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Government of the People's Republic of Bangladesh  
Bangladesh Water Development Board  
Water Resource Planning Organisation

# NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

## DAMPARA WATER MANAGEMENT PROJECT

FEASIBILITY STUDY  
ANNEX D: ECONOMICS  
FINAL REPORT

March 1997



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Northwest Hydraulic Consultants

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Engineering and Planning Consultants Ltd.  
Bangladesh Engineering and Technological Services

Canadian International Development Agency

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**COVER PHOTO:** A typical village in the deeply flooded area of the Northeast Region. The earthen village platform is created to keep the houses above water during the flood season which lasts for five to seven months of the year. The platform is threatened by erosion from wave action; bamboo fencing is used as bank protection but often proves ineffective. The single *hijal* tree in front of the village is all that remains of the past lowland forest. The houses on the platform are squeezed together leaving no space for courtyards, gardens or livestock. Water surrounding the platform is used as a source of drinking water and for waste disposal by the hanging latrines. Life in these crowded villages can become very stressful especially for the women, because of the isolation during the flood season. The only form of transport from the village is by small country boats seen in the picture. The Northeast Regional Water Management Plan aims to improve the quality of life for these people.

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(FAP 6)**

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## ACRONYMS AND ABBREVIATIONS

A	area
BBS	Bangladesh Bureau of Statistics
BR	Bangladesh Railway
BWDB	Bangladesh Water Development Board
CBA	cost-benefit analysis
CPUA	catch per unit area
DAE/MOA	Department of Agricultural Extension, Ministry of Agriculture
DWMP	Dampara Water Management Project
EIRR	economic internal rate of return
EMP	Environmental Management Plan
FAP	Flood Action Plan
FCD	flood control & drainage
FF/FD	damage-free land/damaged land
FPCO	Flood Plan Coordination Organization
FW	future with
FWO	future without
GOB	Government of Bangladesh
HYV	high yielding variety
IDA	International Development Agency
IGAB	incremental gross agricultural benefit
LGED	Local Government & Extension Division
LT Aman	late aman
MCA	multi-criteria analysis
MT	metric tonne
NERP	Northeast Regional Water Management Project
NPV	net present value
O&M	Operation & Maintenance
PR	crop production
t. aman	transplanted aman
Y	yield under flood-free condition



## GLOSSARY OF TERMS

Alluvium	sand, silt and clay soils deposited by rivers
aman	Kharif II late monsoon rice crop
aus	Kharif I early monsoon rice crop
Beel	floodplain lake which may hold water permanently or dry up during the winter rabi season
boro	rabi winter season rice crop
$f_0$	highlands land phase -- seasonal flooding ranges from 0 to 30 cm
$f_1$	medium highlands land phase -- seasonal flooding ranges from 30 to 90 centimetres
$f_2$	medium lowlands land phase -- seasonal flooding ranges from 90 to 180 centimetres
$f_3$	lowlands land phase -- seasonal flooding depth is more than 180 centimetres during the monsoon
floodplain	land made by deposition of river alluvium and subject to seasonal flooding
haor	depression in floodplain located between two or more water channels which functions as a small internal drainage basin
HYV Boro	high yielding variety boro rice
HYV T. Aus	high yielding variety transplanted aus
HYV T. Aman	high yielding variety transplanted aman
Khal	water channel or canal
Kharif II	late monsoon season (July to October)
Kharif I	early pre-monsoon season (mid-March to June)
loc B. Aus	local broadcast aus
loc T. Aman	local transplanted aman
loc B. Aman	local broadcast aman
loc T. Aus	local transplanted aus
rabi	winter season (November to mid-March)

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## ANNEX D: ECONOMICS



### D.1 Introduction

The Flood Action Plan (FAP 6) comprises a number of studies and pilot projects which are expected to lead to water resources management and related projects with an emphasis on flood control and drainage. The Northeast Regional Water Management Project (NERP) is at a critical phase where project impacts on the resource base, social groups, ecology and environment require a financial and economic appraisal to be conducted for selected projects prior to making an investment decision. The Dampara Water Management Project has been identified as a priority investment project and, accordingly, rigorous project appraisal techniques are required to determine its economic feasibility and to assess expected impacts on the resource base and the environment.

The economic evaluation or cost-benefit analysis is a key element in the appraisal stage of the project cycle. Cost-benefit analysis (CBA) is used in this report to assess the economic viability of the Dampara Water Management Project (DWMP). The economic analysis using CBA techniques ensures the most economically efficient use of scarce resources by identifying those projects or project components which offer the highest economic rate of return on an investment. Policy-makers and investors alike must be particularly cognisant regarding the investment of scarce capital resources that will best further national objectives. This is true whether the resources committed are being invested by the government directly or by individuals within the economy.

### D.2 Methodology

The *Guidelines for Project Assessment* have been produced by the FPCO with the aim of standardising the methodology and assumptions applied in the economic analysis undertaken by different FAP studies. They are based on widely accepted techniques for the appraisal of water resource development projects and provide a good basis for achieving the necessary degree of uniformity and comparability between FAP studies. This study used the *FPCO Guidelines for Project Assessment* (May 1992) which outlines the detailed costing procedures for capital, operation and maintenance (O&M) costs; market and economic prices to be used; and areas for which benefits/disbenefits are to be analysed. For comparative purposes and to avoid inflationary distortions, all prices and costs are converted to the price level typical of 1991. The *FPCO Guidelines* also discuss the phasing of benefits, mitigation measures to be taken, the period of analysis, and the rate by which the cost-benefit stream is to be discounted. The *FPCO Guidelines* also illustrates a multi-criteria analysis which provides a comprehensive basis for a comparison of expected impacts in economic, quantitative and qualitative terms.

This study is largely based on NERP longitudinal and cross-sectional data series and supported by NERP hydrological information. The basis of the subsequent economic analysis was the construction of a computer spreadsheet model developed by NERP simulating the expected benefit/cost streams emanating from the with (FW) and without (FWO) situations extending over a 30-year period after project construction is initiated. The economic decision criteria employed are 'Net Present Value and Economic Internal Rate of Return'.



### ***Net Present Value (NPV)***

'Net Present Value' is the sum of the discounted incremental net cash flow stream of the project. It is the cumulative present worth of the incremental national income generated by the investment. For a project to be economically feasible, the NPV must be positive for a pre-determined discount rate which reflects the opportunity cost of capital in Bangladesh (=12%/annum excluding inflation).

### ***Economic Internal Rate of Return (EIRR)***

The discount rate which when applied to the stream of incremental benefits and costs as reflected in the net cash flow of a project produces a zero net present value. It is the maximum (real, non-inflationary) annual rate of interest that a project could pay for the resources used if the project is to recover all its costs and still break even. For a project to be economically feasible, the EIRR must be equal or greater than the opportunity cost of capital (or "cut-off rate") in Bangladesh, i.e. >12%/annum, excluding inflation.

These are estimated on the basis of projected annual incremental net costs and benefit streams from the *future with* (FW) and *future without* (FWO) situations; all expressed in terms of constant (1991) costs and prices. "Economic" costs and prices are synonymous with efficiency prices or undistorted international price levels, exclusive of all taxes and subsidies. They are sometimes called "shadow" prices or "border" prices. The appropriate economic conversion factors are provided in *FPCO Guidelines for Project Assessment* (May 1992).

Additionally, sensitivity analyses are conducted to measure the reliability and robustness of estimates, and to identify the benefit and cost items which have the greatest influence on the overall economics of the project.

The specific impacts which have been quantified in the economic analysis following are:

- agricultural production and employment
- captured and cultured fisheries production
- protection of socio-economic infrastructure
- navigation
- agro-forestry and wetland resources

### **D.3 Future With (FW) and Future Without (FWO) Comparisons**

Project assessment requires the estimation of incremental benefit and cost streams over the economic life of the project. That is, project analysis tries to identify and value all the quantifiable costs and benefits that will arise with the proposed project and to compare them with the situation as it would be without the project. The difference is the incremental net benefit arising from the project investment. This approach accounts for changes in production that would occur without the project.

The without project planning scenario covers the same 30-year period as the with project scenario and assumes that no other publically financed major flood control and drainage measures are undertaken during the period. In the FW project situation, an embankment is proposed along the right bank of the Kangsha River to provide flood protection to the project area. The embankment would be designed to give protection against monsoon floods of 1:20 year return period. The proposed embankment would connect to the existing BWDB embankment at Jaria. As a result of



the flood protection measures, the depth of flooding will be reduced and the area of flood-free land will be increased. The total physical area impacted would be about 15,000 hectares (Table D.1).

Table D.1

Land Use Pattern: Present, FWO and FW Situations (hectares)

Land Use	Present Use	FWO Use	FW Use
Net Cultivated Area	12,525	12,377	12,292
Homesteads	470	546	546
Ponds	120	135	180
Agro-forestry and Homestead Plantation	810	857	831
Infrastructure	485	500	515
Embankment	0	0	51
Channel	415	415	415
Beel	175	170	170
Total	15,000	15,000	15,000

Source: Annex B (Agriculture), Table 7.1

#### D.4 Cost Estimation

##### D.4.1 Capital Cost

Cost estimating procedures are detailed in the FPCO *Guidelines*. As given in the table in the following page, the estimated total capital costs are Tk 64.2 million (1995 prices) inclusive of land acquisition costs, mitigation costs, and enhancement programme costs.

Excluded from the economic analyses following are:

Land Acquisition Costs	: Tk 20.5 million
Enhancement Programme Costs	: Tk 3.9 million

Land acquisition costs of Tk 20.5 million (see Appendix Table 1) are excluded from the economic analysis because land taken out of production by the proposed project is valued in terms of production foregone. Environmental enhancement costs are excluded because an offsetting monetary estimate of the benefits from such an investment was not calculated. Environmental mitigation costs are included in the capital cost summary even though it is similarly true that post-mitigation impacts are not estimated. This may introduce a slight downward bias into the benefit-cost analysis conducted following.

Physical contingencies equal to 15 percent of base construction costs as per FPCO *Guidelines* were used to cover unforeseen costs. Engineering design and supervision costs were computed as 9 percent of base construction costs and physical contingencies.

Capital costs were then deflated to June 1991 constant prices using the appropriate Bangladesh Bureau of Statistics *construction* price index. (Deflator = .875) FPCO -determined conversion factors (see '*Guidelines*') were subsequently used to convert the market cost estimates into economic cost estimates. Total capital costs considered in the economic analysis in 1991 constant economic prices are estimated to be 25.8 million Taka, scheduled to be dispersed as follows:

Year 1	Tk. 852,000
Year 2	Tk 11,622,000
Year 3	Tk 13,317,000
	<b>Tk 25,791,000</b>

Detailed quantity and cost estimates are provided in Annex A (Engineering) and Annex E (Environmental Impact Assessment).

