	-do-	4.3	4.4
4. University Education Enrolment	'000 students	25.0	38.6
5. Technical Education Enrolment	-do-	20.4	22.0
6. Vocational Educatition Enrolment (including community schools)	-do-	554	756
7. Madrasa Education Enrolment	-do-	319	350
Health			
1. No. of Hospital beds/1	'000 numbers	27.6	40.7
2. No. of Doctors	-do-	16.0	22.5
3. No. of Nurses	-do-	6.5	10.2
Population Control			
1. Population Growth Rate	%	2.4	1.8
2. Contraceptive Prevalence Rate (CPR)	-do-	25	40

/* ··· This includes shallow, deep and deepsat hand tubewells.

/1 ··· Basic Needs Supplies (Output)

Source: Third Five-Year Plan (TFYP), 1985-90

Table 2-6 Employment Target

(Unit: lac of men-year)

Sector	1984/85 (Benchmark)	1989/90 (Target)	Increase over Benchmark	Percentage of Increase
1. Agriculture	116.4	150.6	34.2	67.2
2. Industries	19.0	24.3	5.3	10.4
3. Public Utilities	16.9	18.7	1.8	3.5
4. Construciton	5.9	7.3	1.4	2.8
5. Public Services	20.0	25.2	5.2	10.2
6. Trade and others	14.7	17.7	3.0	5.9
Total	192.9	243.8	50.9	100.0

Source: Third Five-year Plan (1985-90)

Table 2-7 Foodgrain Production

(In million tons)

Crops \ Year	1984/85	1985/86	1986/87	1987/88	1989/90 Plan target
Aus	2.78	2.83	3.12	2.99	3.42
Aman	7.93	8.54	8.26	7.72	9.18
Boro	3.91	3.67	4.03	4.70	5.40
Rice	14.62	15.04	15.41	15.41	18.00
Wheat	1.46	1.04	1.07	1.05	2.60
	0.03	0.04	0.02	0.04	0.10
Toral ..	16.11	16.12	16.50	16.50	20.70

Source: Mid-Term Review of the Third Five Year Plan 1985-90

Table 2-8 Government Foodgrain Operations

(Figure in lakh tons)

Description 1	1983-84 (Actual) 2	1984-85 (Actual) 3	1985-86 (Actual) 4	1986-87 (Actual) 5	1987-88 (Estimated) 6
1. Population (crore)	9.67	9.92	10.17	10.41	10.74
2. Foodgrain requirement ..	154.60	163.00	166.00	169.70	173.60
3. (a) Aus	31.71	27.80	28.30	31.30	29.93 (Actual)
(b) Aman	78.11	79.30	85.40	82.67	76.89
(c) Boro	35.00	39.10	36.70	40.00	46.64
(d) Wheat	11.90	14.60	10.40	11.00	10.50
Total production	156.72	160.80	160.80	164.97	163.96
4. Net availability of foodgrains ..	140.72	144.80	144.80	148.50	148.00
5. Food deficit/surplus	13.88	18.20	21.20	21.20	25.60
6. Government foodgrain operations					
(a) Opening stock	6.88	8.68	11.46	10.58	8.33
(b) Internal procurement (+) ..	2.68	3.49	3.50	2.18	2.00
(c) External procurement (+) ..	20.57	25.89	11.95	17.68	30.73
Total foodgrain stock ..	30.13	38.06	26.91	30.44	41.06
7. Foodgrain distribution (-)	20.51	25.63	15.40	21.20	28.00
8. Stock loss (-)	0.94	0.97	0.93	0.91	1.00
Foodgrain closing stocks	8.68	11.46	10.58	8.33	12.06

N.B. Source: Food Division

(a) Total production × 0.90 (10% for seed, feed and waste) = net production

(b) Foodgrain requirements (-) Net production = Food deficit/Surplus

(c) Foodgrain opening stock (+) Internal procurement (+) External procurement = Foodgrain total stock

(d) Foodgrain total stock (-) Foodgrain distributions and Stock loss = Foodgrain closing stock

Source; Ministry of Finance, Bangladesh Economic Survey 1987/88