Capital Cost Summary ('000 Tk)		
Type	Item	1995 Price
FCD Interventions	Embankments	16,294
	Structures	3,524
	Channel	1,302
	Closure & Diversion Channel	866
Sub-Total		<b>21,986</b>
Mitigation Measures	Fisheries	2,000
	Wetland & Wildlife	400
	Homestead Raising	2,940
Sub-Total		<b>5340</b>
Enhancement Programme	Agriculture	400
	Fisheries	1,000
	Social	2,000
Sub-Total		<b>3,400</b>
Land		20,500
Total		<b>51,226</b>
Physical Contingencies (15 % of total)		7,684
Sub-Total		<b>58,910</b>
Study Cost (9 % of Sub-Total)		5302
Grand Total		<b>64,212</b>



#### D.4.2 O&M Costs

Again following the FPCO *'Guidelines for Project Assessment* (May 1992), Operation & Maintenance (O&M) costs have been calculated as a percentage of capital costs: 6 percent for embankments and drainage channels, 3 percent for structures, and 5 percent for other costs. Homestead raising does not have any O&M cost associated with it. Physical contingencies equal to 15 percent of O&M costs are then added to the sub-total to obtain the total estimated O&M cost per year. O&M costs are expected to amount to about Tk. 1.17 million by Year 3 and Tk. 1.79 million/year during Years 4 through 30 (Appendix Table 1).

#### D.4.3 Phasing & Disbursement

Three years are required to implement the proposed project. Cadastral surveys, topographic surveys, detailed engineering design as well as preparation of tender documents and awarding of contract would be carried out in Year 1. Land acquisition must be completed prior to the start of construction. Construction would start in Year 2 and should be completed in Year 3. The implementation of the mitigative measures would also start in Year 2 and continue into Year 3. There would not be any payback to the project until Year 4.

#### D.4.4 Benefits & Disbenefits

The principal direct benefits is the projected increase in agricultural production in the project area while supplementary benefits are due to a reduction in damages in public infrastructure, commercial and agricultural assets, fish ponds, homestead plantations and agro-forestry. Substantial indirect benefits will also be realized by the World Bank/IDA Kangsha River Project through the flood protection afforded. The main disbenefits come from expected losses to the floodplain fishery resource along with navigation and wetland resource losses. These are discussed in detail under the following respective sub-headings:

- D.5 Agriculture
- D.6 Fisheries
- D.7 Socio-Economic Infrastructure
- D.8 Navigation
- D.9 Homestead Gardens, Agro-Forestry & Wetland Resources

#### D.5 Agriculture

##### D.5.1 Anticipated Benefits

The major benefits expected from the proposed project relate to increased crop production. This would largely arise through less direct flood damage to crops, as well as the substitution of local rice varieties for HYV rice for planting during the monsoon season. That is to say, with improved flood control, two major crop production changes are expected:

1. the proportion of damage-free land versus flood-damaged land increases; thus increasing average crop yields and output for any and all cropping patterns; and,
2. the cropping pattern will shift in favour of higher-yielding crops, particularly HYV rice production



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Growing the shorter HYV rice becomes increasingly feasible when the risk of flooding decreases and the window available for re-planting during the monsoon season increases. (For additional details, see Annex B (Agriculture)).

#### D.5.2 Market & Economic Shadow Prices

The analysis uses the FPCO *'Guidelines'* which indicates both market prices and economic shadow prices for agricultural products as well as agricultural production inputs. These prices are designated *1991 constant prices* to be employed in all FAP Planning studies. (See attached Appendix Tables 2 & 3).

#### D.5.3 Present & Without Project (FWO) Crop Yields

It has been assumed that overall yields under flood free conditions will increase for spices, vegetables, oilseeds and wheat as indicated in the past ten years' national trend (re: *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics, various years). Since these yield increases are not due to the implementation of the project, however, they are the same for both the without project (FWO) and with-project (FW) situations. The proposed project will not have any impact on these yield changes. It is assumed that the remaining crop yields—including all rice crops and sugarcane—will remain constant in the present and FWO situations (see Table D.2). However, the average yields representing the weighted average of the yields in flood-free and flood-damaged land are not the same for the present and FWO situations. This is because some changes are expected in the damage-free areas in the FWO situation (Table D.2).

For the with-project (FW) situation, average overall yields effectively increase for all rice crops because of the expected reduction in the rice area flooded, as well as the opportunity to shift to more HYV rice. For all other crops, the yield levels are considered to be the same for both the FWO and FW situations, as also illustrated in Table D.2.

Yield estimates for Damaged Crop areas were estimated through a Farm Household Survey. These estimates generally range from 50 to 75 percent of undamaged crop yields.

#### D.5.4 Cropping Pattern

For the FWO situation, a review of the recent flood frequency and Bangladesh Bureau of Statistics (BBS) annual crop production data show that crop losses will continue to increase in the Kharif II monsoon season. Flood damage would be expected to affect local transplanted aman (t. aman) and decrease the *present* crops in F<sub>3</sub> lowland areas by about 2.0 percent.

To project cropping patterns after project implementation, the area in each land type was re-estimated according to post-project flood depth and then adjusted for the crops currently grown on each type of land. Land types are defined in terms of monsoon flood depth:

Land Type	Flood Depth (m.)
F <sub>0</sub>	0.0 - 0.3
F <sub>1</sub>	0.3 - 0.9
F <sub>2</sub>	0.9 - 1.8
F <sub>3</sub>	> 1.80

Using this general procedure (as detailed in Annex B - Agriculture), it is expected that cropping patterns would change quite considerably as a result of, in particular, increased flood protection in the Kharif II monsoon season. Flood protection would permit more timely planting of aman rice and allow farmers to replace low-yielding traditional varieties with HYV transplanted aman during the monsoon season. It is likely that farmers will adopt these more intensive cultivation practices due to reduced risk from flood damage in the Kharif II monsoon season. It is expected that the total area cropped/calender year will also increase slightly, as the cropping intensity climbs from 194 percent to a projected 202 percent in the FW project situation.

These simulations are provided in Appendix Tables 4, 5, and 6.

**Table D.2**

**Yield of Crops: Present, FWO and FW Scenarios  
(metric tonne/hectare)**

Crops	Damage Free Area			Damaged Area			Weighted Average*		
	Present	FWO	FW	Present	FWO	FW	Present	FWO	FW
Loc B Aus	1.80	1.80	1.80	0.87	0.87		1.74	1.74	1.80
Loc T Aus	2.10	2.10	2.10	1.60	1.60		2.06	2.03	2.10
HYV T Aus	3.90	3.90	3.90	3.10	3.10		3.84	3.85	3.90
Loc B Aman	1.60	1.60	1.60	1.28	1.28		1.41	1.41	
Loc T Aman	2.20	2.20	2.20	1.60	1.60	1.60	1.73	1.69	2.07
HYV T Aman	3.40	3.40	3.40	2.60	2.60	2.60	2.67	2.73	3.35
Local/Imp Boro	2.40	2.40	2.40	1.81	1.81		2.39	2.39	2.40
HYV Boro	4.60	4.60	4.60	4.00	4.00		4.56	4.56	4.60
Wheat	2.03	2.24	2.24				2.03	2.24	2.24
Oilseeds	1.00	1.10	1.10				1.00	1.10	1.10
Jute	1.50	1.50	1.50				1.50	1.50	1.50
Vegetables	10.70	12.20	12.20				10.70	12.20	12.20
Spice	3.50	4.98	4.98				3.50	4.98	4.98
Sugarcane	22.00	22.00	22.00				22.00	22.00	22.00

\* Weighted average of yields in damage-free and damaged land where the weights represent the damaged and damage-free area under the respective crops.

Source: Imputed from Appendix Tables 7,8 and 9.



### D.5.5 Total Production & Revenue: Main & By-Product

Estimated cropping patterns (i.e. areas) together with estimated yields for the *present*, FWO, and FW situations allow the project analysts to estimate production levels for each crop (see Appendix Tables 7, 8 and 9). Additionally, the FPCO *Guidelines* indicate the amount of by-product (e.g., rice straw, wheat straw, etc.) produced per unit of main product (see Appendix Table 2).

The gross revenue earned from each crop is derived from both the main product and its by-product and is given by:

$$\text{Gross Revenue} = \text{Area} \times \text{Yield} \times \text{Price}$$

where prices are expressed in terms of both market prices and economic prices (See above). Table D.3 shows the total estimated gross revenue earned for each crop under the three different scenarios (i.e. present, FWO and FW) using both market and economic prices. Per-hectare estimates are provided in Appendix Tables 10 and 11.

### D.5.6 Crop Input Use & Cost of Production

Per -hectare input requirements have been estimated for each crop for the *present*, FWO and FW situations (see Appendix Tables 12, 13 and 14). The *present* scenario is intended to represent typical existing (not recommended) input levels which are commensurate with the corresponding yield levels recorded. The production inputs considered include labour, fertilizer (i.e., nitrogen, phosphorous and potassium but excluding minor nutrient elements—sulphur, zinc, magnesium, etc.), traditional and modern irrigation methods, draught animal use (there was no power tiller use reported in the project area), seed and pesticide.

The total cost-of-production estimates for the *present*, FWO and FW situations are calculated as follows:

$$\text{Cost} = \text{Per-Hectare Input Requirements} \times \text{Area} \times \text{Unit Input Prices} \\ [\text{Appendix Tables 12,13,14}] \times [\text{Appendix Tables 4,5,6}] \times [\text{Appendix Table 3}]$$

Prices are again expressed in terms of both market prices and economic (or shadow) prices. In addition, the financial (market) analysis includes some costs which are excluded from the economic analysis. These are loan interest on working capital and miscellaneous expenses. Loan interest is taken out of the economic calculations because they are considered a transfer payment (to capital) within the nation. Loan interest is included in the financial analysis at an interest rate of 17.5 percent per year for a six month period on 80 percent of cash costs of production for each crop. The miscellaneous expenses are assumed to be 10 percent of the cash costs and the loan interest. The resulting total costs of production using both market and economic prices under different scenarios are shown in Table D.4 below.



Table D.3

Total Gross Revenue Earned for Present, FWO and FW Scenarios  
in Market and Economic Prices  
(million Taka)

Crops	Market Price			Economic Price		
	Present	FWO	FW	Present	FWO	FW
Loc B Aus	16.24	15.76	16.18	14.25	13.83	14.20
Loc T Aus	3.34	2.20	2.22	2.93	1.93	1.95
HYV T Aus	4.24	5.27	5.15	3.73	4.63	4.52
Loc B Aman	0.87	0.87	0.00	0.76	0.76	0.00
Loc T Aman	106.96	96.44	86.88	93.88	84.65	76.26
HYV T Aman	67.63	74.44	151.04	59.45	65.44	132.76
Local/Imp Boro	56.80	59.73	57.06	49.85	52.43	50.08
HYV Boro	247.47	240.20	245.50	217.52	211.13	215.79
Wheat	2.29	3.03	3.20	2.88	3.80	4.02
Oilseeds	8.97	9.38	12.50	7.90	8.26	11.00
Jute	0.42	0.41	0.42	0.41	0.41	0.42
Vegetables	8.19	9.63	14.59	7.13	8.38	12.70
Spice	1.35	1.99	3.01	1.18	1.73	2.62
Sugarcane	0.01	0.01	0.01	0.01	0.01	0.01
<b>Total</b>				<b>461.88</b>	<b>457.39</b>	<b>526.33</b>

Source: Derived from Appendix Table 2 times Appendix Tables 7-8-9.



Table D.4

**Total Cost of Production: Present, FWO & FW Scenarios(million Taka)  
(million Taka)**

Crops	Market Price			Economic Price		
	Present	FWO	FW	Present	FWO	FW
Loc B Aus	9.33	9.06	9.00	7.09	6.88	6.84
Loc T Aus	1.55	1.03	1.01	1.18	0.79	0.77
HYV T Aus	2.02	2.50	2.44	1.69	2.09	2.03
Loc B Aman	0.54	0.54	0.00	0.40	0.40	0.00
Loc T Aman	71.17	65.67	53.02	54.07	49.89	40.40
HYV T Aman	41.58	44.87	83.09	32.43	35.00	64.89
Local/Imp Boro	25.96	27.30	26.00	20.42	21.47	20.45
HYV Boro	109.37	106.19	108.71	88.17	85.60	87.85
Wheat	1.63	2.01	2.12	1.41	1.75	1.85
Oilseeds	4.95	4.75	6.33	4.00	3.86	5.14
Jute	0.24	0.24	0.25	0.19	0.19	0.19
Vegetables	5.44	6.14	9.31	4.16	4.70	7.12
Spice	1.18	1.44	2.18	0.89	1.08	1.63
Sugarcane	0.01	0.01	0.01	0.01	0.01	0.01
<b>Total</b>				<b>216.11</b>	<b>213.71</b>	<b>239.17</b>

Source: [Appendix Tables 12,13,14] x [Appendix Tables 4,5,6] x [Appendix Table 3]

#### D.5.7 Net Margin & Net Incremental Benefit

The estimated net margin for each crop is determined by subtracting the total cost-of- production from the gross revenue earned:

$$\text{Net Margin} = \text{Gross Revenue} - \text{Cost-of-Production}$$

[Table D.3] - [Table D.4]

Since all labour costs (including family labour) are included in the respective Cost-of-Production estimates, this is essentially a net return to capital and management. This is sometimes termed a gross profit margin or, in benefit-cost analyses, the net benefit.



The net incremental benefit attributable to the proposed project is, therefore, given as:

$$\text{Net Incremental Benefit} = \text{Net Benefit FW} - \text{Net Benefit FWO}$$

In public benefit-cost analyses, it is the economic net incremental benefit which is of particular concern. All of the net benefit calculations, as well as the net incremental economic benefits, by crop, are summarized in Table D.5 following. These calculations indicate that at project maturity the project should generate an average annual net incremental benefit of about Tk. 43.5 million per year. This translates into an average of about Tk. 3500/physical ha./year; a relatively large annual benefit.

**Table D.5**

**Agricultural Net Margin & Net Incremental Benefit: Present, FWO & FW Scenarios  
(million Taka)**

Crops	Market Price			Net Incremental Benefit	Economic Price			Net Incremental Benefit
	Present	FWO	FW		Present	FWO	FW	
Loc B Aus	6.91	6.70	7.18	0.48	7.17	6.95	7.36	0.42
Loc T Aus	1.79	1.17	1.21	0.04	1.74	1.14	1.18	0.04
HYV T Aus	2.22	2.76	2.71	-0.06	2.04	2.54	2.49	-0.05
Loc B Aman	0.33	0.33	0.00	-0.33	0.36	0.36	0.00	-0.36
Loc T Aman	35.79	30.78	33.86	3.08	39.82	34.77	35.86	1.10
HYV T Aman	26.05	29.57	67.95	38.38	27.02	30.43	67.88	37.44
Local/Imp Boro	30.84	32.43	31.06	-1.37	29.43	30.96	29.63	-1.32
HYV Boro	138.10	134.01	136.79	2.77	129.35	125.50	127.90	2.41
Wheat	0.66	1.02	1.08	0.06	1.46	2.04	2.16	0.12
Oilseeds	4.02	4.63	6.17	1.54	3.90	4.40	5.86	1.46
Jute	0.17	0.17	0.18	0.00	0.22	0.22	0.23	0.01
Vegetables	2.75	3.49	5.29	1.80	2.96	3.68	5.58	1.90
Spice	0.17	0.55	0.83	0.28	0.29	0.65	0.98	0.33
Sugarcane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>					245.80	243.70	287.10	43.49

Source: Derived from Appendix Table 2 times Appendix Tables 7-8-9.



### D.5.8 Impacts

The agricultural sector will realize the largest impact from the project, mostly from increases in aman crop production during the Kharif II monsoon season. In the monsoon season, benefits will be achieved in the FW project situation due to: i) gains from earlier (i.e., more timely) planting of late (LT) and HYV Aman; ii) intensification of production by switching from broadcast and local transplanted LT aman to HYV aman rice varieties; and, iii) higher long term overall average yields due to reduced flood losses. In the rabi season, improved drainage may protect the irrigated boro crop from damage and facilitate crop intensification through more extensive cultivation of boro rice and rabi season crops. In addition, young aus seedlings will be protected from pre-monsoon rainfall run-off and waterlogging.

During the Kharif II season, crop production will increase by approximately 43 percent. The impact on rice production in the aus and rabi seasons is comparatively very low; production is expected to increase by about 1 percent in each season. However, the project will have considerable impact on the production of non-rice rabi crops which are expected to increase by nearly 47 percent. This increased crop diversification is also considered a benefit of the project.

The project is expected to increase rice crop production from 67,260 MT (FWO) to 77,200 MT FW or 9,942 MT ( 14.8 percent) and non-rice crop production from 3,544 MT to 5,022 MT or 1,478 MT (41.7 percent) per year. The cropping intensity increases by 4 percent from 1.94 to 2.02. It is also expected that the project will have a considerable impact on the adoption of HYV rice. The ratio of the area under local rice varieties to HYV rice is expected to change from a 60: 40 ratio to a 40: 60 ratio in the FW project scenario.

Additionally, the project will have a considerable impact on agricultural employment in the region. Due to increases in cropping intensity, the demand for labour per hectare of land should increase from an average of 126 to about 137 person days (or 8.7 percent) per annum. Total agricultural employment in the project area is expected to increase from 3.03 million person days to 3.41 million person days per year.

All of these calculations ignore the probability that some flooding is still going to occur, albeit rarely, because of both external (river-flooding) and internal (rainfall) events. To account for this likelihood, all of the preceding projections regarding production and employment should be deflated by about eleven percent (see Section D.5.9).

Additional details regarding the anticipated on-farm impacts are provided in Section D.11 following.

### D.5.9 Adjustments to Increased Agricultural Benefits

There are three required downward adjustments to the basic estimate of Tk. 43.49 million/year calculated previously. These are:

- The project is designed to give protection against (externally-generated) monsoon floods for a 1:20 year return period. Thus, it is probable that during the 30-year project period the entire crop might still be completely destroyed about 1.5 times. This is mathematically equivalent to a loss of about 5 percent of the incremental net benefit/annum.

- The drainage system has only been designed for a 1:5 year rainfall. This “internal event”, therefore, will still generate additional flooding 20 percent of the time irrespective of the flood control measures here being considered. It is expected that this will effectively destroy about 30 percent of the crop affected in this manner. This is mathematically equivalent to about 6 percent of the incremental net benefit/annum.
- Thirdly, it is mandatory to account for the farm management adjustment process that will gradually take place after the project is operational. With improved flood control, farmers will only gradually adjust their crop production practices to take advantage of the new opportunities available to them. This is often referred to as the S-shaped adoption process. The FPCO *Guidelines* stipulate that we should expect full crop benefits to only be achieved by the end of Year 8. Incremental net benefits are expected to climb ( linearly) 20 percent per year through Years 4,5,6,7,and 8.

These probabilistic and behavioural imperatives are not discretionary “adjustments” to the preceding calculations. They are inherent to the most-likely Base Case scenario, as summarized in Table D.6 following.

**Table D.6**

**Simulated Annual Net Incremental Agricultural Benefit  
Base Case - Final Estimate**

	Annual Net Incremental Benefit			
	Rice (ton)	Non-Rice (ton)	Net Economic (mtk)	Employment (mpd)
Non-Probabilistic Estimate	9,942	1,478	43.49	0.38
Less Damage from Residual External Flood Probability (5%)	-497	-74	-2.18	-0.02
Less Damage from Residual Internal Flood Probability (6%)	-597	-89	-2.61	-0.02
Base Case - Annual Incremental Benefit	8848	1,315	38.70	0.34



## D.6 Fisheries

### D.6.1 Market & Economic Prices

Wholesale market fish prices are taken from FAP 17 *Fisheries Study and Pilot Project: Fish Marketing & Prices* (June 1994). Market prices were deflated to 1991 constant prices as prescribed in the *FPCO Guidelines*. The *Guidelines*' standard conversion factor has been used to determine the economic prices (see Appendix Table 17).

Harvest costs have been determined for both the open-access capture and pond culture fisheries (again see Appendix Table 17). These costs have been taken as constant. This is not an entirely satisfactory approach because variable (i.e., direct) costs are inversely related to the amount of fish available for harvest; for instance, as fish stocks increase the variable cost declines and, as fish stocks decrease then the variable cost increases, reflecting the demand for more labour and gear resources to chase declining fish stocks. This marginal increase/decrease in harvest costs has not been reflected in the analysis.

### D.6.2 Habitat Areas & Production Parameters

The present, FWO and FW analysis is based on primary data collection efforts including the NERP "Fishing Effort Survey" and the "Catch Assessment Survey" which was conducted in the Dampara Project area over a twelve month period. The respective habitat areas (floodplain & beel, river, and culture ponds) and corresponding production parameters used in the subsequent analysis are given in Appendix Table 18.

#### *Floodplain & Beel Fisheries*

There has been a downward trend of between 3 to 5 percentage points per annum in relation to fisheries production for the open access common fisheries resources in Bangladesh. It has been assumed that this trend is likely to continue unless there are strong mitigation measures taken by the Government of Bangladesh. Consequently, in the FWO and FW situation, a steady decline of 3 per cent per year is expected for all land classes (F0 thru F3) for the duration of the project period (Year 30). The resulting estimates of fishery production per hectare for each land class over the 30 year period under FWO and FW conditions are given in Appendix Tables 19 and 20, respectively.

#### *Riverine Fisheries*

A downward trend in riverine fish production is also anticipated for both FWO and FW situation at a rate of 3 percentage points per annum over the 30 year life of the project (again see Appendix Tables 19 and 20).

#### *Cultured Pond Fisheries*

There are presently 85.0 hectares of flood-free pond and 35.0 hectares of flood-prone pond culture fisheries in the Greater Dampara Project area. Following the present trend in the IDA-funded Kangsha River Project area, it is expected that there will be a gradual increase in "flood-free" pond culture fisheries during the next ten years under the FWO project situation. It is expected that the area of "flood-free" pond culture fisheries will gradually climb to 135 hectares over the next ten years. This would represent a 1.64 percent increase per annum (see Appendix Table 21).



Under the FW project scenario, all 35.0 hectares of flood-prone pond culture fisheries would become flood-free ponds by Year 4 of project implementation. A survey conducted in the IDA-funded Kangsha River Project area revealed that flood control interventions increased the total pond area by around 200 percent over a ten year period following project implementation. The project analysts expect a similar level of development to take place in the Dampara project area for the FW situation. Consequently, it has been assumed that there will be a 150 percent increase in flood-free pond area over a ten year period which will then stabilize at 180 hectares of flood-free pond culture fisheries by Year 14 of the FW project cycle. This would represent a 4.14 percent increase per annum from Year 4 - 14 and stabilizing in Year 14 (Appendix Table 21).

### D.6.3 Fishery Production

Anticipated annual total production for each type of habitat for both the FWO & FW scenarios are obtained by multiplying the projected area under each habitat with the corresponding projected unit production levels for the respective habitat per hectare of area. Total production from open-access fisheries represents the aggregate of floodplain and beel production, and river production. Total production from cultured fisheries consists of production from both flood-free and flood-prone ponds. The incremental production represents the total expected change in fisheries production between FW and FWO (Appendix Table 22).

### D.6.4 Fishery Gross Revenue & Costs

Applying market and economic prices (Appendix Table 17) to the anticipated FW and FWO production situations (Appendix Table 22) yields the projected gross revenue generated from fisheries production (Appendix Table 23).

Production costs are calculated by multiplying the unit area costs (Appendix Table 17) by the respective fishery areas (Appendix Tables 19 to 22).

### D.6.5 Fishery Net Returns & Incremental Net Benefits/Disbenefits

Net returns are obtained by subtracting the harvest costs from total revenue (Appendix Table 23) and are given in Appendix Table 24. The annual incremental benefit (disbenefit) to fisheries is obtained by subtracting the projected net return for the FWO situation from that of the FW situation. These estimates for both captured and cultured fisheries are summarized in Table D.7.

### D.6.6 Impacts

The results show that the floodplain and beel fisheries production is reduced over the years in both the FW and FWO situations. (Appendix Table 23) However, in the FWO situation the reduction in production is due to an anticipated general decline of 3 percent per year in the fisheries resource (i.e., a trend reflected throughout Bangladesh) while in the FW scenario the loss in *open-access* fisheries is accentuated due to i) a contraction of feeding areas; and, ii) a shift towards more low-yielding fish habitat (i.e.,  $F_0$  land type, with  $< .30$  meters of flood waters). In the *present* situation,  $F_2$  land areas return the highest catch per unit of effort (CPUE) but these areas will be reduced from 2,250 ha. to 603 ha. in the FW situation.  $F_0$  land areas which return the lowest CPUE in the *present* situation will increase from 6,000 ha. to 9,000 hectares. Anticipated changes in the respective *land areas* represent the main cause in the reduction of the fishery resource although, a reduction in the feeding area by 978 ha. is also a contributing factor.

Table D.7

**Incremental Net Benefits/Disbenefits to Fisheries in Market & Economic Prices**  
(million Taka)

Year	MarketPrice			Economic
	Capture	Culture	Total	Total Fisheries
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	-8.32	0.00	-8.32	-7.24
4	-8.05	0.60	-7.45	-6.48
5	-7.79	0.70	-7.09	-6.17
6	-7.53	0.80	-6.73	-5.86
7	-7.29	0.91	-6.38	-5.55
8	-7.05	1.02	-6.02	-5.24
9	-6.81	1.14	-5.67	-4.93
10	-6.59	1.27	-5.32	-4.63
11	-6.37	1.44	-4.93	-4.29
12	-6.16	1.62	-4.54	-3.95
13	-5.95	1.81	-4.14	-3.61
14	-5.75	1.81	-3.94	-3.43
15	-5.56	1.81	-3.75	-3.26
16	-5.37	1.81	-3.56	-3.10
17	-5.19	1.81	-3.38	-2.94
18	-5.01	1.81	-3.21	-2.79
19	-4.84	1.81	-3.03	-2.64
20	-4.68	1.81	-2.87	-2.49
21	-4.52	1.81	-2.71	-2.35
22	-4.36	1.81	-2.55	-2.22
23	-4.21	1.81	-2.40	-2.09
24	-4.06	1.81	-2.25	-1.96
25	-3.92	1.81	-2.11	-1.83
26	-3.78	1.81	-1.97	-1.71
27	-3.65	1.81	-1.84	-1.60
28	-3.51	1.81	-1.71	-1.48
29	-3.39	1.81	-1.58	-1.37
30	-3.27	1.81	-1.46	-1.27

Source: Appendix Table 24



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Conversely, the simulations indicate that there should be a net benefit accruing to pond culture fisheries as early as FW Year 4. This is due to the fact that all the 35 hectares of flood-prone ponds become flood-free ponds. Moreover, flood control interventions accelerate an increase in the pond area as noted in the IDA-funded Kangsha River project area. However, production gains from pond culture fisheries do not totally offset the substantial losses accruing to the open access captured fisheries resource base. The net result is that there will most likely be disbenefits in the fisheries sector from the first year of the implementation of the project (i.e., Year 3) which will continue throughout the economic life of the project.

## D.7 Non-Agricultural Infrastructure Benefit

In the present situation flood damage occurs not only to standing crops and livestock but also to stock resources. Flood damage to stock resources includes the following:

- damage to infrastructure (including roads, railways, bridges, culverts and hydraulic structures)
- damage to public and private buildings, houses and installations, including industrial and commercial premises, equipment and supplies.

### D.7.1 Data Sources

Data were collected from the Local Government & Extension Division (LGED), Department of Agricultural Extension/Ministry of Agriculture (DAE/MOA), Bangladesh Railway (BR), Bangladesh Water Development Board (BWDB) and Thana Union offices in the project area for the following years:

- i) 1988 with a probability of a 1:25 year return period;
- ii) 1991 with a probability of a 1:2 year return period;
- iii) 1993 with a probability of a 1:20 year return period; and
- iv) 1995 with a probability of a 1:10 year return period.

In a number of cases, however, flood damage data collected from GOB offices was found to be grossly inflated when compared with other secondary sources—including World Bank 1991 *Cyclone Damage Report*, *Jamalpur Priority Project Study* (January 1993), and NERP engineering information. Necessary adjustments were made where such inflated values were detected. Sectoral deflators published by the Bangladesh Bureau of Statistics (BBS) were then used to summarize all damage estimates in terms of constant 1991 prices. These estimates are summarized in Appendix Table 25.

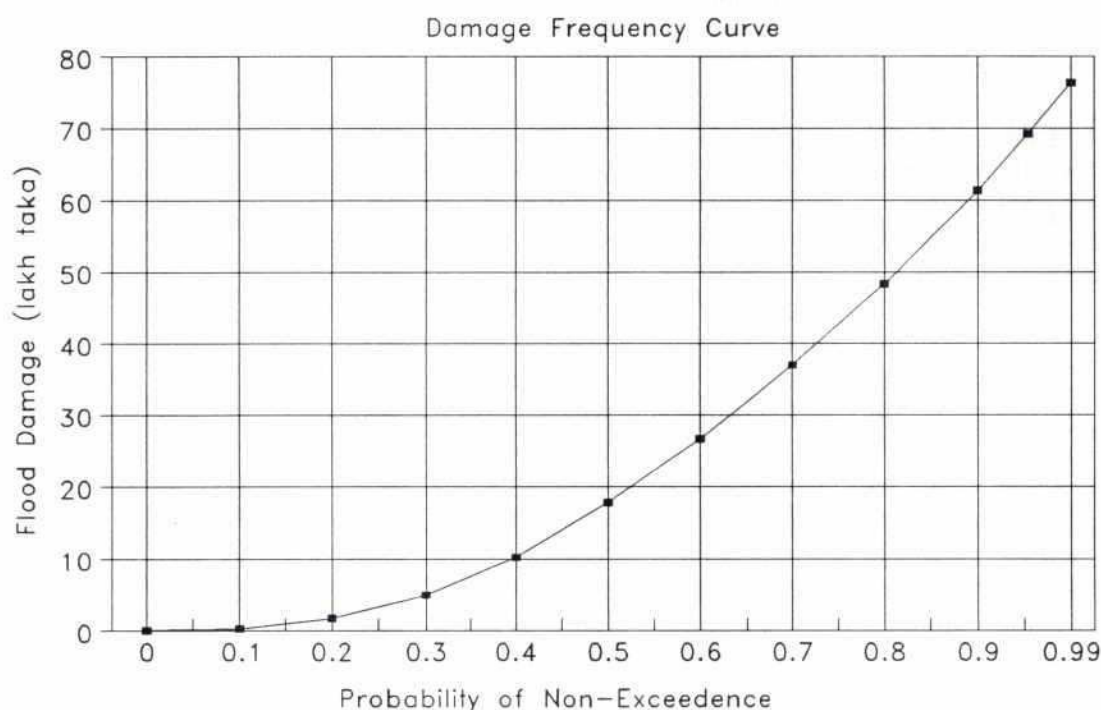
The 1993 flood damage estimates were found to be very inconsistent with the expected 1:20 year estimates and therefore were not employed in the analyses conducted immediately following. This anomaly lies in the methodology. The main difficulty lies in attempting to assign a return period to the reference years which is based only on the level of water in the sample sites during flood. The complexity of the flood phenomenon and the multiplicity of the causes of damage—including depth of water in the rivers, discharges and water speed, local rainfall, duration of flood peaks, dates of occurrence of floods in the cropping calendar, etc.—are all reasons for the difficulty in conducting a statistical analysis of the flood damages in Bangladesh and elsewhere.



### D.7.2 Calculation of Mathematical Expectation of Damage

Flood damage data for the 1991, 1995 and 1988 year time series were used to determine the mathematical expectation of annual flood damage as per the FPCO *Guidelines*. The horizontal scale of Figure D.1 (see following) depicts the average frequency of occurrence, and the vertical scale gives the damage valuation in Taka. A smooth curve is drawn through these points and extended in both directions. This curve can be approximated by the use of a quadratic equation of the form  $y = a + bx + cx^2$  where  $y$  is the estimated flood damage,  $x$  is the average frequency of occurrence, and  $a$ ,  $b$ , and  $c$  are the parameters to be estimated. An OLS regression was then run using the data available for 1991, 1995, and 1988 to estimate the respective parameters (Table D.8).

**Figure D.1**  
**Non-Agricultural Damage -Flood Frequency Curve**



On this basis, it is then possible to estimate flood damage costs associated with different flood frequencies by substituting various frequency return periods into the estimated quadratic equation. These estimates are summarized in Column [3] of Table D.9 below and illustrated graphically in accompanying Figure D.1.

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**Table D.8**  
**Estimation of Damage-Frequency Curve Using Regression**  
**Analysis:  $y = a + bx + cx^2$**

Year	y (flood damage)	x (Probability of Flood)	$x^2$
1991	19.51	0.50 (1:2 year)	0.25
1995	51.42	0.90 (1:10 year)	0.81
1988	79.16	0.96 (1:25 year)	0.92
Regression Output	Constant (a)	x coefficient (b)	$x^2$ coefficient (c)
	0.51	-10.14	86.70

Source: Appendix Table 26. (Note: 1 Lakh = 100,000)

**Table D.9**  
**Estimated Annual Flood Damage for Various Flood Frequencies**  
**(lakh Taka)**

Flood Year	Frequency (non-	Estimated	Cost & Frequency	Cumulated Cost
	0.0		0.03	
	0.1	0.36	0.10	0.03
	0.2	1.94	0.35	0.13
	0.3	5.27	0.77	0.48
	0.4	10.32	1.36	1.25
1991	0.5 [1:2]	17.11	2.12	2.61
	0.6	25.63	3.06	4.73
	0.7	35.89	4.17	7.79
	0.8	47.88	5.46	11.96
1995	0.9 [1:10]	61.61	3.27	17.42
1993	0.95 [1:20]	69.12	0.70	<b>20.69</b>
1988	0.96 [1:25]	70.68	1.45	21.39
	0.98 [1:50]	73.84	0.75	22.84
	0.99 [1:100]	75.45	0.38	23.59
	0.995 [1:200]	76.26	0.23	23.97
	0.998 [1:500]	76.74	0.08	24.20
	0.999 [1:1000]	76.91		24.28

Source: Column [ 3 ] is generated from the estimated quadratic equation, Table D.8.



### D.7.3 Value of Annual Non-Agricultural Flood Damage Protection Benefit

Integral calculus has been used to determine the surface area under the curve, as given by the cost and frequency differential values in Table D.9, Column [4]. The cumulative surface area (the summation of the values in Col. [4]) is indicated in Column [5].

The *Dampara Water Management Project* (DWMP) proposes construction of an embankment providing full-flood protection for a flood return period of 1:20 years (i.e., 95 per cent non-exceedance frequency). Further if it is assumed that only floods exceeding an average frequency of 0.5 (1:2 year return period) cause significant damage, then the surface area under the damage frequency curve between the frequencies 0.5 and 0.95 yield the mathematical expectation of annual damage. This is estimated to be equal to 1.95 million Taka/year (see Col. [5]).

It is expected that this will be the value of the annual non-agricultural flood damage protection benefit, beginning in Project Year 4. Thereafter, it is expected (according to the *FPCO Guidelines*) that this capital stock (and thus the damage incurred to this capital) would grow at an annual rate of approximately 3 percent per year for the duration of the economic life of the project, i.e. 30 years. These are the estimates utilized in the economic benefit-cost analysis conducted in Section D.10 following.

### D.8 Navigation

The Kalihar Channel is the only navigational route in the Dampara Water Management Project (DWMP) area. The 1995 NERP "Boat Traffic Survey" indicated that approximately 1,060 metric tonnes of cargo are transported through this route.

The DWMP will close the Channel with a drainage regulator so that it will then be necessary to transfer cargo across this structure. The additional trans-shipment cost incurred is estimated to amount to a relatively modest Taka 26,500 per annum (i.e. 25.00 taka/MT) throughout the 30 year economic life of the proposed project. These additional transfer costs are a disbenefit in the FW project situation.

### D.9 Homestead Gardens, Agroforestry & Wetland Resources

The proposed project would have substantial positive impacts for homestead gardens and agroforestry resources by offering increased security against flood damage. Under *present* conditions, approximately 98 percent of homestead trees are vulnerable to flood damage. People are presently reluctant to plant tree saplings around their homesteads because of the likelihood of flood damage.

In the flood-prone area, the present annual production for homestead gardens and agroforestry is approximately Taka 100,000 and Taka 152,000 per hectare respectively. (Table D.10). Survey results indicate annual production from these resources generally increases to about Taka 130,000 and Taka 170,000 in flood-free areas. At the same time, in the FW situation it is expected that 24 hectares of homestead gardens and 2 hectares of agroforestry resources will be required for construction of the flood control embankment. This is a very real offsetting cost.

In the case of wetland resources, an incremental decrease between the FW and FWO scenarios of Taka 155,300 in 1991 constant economic prices is expected.. Decreasing wetland production

appears to be a natural devolution rather than symptomatic of implementation of the Dampara Water Management Project.

The net result is that at project maturity the expected flood protection benefits attributable to homestead gardens, agro-forestry and wetland resources are expected to eventually amount to about Taka 2.2 million per year. This would arise in Year 13; ten years after the flood control measures are in place. These calculations are all summarized in accompanying Table D.10.

## **D.10 Economic Analysis**

### **D.10.1 Introduction**

The economic analysis of a project measures its effect on the economic or allocative efficiency of the whole economy. The economic analysis of a project differs from the financial analysis in the sense that the latter focuses on the money profits accruing to individual farmers, fisherman and firms based on market costs. Rather than market prices, economists use shadow (or efficiency) prices that reflect opportunity costs (i.e., the benefit forgone by using a scarce resource for one purpose instead of its next best alternative use). The economic analysis includes the valuation of externalities wherever practical.

In this project analysis, costs and benefits are identified which arise from the *future with* (FW) project scenario compared to the situation as it would be in the *future without* (FWO) project situation. The difference is the net incremental benefit arising from the project investment. Accordingly, the most basic economic criterion for accepting a project compares the FWO and FW costs and benefits to ensure that the net present value (NPV) of benefits is positive. All incremental benefits and costs are defined as the difference between what would occur in the FWO and FW situations once the project has been implemented.

The economic decision-making criteria employed are Net Present Value (NPV) and Economic Internal Rate of Return which are defined in Section D.2.

### **D.10.2 Rate of Discount**

The appropriate discount (or interest) rate reflects the opportunity cost of money to the national economy. The FPCO *Guidelines for Project Assessment* (May 1992) indicates the economic analysis should use a real discount rate of 12 per cent to estimate the net present value (NPV) of the benefit-cost stream. "Real" means excluding inflation. Accordingly, a project with a positive NPV using a 12 per cent discount rate can be considered a viable project and, similarly, a project which is calculated to have an economic internal rate of return in excess of 12 percent would likewise be considered a viable project.





Table D.10

## Estimated Impacts on Homestead Gardens, Agro-Forestry &amp; Wetland Resources

Resource	Scenario	Area (ha)	Impacted Area (ha)	Per Hectare Annual Return 1995 Taka Price	Annual Return (million Taka)		Annual Benefit/Disbenefit (million Taka)			Present Value (million Taka)
					1995 Prices	1991 Prices	1995 Prices	1991 Prices	1991 Econ.Prices	
Homestead Garden	Present	300								
	FWO	300	200	100,000	20.00	17.42				
	FW	279	176	130,000	22.88	19.93	2.88	2.53	2.20	
Agroforestry	Present	50								
	FWO	50	30	152,000	4.56	3.97				
	FW	45	28	170,000	4.76	4.15	0.20	0.18	0.15	
Winter Wetland	Present	855								
	FWO	860	860	300	0.26	0.22				
	FW	787	787	300	0.24	0.21	-0.022	-0.019	-0.017	
Summer Wetland	Present	2048								
	FWO	2048	2048	300	0.61	0.54				
	FW	1438	1438	300	0.43	0.38	-0.18	-0.16	-0.14	
Homestead Garden and Agro-forestry Sub-Total					Homestead Garden and Agro-forestry Sub-Total			2.36		18.97
Wetland Resources Sub-Total					Wetland Resources Sub-Total			-0.16		-1.24
Total					Total			2.2		17.73

### **D.10.3 Period of Analysis**

The *FPCO Guidelines* indicate that planners are to use a 30-year project cycle for the discounting period. Unlike the FPCO Guidelines, the NERP economists have stipulated Year 1 as the initial implementation year rather than Year 0. Gittinger (1982:95) suggests that the discount process used in discounted cash flow analysis implicitly assume that every transaction falls at the end of the accounting period. This is simply accomplished if we consider the initial investment to take place at the end of Year 1 of the project, regardless of whether it will actually take a full year or only a few months.

### **D.10.4 Residual Value**

The residual value of the project is generally added to the benefit stream in the last year of the project. It is often taken to be the "resale value" of remaining assets. The residual value of project facilities in the FW situation are ignored in this analysis because their discounted residual value is minimal by the end of the project (i.e., Year 30).

### **D.10.5 Land Acquisition Cost**

The financial land acquisition cost has not been included in the economic analysis because land taken out of production by the project is, instead, valued in terms of the annual production foregone.

### **D.10.6 Economic Cost-Benefit Stream**

The economic cost-benefit stream of the proposed project is given in Table D.11. The cost stream consisting of capital and O&M costs for the proposed project is taken from Section D.4 and Appendix Table 1.

The benefit stream for agriculture has been developed according to text Table D.6. The estimated benefit/disbenefit stream for the fisheries sector has been taken from text Table D.7.

The stream of non- agriculture/fisheries flood damage benefits has been developed by multiplying the annual expected flood damage benefit of Taka 1.94 million, beginning in Year 4, by an annual 3 percent growth factor for Years 5 through 30. (see Table D.9).

The anticipated disbenefit to the navigation sector is assumed to be a constant figure of Taka 23,000 per annum over the 30-year life period of the project. (see Section D.8). The expected benefit stream for Gardens, Agro-Forestry, & Wetland Resources has been constructed assuming that the full benefit will only be achieved at the end of Year 14; climbing approximately 10 per cent per year during the preceding Years 4 through 13 (see Table D.10 for full-benefit estimate).

The projected incremental net benefit stream of the project has been calculated by subtracting the cost stream from the benefit/disbenefit stream.



Table D.11: Economic Cost-Benefit Stream: Base Case (million Taka)

Year	Cost		Total Cost		Benefit/Disbenefit						Total Benefit		Net Benefit	
	Capital	O&M	Nominal	Discount	Crop	Fisheries	Infrastruc	Navigati	Agro-		Nominal	Discount	Nominal	Discount
1	.85	0.00	0.85	0.76	0.00	0.00	0.00	0.00	0.00		0.00	0.00	-0.85	-0.76
2	11.62	0.00	11.62	9.26	0.00	0.00	0.00	0.00	0.00		0.00	0.00	-11.62	-9.26
3	13.32	1.17	14.49	10.31	0.00	-7.24	0.00	-0.02	-0.16		-7.42	-5.28	-21.91	-15.59
4	0.00	1.79	1.79	1.14	7.74	-6.48	1.94	-0.02	0.08		3.26	2.07	1.48	0.94
5	0.00	1.79	1.79	1.01	15.48	-6.17	2.00	-0.02	0.32		11.61	6.59	9.82	5.57
6	0.00	1.79	1.79	0.91	23.22	-5.86	2.06	-0.02	0.55		19.95	10.11	18.17	9.20
7	0.00	1.79	1.79	0.81	30.96	-5.55	2.12	-0.02	0.79		28.30	12.80	26.51	11.99
8	0.00	1.79	1.79	0.72	38.70	-5.24	2.19	-0.02	1.02		36.65	14.80	34.86	14.08
9	0.00	1.79	1.79	0.64	38.70	-4.93	2.25	-0.02	1.26		37.25	13.43	35.46	12.79
10	0.00	1.79	1.79	0.58	38.70	-4.63	2.32	-0.02	1.49		37.86	12.19	36.07	11.61
11	0.00	1.79	1.79	0.51	38.70	-4.29	2.39	-0.02	1.73		38.50	11.07	36.72	10.56
12	0.00	1.79	1.79	0.46	38.70	-3.95	2.46	-0.02	1.96		39.15	10.05	37.37	9.59
13	0.00	1.79	1.79	0.41	38.70	-3.61	2.54	-0.02	2.20		39.80	9.12	38.02	8.71
14	0.00	1.79	1.79	0.37	38.70	-3.43	2.61	-0.02	2.20		40.05	8.20	38.27	7.83
15	0.00	1.79	1.79	0.33	38.70	-3.26	2.69	-0.02	2.20		40.30	7.36	38.51	7.04
16	0.00	1.79	1.79	0.29	38.70	-3.10	2.77	-0.02	2.20		40.54	6.61	38.76	6.32
17	0.00	1.79	1.79	0.26	38.70	-2.94	2.86	-0.02	2.20		40.79	5.94	39.00	5.68
18	0.00	1.79	1.79	0.23	38.70	-2.79	2.94	-0.02	2.20		41.02	5.33	39.24	5.10
19	0.00	1.79	1.79	0.21	38.70	-2.64	3.03	-0.02	2.20		41.26	4.79	39.47	4.58
20	0.00	1.79	1.79	0.19	38.70	-2.49	3.12	-0.02	2.20		41.50	4.30	39.71	4.12
21	0.00	1.79	1.79	0.17	38.70	-2.35	3.21	-0.02	2.20		41.73	3.86	39.94	3.70
22	0.00	1.79	1.79	0.15	38.70	-2.22	3.31	-0.02	2.20		41.96	3.47	40.18	3.32
23	0.00	1.79	1.79	0.13	38.70	-2.09	3.41	-0.02	2.20		42.19	3.11	40.41	2.98
24	0.00	1.79	1.79	0.12	38.70	-1.96	3.51	-0.02	2.20		42.43	2.80	40.64	2.68
25	0.00	1.79	1.79	0.11	38.70	-1.83	3.62	-0.02	2.20		42.65	2.51	40.87	2.40
26	0.00	1.79	1.79	0.09	38.70	-1.71	3.73	-0.02	2.20		42.88	2.25	41.10	2.16
27	0.00	1.79	1.79	0.08	38.70	-1.60	3.84	-0.02	2.20		43.11	2.02	41.32	1.94
28	0.00	1.79	1.79	0.07	38.70	-1.48	3.95	-0.02	2.20		43.34	1.81	41.55	1.74
29	0.00	1.79	1.79	0.07	38.70	-1.37	4.07	-0.02	2.20		43.57	1.63	41.78	1.56
30	0.00	1.79	1.79	0.06	38.70	-1.27	4.19	-0.02	2.20		43.80	1.46	42.01	1.40
PV				30.44							164.42		NPV	133.98



### D.10.7 Net Present Value (NPV) and Economic Internal Rate of Return (EIRR)

The economic NPV of the incremental net benefit stream is equal to:

$$\begin{aligned} & \Sigma(\text{Discounted Annual Incremental Benefits}) \text{ less } \Sigma(\text{Discounted Annual Incremental Costs}) \\ & = B - C \\ & = 133.98 \text{ million Taka (Table D.11)} \end{aligned}$$

This discounted total is about 5 times the size of the initial economic investment. A positive and relatively large NPV estimate indicates that at least from an economic perspective the proposed *Dampara Water Management Project* appears to be a very feasible investment opportunity.

Similarly, the EIRR is defined as that discount rate (or interest rate) where:

$$\Sigma(\text{Discounted Annual Incremental Benefits}) = \Sigma(\text{Discounted Annual Incremental Costs})$$

That is, that discount rate where  $B = C$ .

The imputed EIRR is determined to be about 41.9 % per annum; much higher than the designated "cut-off" rate of 12 % per annum (Table D.11). This EIRR estimate once again emphasizes that the DWMP appears to be a very attractive economic investment opportunity.

### D.10.8 Qualifications

Because the estimated NPV & EIRR are relatively high, it is useful to also identify why this is the case. The principal reasons for this are the following:

1. Economic costs are relatively low because:
  - the proposed embankment is only on one side (not three);
  - two major drainage structures are already in place (and, thus, a "sunk cost");
  - the design includes virtually no "internal" structure, e.g. roads, bridges and cross-regulators, etc.
2. Agricultural benefits, at the same time, may be over-estimated with respect to:
  - a) flood damaged area yields; b) the extent or rate that cropping patterns will actually shift to HYV rice; and/or c) profit margin estimates.

A "worst case" scenario -- the potential downside (if any) to this proposed project -- is simulated in the Sensitivity Analysis conducted immediately following.

### D.10.9 Sensitivity Analysis

The economic analysis preceding is based on uncertain future events and imperfect data. Consequently, a sensitivity analysis must be conducted to systematically assess the reliability and robustness of the Base Case estimates calculated in Section D.10.8 above. It is particularly important to identify the benefit and cost items which have the greatest influence on the overall economics of the project, as well as the extent of their influence.



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The variables tested in the sensitivity analysis are:

1. The inclusion of the costs of two existing drainage structures if they had to be built. This cost is approximately 23 million Taka(1991 Market Price), assumed to have otherwise taken place in Year 2.
2. A 20% increase in capital and O&M costs
3. The exclusion of all benefits/disbenefits other than crop production benefits
4. Yield losses are 50% of Base Case Yields on damaged flood lands
5. Full agricultural benefits are achieved in 10 years (rather than 5)
6. Costs-of-production are inflated by 20%
7. Project implementation is delayed by 2 years

The implications of these changes on the NPV and EIRR are summarized in Table D.12 following:

**Table D.12**

**Summary of Sensitivity Tests**

<b>Item</b>	<b>NPV (Taka m. 1991)</b>	<b>EIRR (percent)</b>
BASE CASE	134.0	41.9
1. Sunk Costs Included (Tk 21 m; 1991)	112.7	30.1
2. Capital + O&M Costs Increase 20%	124.2	37.2
3. Exclusion of All Non-Crop Impacts	144.1	52.5
4. Damaged Flood Lands Yield Losses 50%	64.3	28.2
5. Full Ag. Benefits Delayed to 10 Yrs	93.9	29.5
6. Ag. Costs of Production Increase 20%	113.5	38.2
7. Project Implementation Delay by 2 Years	104.0	40.9
WORST CASE SCENARIO (Items 2-6)	30.5	20.3

These simulations highlight the following:

The very economical project design does enhance the EIRR considerably. Assuming the two existing drainage structures where current (rather than sunk) costs, for example, would drop the EIRR from 42%/annum to 30% per annum.

On the other side of the ledger, a similar negative impact would be expected if the projected agricultural benefits were not fully realized for 10 years after construction. The same general impact on the EIRR would be expected if, in fact, flood damaged crop yield losses are being greatly over-estimated.

At the same time, these sensitivities unambiguously highlight the fact that if it wasn't for the negative net impact on fisheries, this project would have an exceptionally high EIRR. In most cases, a positive Net Present Value of something of the order of 100 million Taka (in 1991 terms) should be expected and this would be about four times the cumulative project investment level.

The Worst-Case Scenario suggests that the lowest EIRR that we might expect is 20% per annum; almost double the 12% /annum requirement for project acceptance. A 20% EIRR would correspond to a positive NPV of about 30 million Taka which implies a real rate of return which is still two times the cumulative project investment level over a 30 year time frame.

These sensitivity tests generally reinforce the principal conclusion of the economic analysis conducted in the preceding. (Section D.10.7). That is:

**From an economic perspective, the proposed Dampara Water Management Project appears to be a very feasible and relatively low risk investment opportunity for the Government of Bangladesh.**

## **D.11 Financial Analysis**

There are two particularly important financial considerations:

1. Financial Impact on Project Beneficiaries
2. Financial Impact on Government

### **D.11.1 Project Beneficiaries**

Potential project beneficiaries in the project area are profiled in Table D.13. The principal project beneficiaries will be these 14,000 households who own cultivated land: small farms of about 1/3<sup>rd</sup> hectare; medium-sized farms which are about 1.5 ha. in size; and larger farms which average about 4 ha. in size. This is their average physical size; with a cropping intensity of about 2.0, the area actually cropped/annum is approximately twice this size. Crop budgets for each of these three farm sizes have been prepared in Appendix Tables 26-27 and summarized in accompanying Table D.14.



Table D.13: Potential Project Beneficiaries

Class	No. of Households		Cultivable Land Owned		Average Farm Size	Av. Annual HH Income <sup>1</sup>
	No.	%	ha	%	ha	Taka
Landless	7418	34.4	0	0	0	22,371
Small Farms	9466	43.9	2781	22.2	0.3	32,943
Medium Farms	3709	17.2	5686	45.4	1.5	55,491
Large Farms	970	4.5	4058	32.4	4.2	174,977
Total	21563	100%	12525	100%	0.9	42,577

<sup>1</sup> Kalni-Kushiyara Farm Household Survey.

Source: Dampara Farm Household Survey. (See Social Annex)

These farm budgets highlight the following:

- the proposed project should make a substantial difference to gross farm income (at project maturity), increasing small and medium-sized gross farm income by more than 20 percent;
- the projects' overall impact on total farm family income, however, is a function of how dependent they are on the farm as a source of total family income. The largest relative impact would be on medium-sized farms (16% increase) while the smallest relative impact would be on small farms (7%). Both small and large farms tend to rely more on other sources of income for their livelihood;
- incremental gross farm income/person would, at the same time, be highly skewed in favor of larger farmers. This is equally true of the incremental gross farm income/person day estimates. This is because of the relative size of the farms since, on a per-hectare basis, the change would actually be greater for small farmers; and,
- the overall change in the family labor required would be about 5 days/year for small farmers and 14 days/year for middle-sized farmers. It is estimated (see elsewhere) that perhaps 10% of this change would be a female labour requirement.

These estimates consider the cost of 6 month operating capital (at 17.5% interest) but ignore other possible lease, mortgage, or tax payments –all of which can also greatly affect financial well-being in the project area. At least one-third of all households have a land lease arrangement. *Rangjoma* is a leasing system where the cultivator pays a fixed rent in cash at the time of the contract. The current rate is about Taka 10,000 for single-cropped land and Taka 10,200-10,500 for double-cropped land. *Barga* is a system of share-cropping where the cultivator and the land-owner share the costs of seed, fertilizers and water equally and divide the output among them equally. Other costs including labour are borne by the cultivator. In addition, *bandhak* is a traditional mortgage system where land is provided as collateral when money is borrowed. The

Table D.14: Farm Budget Analysis, by Farm Size (Taka per Year)

Item	Small Farm (0.3 ha)			Medium Farm (1.5 ha)			Large Farm (4.0 ha)		
	Present	FWO	FW	Present	FWO	FW	Present	FWO	FW
Gross Value of Production	14309	14201	16759	62598	62662	74006	161695	161779	178813
Total Cash Costs	4215	4189	4596	23557	23569	26186	71231	71367	73774
Gross Farm Income	10094	10012	12162	39041	39093	47819	90464	90412	105039
Incre. Gross Farm Income <sup>1</sup>			2150			8726			14627
Total Family Income <sup>2</sup>	32943	32861	35011	55491	55543	64270	174977	174926	189552
Percent Change in Family Income		-0.2%	6.5%		0.1%	15.7%		0.0	8.4%
<b>Return per Family Member</b>									
Average No. in Family	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Gross Farm Income/person	1941	1925	2339	7508	7518	9196	17397	17387	20200
Incre. Gross Farm Income/Person			414			1678			2813
<b>Return to Family Labour</b>									
Family Labour (person days)	66	66	71	254	253	268	277	277	276
Gross Farm Income/Person Day	152	152	172	154	154	179	327	326	381
Incre. Gross Farm Income/Person Day			30			33			53

Percent of Households	44	17	5
Percent of Cultivable Land	22	45	32

<sup>1</sup> Base data in Appendix Tables 26, 27 and 28<sup>2</sup> Kalni-Kushiyara Household Survey



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lender then holds the right to cultivate the mortgaged land and gets all of the benefits from it until the loan is repaid. If one is not able to repay the loan within a stipulated period, the land is forfeited to the lender.

Although not illustrated in this static farm financial balance sheet, it must be noted that the proposed project will also *reduce income variability* and thus *enhance seasonal food security*. Despite not being quantified, this too is a very real on-farm financial benefit.

#### D.11.2 Government Receipts & Expenditures

There are two particular government concerns:

- Cost Recovery Potential
- Net Impact on Foreign Exchange

##### *Cost Recovery Potential*

Potential cost recovery is measured by:

$$CRI = T/E$$

where CRI = Cost Recovery Index; T = taxes and other charges on project beneficiaries; and E is project expenditures by government. The two important issues to be addressed when formulating a cost recovery policy are:

- 1) the proportion of the cost expended on a project to be repaid; and,
- 2) the proportion of the benefit received by individuals (which may be far higher than the cost) to be recovered through direct charges or increased taxes.

The financial analysis regarding projected crop production changes suggests that policy-makers could probably introduce a viable cost recovery policy for operation and maintenance of the proposed works. That is, if the additional financial income generated by the project is (say) 5,000 Taka per hectare per annum during Years 8-30 (as suggested in Table D.14 above) while the project O&M cost is 1.79 million Taka per year or 146 Taka per hectare of cultivated land, these O&M costs would only amount to about 3 percent of the incremental crop income. Crop farmers with land ownership should have the financial capacity to pay this amount.

##### *Net Impact on Foreign Exchange*

This analysis compares the foreign exchange requirements during project construction with the foreign exchange savings subsequently generated by the project. These savings would largely come from the production of additional food which would otherwise have to be imported.

#### D.12 Multi-Criteria Analysis

Finally, the FPCO *Guidelines* describe a methodology for assessing *impacts* accruing from the proposed DWMP implementation which cannot be based solely on the benefit-cost stream of the financial and economic analyses. Impacts that can only be quantified in physical terms or described qualitatively should also be taken into account in the decision making process. Multi-criteria analysis (MCA) provides a taxonomy and framework for including those impacts in a

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concise, standardized and comparable manner.

The MCA framework facilitates a direct comparison of the impacts of a project in economic, financial, quantitative and qualitative terms:

- Economics: Wherever possible, impacts are valued in monetary terms and incorporated into single-valued measures, including the economic internal rate of return (EIRR) and the net present value (NPV). (Section D.10 above)
- Financial Impacts: Considers financial impacts on beneficiaries and government. Focuses on income changes to beneficiaries. (Section D.11 above)
- Quantitative Impacts: Considers related parameters such as production, employment, risk, input requirements, etc.
- Qualitative Impacts: Indexes other relevant criteria such as: consistency with government objectives, income distribution, gender, externalities, environmental issues, and other quality-of-life issues. This employs an ordinal ranking, “+10” being the most beneficial impact, “0” being a benign impact, and “-10” being the most severe negative impact.

This is elaborated upon in the 'Main Report', Chapter 9.



## APPENDIX

Table 1: Capital Cost Investment and O &amp; M Cost Schedule

(In thousand taka.)

Capital Costs	Item	1995 Market Prices	Conversion Factor	1991 Economic Prices	Capital Cost Investment and O & M Cost Schedule (Economic Price)				
					Year 1	Year 2	Year 3	Year 4	Year 5 +
Capital Costs	Embankment								
	Earthwork in filling	11660.53	0.87	8883.43					
	Royalty of specified earth	2638.96	0.87	2010.46					
	Turfing	1711.50	0.87	1303.88					
	Dismantling & resoling of brick work	282.99	0.87	215.60					
	<b>Total</b>	<b>16293.98</b>	<b>0.87</b>	<b>12413.37</b>		6206.69	6206.69		
	Structure								
	Earthwork in excavation	17.27	0.87	13.16					
	Supply of pipes	126.99	0.87	96.75					
	Lean concrete	29.65	0.79	20.51					
	R.C.C. work	227.17	0.79	157.15					
	Reinforcement	118.25	0.75	77.66					
	Shuttering	39.71	0.65	22.60					
	CC Block	204.76	0.79	141.65					
	Sand & Khoo	26.81	0.87	20.42					
	Rehab. of Khatair Regulator	100.00	0.80	70.05					
	Steel gate	35.00	0.75	22.99					
	Wooden gate	0.50	0.87	0.38					
	LLP Inlet Structure	2598.00	0.79	1797.25		1220.15	1220.15		
	<b>Total</b>	<b>3524.00</b>		<b>2440.30</b>		1220.15	1220.15		
O & M Costs (per annum)	Channel: Closure & Diversion	2168.00	0.87	1651.67		496.00	1156.00		
	EMP construction (mitigation measures)	5340.00	0.87	4068.21		1627.29	2440.93		
	<b>Base Cost</b>								0.00
	Physical contingencies (15% of Base cost)	27325.98		20573.55		9550.12	11023.76	0.00	
	<b>Subtotal</b>								
	Engineering Design & Supervision Cost (9% of subtotal)	4098.90		3086.03		1432.52	1653.56		
	Land acquisition (not included in economic analysis)	31424.88		23659.58		10982.64	12677.33	0.00	
	<b>TOTAL</b>				851.74	638.81	638.81		
	Embankment (6% of cost)	20500.00		2129.36					
	Structure (3% of cost; includes two existing structures)	54753.12		25788.94					
	Channel (6% of cost)	977.64		744.80					
	EMP construction (5% of cost excluding homestead raising)	893.68		618.86					
	<b>Subtotal</b>								
	Physical Contingencies (15% of above)	120.00		91.42					
TOTAL COSTS	<b>TOTAL</b>	2121.40		1554.18					
		318.21		233.13					
		<b>2439.61</b>		<b>1787.31</b>					
					851.74485	11621.445	14490.249	1787.306	1787.306

\* Adjusted from 1995 market prices by employing the construction price index (Deflator = 0.875), BBS.

Source: Amur A (Engineering)



Table 2: Economic Prices of Agricultural Outputs

Crops	Main Product			By-Product			By Product Factor (MT/MT)
	Market (Tk/MT)	Conversion Factor	Economic (Tk/MT)	Market (Tk/MT)	Conversion Factor	Economic (Tk/MT)	
Loc B Aus	6074	0.88	5345	950	0.87	827	2
Loc T Aus	6074	0.88	5345	950	0.87	827	2
HYV T Aus	6074	0.88	5345	700	0.87	609	1
Loc B Aman	6438	0.88	5665	950	0.87	827	1
Loc T Aman	6438	0.88	5665	950	0.87	827	2
HYV T Aman	6438	0.88	5665	700	0.87	609	1
Loc/Imv L Boro	6212	0.88	5467	950	0.87	827	2
HYV Boro	6212	0.88	5467	700	0.87	609	1
Wheat	6312	1.29	8142	600	0.88	528	1
Oilseeds	13466	0.88	11850				
Jute	8012	1.06	8493	2550	0.87	2219	2
Vegetables	4461	0.87	3881				
Spice	9047	0.87	7871				
Sugarcane	1012	0.95	961				

Source : Guidelines for Project Assessment, Dhaka May 1992, FPCO,  
Water Development and Flood Control

Table 3: Economic Prices of Crop Inputs

Inputs	Market	Conversion Factor	Economic
Fertilizer (Tk/kg)			
Urea	4.58	1.45	6.64
TSP	5.4	1.88	10.15
MP	4.05	2	8.10
Seeds (Tk/kg)			
Loc B Aus	10.5	0.88	9.24
Loc T Aus	10.5	0.88	9.24
HYV T Aus	10	0.88	8.80
Loc B Aman	10	0.88	8.80
Loc T Aman	10	0.88	8.80
HYV T Aman	9	0.88	7.92
Loc/Imv L Boro	10	0.88	8.80
HYV Boro	10	0.88	8.80
Wheat	12	1.29	15.48
Oilseeds	19	0.88	16.72
Jute	24	1.06	25.44
Vegetables	400	0.95	380.00
Spice	600	0.87	522.00
Sugarcane	400	0.87	348.00
Irrigaion (Tk/ha)			
Traditional	1000	0.8	800.00
Modern	2000	0.8	1600.00
Others			
Labour (Tk/pd)	50	0.75	37.50
Bullock (Tk/bd)	45	0.87	39.15
Pesticide	504	0.87	438.48

Table 4: Present Crop Patterns by Land Type (ha)

Crop Pattern	F0	F1	F2	F3	Total
Mixed B. Aus and B. Aman	0	0	83.5	0	83.5
B. Aus-Rabi	42.1	48.4	81.8	94.5	266.8
B. Aus-HYV T. Aman	25.0	91.5	122.6	30.5	269.6
B.Aus-Local T. Aman	21.4	150.3	145.2	60.0	376.9
B. Aus-Local T. Aman-Rabi	4.7	44.8	5.7	1.5	56.7
B.Aus-HYV T. Aman-Rabi	80.6	21.5	12.6	0.0	114.7
Local T. Aus-Local T. Aman	148.6	0.0	0.0	0.0	148.6
Local T. Aus-Local T. Aman-Rabi	18.8	5.6	23.0	4.8	52.2
Local T. Aus-HYV T. Aman-Rabi	0.0	0.0	2.7	0.0	2.7
HYV T. Aus-Local T. Aman-Rabi	0.0	10.3	26.1	17.9	54.3
HYV T. Aus-HYV T. Aman-Rabi	9.7	17.3	48.9	32.9	108.8
Jute-Local T. Aman-Oilseed	2.1	7.9	0.0	0.0	10.0
Jute-Fallow	0.0	0.0	9.9	1.3	11.2
HYV Aman-Fallow	0.0	0.0	3.4	0.0	3.4
Local T. Aman-Fallow	1.3	20.4	12.4	43.2	77.3
Local T. Aman-Rabi	40.6	5.5	27.4	0.0	73.5
Loc T. Aman-Oilseed-Local/Improved Local Boro	0.7	3.9	13.3	2.9	20.8
Local T. Aman-Oilseed-HYV Boro	5.6	47.3	25.9	11.4	90.2
HYV T. Aman-Oilseed-HYV Boro	1.9	45.8	103.1	9.2	160.0
HYV T. Aman-Oilseed-Local/Improved Local Boro	0.0	0.0	2.2	0.0	2.2
HYV T. Aman-HYV Boro	359.7	352.3	1057.2	924.0	26;3.2
HYV T. Aman-Loc/Improved Loc Boro	0.0	0.0	107.5	80.0	187.5
Local T. Aman-HYV Boro	8.0	262.5	1700.3	2701.8	4672.6
Local T. Aman-Loc/Improved Loc Boro	0.0	170.1	986.0	625.8	1781.9
HYV Boro-Fallow	0.0	6.7	1.9	231.7	240.3
Local/Improved Local Boro-Fallow	4.5	4.4	103.3	822.4	934.6
Vegetables	0.0	1.8	2.3	25.4	29.5
Sugarcane	0.0	0.4	0.0	0.0	0.4
Fallow	1.4	0.0	0.0	0.0	1.4
<b>Total</b>	<b>776.7</b>	<b>1318.7</b>	<b>4708.2</b>	<b>5721.2</b>	<b>12524.8</b>





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Table 5: Projected Crop Patterns - Future Without Project (ha)

Crop Pattern	FO	F1	F2	F3	Total
Mixed B. Aus and B. Aman	0.0	0.0	83.5	0.0	83.5
B. Aus-Rabi	35.1	48.4	81.8	94.0	259.3
B. aus-Local T. Aman	17.9	147.6	145.2	60.0	370.7
B. Aus-Local T. Aman-Rabi	4.0	44.8	5.7	1.5	56.0
B. Aus-HYV T. Aman	21.0	89.8	122.6	30.2	263.6
B. Aus-HYV T. Aman-Rabi	67.3	21.5	12.6	0.0	101.4
Local T. Aus-Local T. Aman	83.8	0.0	0.0	0.0	83.8
Local T. Aus-Local T. Aman-Rabi	15.8	5.6	23.0	4.8	49.2
Local T. Aus-HYV T. Aman-Rabi	0.0	0.0	2.7	0.0	2.7
HYV T Aus-Local T. Aman-Rabi	40.5	10.3	26.1	17.9	94.8
HYV T Aus-HYV T. Aman-Rabi	8.1	17.3	48.9	32.9	107.2
Jute-Fallow	0.0	0.0	9.9	1.3	11.2
Jute-Local T. Aman-Oilseed	1.7	8.1	0.0	0.0	9.8
HYV Aman-Fallow	0.0	0.0	3.4	0.0	3.4
Local T. Aman-Fallow	1.1	20.4	12.4	43.2	77.1
Local T. Aman-Rabi	34.0	5.3	27.4	0.0	66.7
Local T. aman-Oilseed-Local/Improved Local Boro	0.6	33.9	13.3	2.9	50.7
Local T. aman-Oilseed-HYV Boro	4.7	17.3	25.9	11.4	59.3
HYV T. Aman-Oilseed-HYV Boro	1.5	45.8	103.0	9.2	159.5
HYV T. Aman-Oilseed-Local/Improved Local Boro	0.0	0.0	2.2	0.0	2.2
HYV T. Aman-HYV Boro	300.9	415.3	1356.0	923.0	2995.2
HYV T. Aman-Local/Improved Local Boro	0.0	0.0	107.5	80.0	187.5
Local T. Aman-HYV Boro	6.7	90.0	1372.0	2699.6	4168.3
Local T. Aman-Local/Improved Local Boro	0.0	265.4	1012.1	477.5	1755.0
HYV Boro-Fallow	0.0	6.7	1.9	236.7	245.3
Local/Improved Local Boro-Fallow	3.8	4.4	103.2	970.7	1082.1
Vegetables	0.0	1.8	2.3	25.4	29.5
Sugarcane	0.0	0.4	0.0	0.0	0.4
Fallow	1.4	0.0	0.0	0.0	1.4
Total	650.0	1300.0	4705.0	5722.0	12377.0



Table 6: Projected Crop Patterns - Future With Project (ha)

Crop Pattern	FO	F1	F2	F3	Total
B. Aus-Rabi	187.9	11.1	11.2	0.0	210.2
B. Aus-HYV T. Aman	161.3	13.6	0.0	0.0	174.9
B. aus-Local T. Aman	247.1	10.5	28.3	21.6	307.5
B. aus-Local T. Aman-Rabi	115.6	15.7	1.8	0.0	133.1
B. Aus-HYV T. Aman-Rabi	301.6	0.0	0.0	0.0	301.6
Local T. Aus-Local T. Aman	81.6	0.0	0.0	0.0	81.6
Local T. Aus-local T. Aman-Rabi	41.7	1.8	0.0	0.0	43.5
Local T. Aus-HYV T.Aman-Rabi	7.6	0.0	0.0	0.0	7.6
HYV T Aus-Local T. Aman-Rabi	44.1	33.5	1.0	0.0	78.6
HYV T Aus-HYV T. Aman-Rabi	108.0	7.0	1.2	0.0	116.2
Jute-local T. Aman-Oilseed	1.8	18.4	0.0	0.0	20.2
Jute-local T. Aman	0.0	0.0	1.3	0.0	1.3
HYV Aman-Fallow	3.3	0.0	0.0	0.0	3.3
Local T. Aman-Fallow	20.4	0.0	9.7	0.0	30.1
Local T. Aman-Rabi	68.4	0.7	30.1	0.0	99.2
Local T.aman-Oilseed-Local/Improved Local Boro	17.7	31.5	0.0	0.0	49.2
Local T.aman-Oilseed-HYV Boro	30.5	28.0	0.0	0.0	58.5
HYV T. Aman-Oilseeds-HYV Boro	164.7	0.0	0.0	0.0	164.7
HYV T. Aman-Oilseeds-Local/Improved Local Boro	73.0	0.0	0.0	0.0	73.0
HYV T. Aman-HYV Boro	3825.1	778.8	251.9	99.9	4955.7
HYV T. Aman-Local/Improved Local Boro	329.9	139.6	43.4	8.9	521.8
Local T. Aman-HYV Boro	1361.9	273.8	501.9	251.6	2389.2
Local T. Aman-Local/Improved Local Boro	1304.3	164.0	188.6	97.6	1754.5
HYV Boro-Fallow	6.7	24.6	42.4	79.5	153.2
Local/Improved Local Boro-Fallow	5.4	21.3	210.7	294.9	532.3
Vegetables	5.0	8.4	15.6	0.0	29.0
Sugarcane	0.4	0.0	0.0	0.0	0.4
Fallow	1.4	0.0	0.0	0.0	1.4
Total	8516.4	1582.3	1339.3	854.0	12292.0



Table 7 : Present Production; Main Product and By-Product

Crop	Main Product								By - Product	
	Damage Free Area			Damaged Area			Total		Factor (mt/mt)	Production (mt)
	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Production (mt)		
Loc B Aus	1097.2	1.80	1974.96	71.0	0.87	61.77	1168.2	2036.73	2	4073.46
Loc T Aus	185.5	2.10	389.55	18.0	1.60	28.80	203.5	418.35	2	836.70
HYV T Aus	150.1	3.90	585.39	13.0	3.10	40.30	163.1	625.69	1	625.69
Loc B Aman	33.4	1.60	53.44	50.0	1.28	64.00	83.4	117.44	1	117.44
Loc T Aman	1607.3	2.20	3536.06	5807.7	1.60	9292.32	7415.0	12828.38	2	25656.76
HYV T Aman	331.6	3.40	1127.44	3210.5	2.60	8347.30	3542.1	9474.74	1	9474.74
Loc/Imv L Boro	2889.0	2.40	6933.60	38.0	1.81	68.78	2927.0	7002.38	2	14004.76
HYV Boro	7296.3	4.60	33562.98	560.0	4.00	2240.00	7856.3	35802.98	1	35802.98
Wheat	163.5	2.03	331.91				163.5	331.91	1	331.91
Oilseeds	666.4	1.00	666.40				666.4	666.40		
Jute	21.2	1.50	31.80				21.2	31.80	2	63.60
Vegetables	170.8	10.70	1827.56				170.8	1827.56		
Spice	42.7	3.50	149.45				42.7	149.45		
Sugarcane	0.4	22.00	8.80				0.4	8.80		

Table 8 : FWO Production; Main Product and By-Product

Crop	Main Product								By - Product	
	Damage Free Area			Damaged Area			Total		Factor (mt/mt)	Production (mt)
	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Production (mt)		
Loc B Aus	1063.5	1.80	1914.30	71.0	0.87	61.77	1134.5	1976.07	2	3952.14
Loc T Aus	117.7	2.10	247.17	18.0	1.60	28.80	135.7	275.97	2	551.94
HYV T Aus	189.0	3.90	737.10	13.0	3.10	40.30	202.0	777.40	1	777.40
Loc B Aman	33.4	1.60	53.44	50.1	1.28	64.13	83.5	117.57	1	117.57
Loc T Aman	1033.7	2.20	2274.14	5808.0	1.60	9292.80	6841.7	11566.94	2	23133.88
HYV T Aman	612.2	3.40	2081.48	3210.5	2.60	8347.30	3822.7	10428.78	1	10428.78
Loc/Imv L Boro	3039.5	2.40	7294.80	38.0	1.81	68.78	3077.5	7363.58	2	14727.16
HYV Boro	7067.6	4.60	32510.96	560.0	4.00	2240.00	7627.6	34750.96	1	34750.96
Wheat	195.7	2.24	438.37				195.7	438.37	1	438.37
Oilseeds	633.3	1.10	696.63				633.3	696.63		
Jute	21.0	1.50	31.50				21.0	31.50	2	63.00
Vegetables	176.2	12.20	2149.64				176.2	2149.64		
Spice	44.1	4.98	219.62				44.1	219.62		
Sugarcane	0.4	22.00	8.80				0.4	8.80		

Table 9 : FW Production; Main Product and By-Product

Crop	Main Product								By - Product	
	Damage Free Area			Damaged Area			Total		Factor (mt/mt)	Production (mt)
	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Production (mt)		
Loc B Aus	1127.3	1.80	2029.14				1127.3	2029.14	2	4058.28
Loc T Aus	132.7	2.10	278.67				132.7	278.67	2	557.34
HYV T Aus	194.8	3.90	759.72				194.8	759.72	1	759.72
Loc B Aman		1.60	0.00				0.0	0.00	1	0.00
Loc T Aman	3913.0	2.20	8608.60	1132.2	1.60	1811.52	5045.2	10420.12	2	20840.24
HYV T Aman	5913.5	3.40	20105.90	405.3	2.60	1053.78	6318.8	21159.68	1	21159.68
Loc/Imv L Boro	2930.8	2.40	7033.92				2930.8	7033.92	2	14067.84
HYV Boro	7721.3	4.60	35517.98				7721.3	35517.98	1	35517.98
Wheat	206.9	2.24	463.46				206.9	463.46	1	463.46
Oilseeds	843.8	1.10	928.18				843.8	928.18		
Jute	21.5	1.50	32.25				21.5	32.25	2	64.50
Vegetables	267.1	12.20	3258.62				267.1	3258.62		
Spice	66.8	4.98	332.66				66.8	332.66		
Sugarcane	0.4	22.00	8.80				0.4	8.80		

Table 10 : Revenue Earned Per Hectare of Land in Financial Prices; Present, FWO &amp; FW Scenario

(in taka)

Crop	Present			FWO			FW		
	Main Product	By-Product	Total	Main Product	By-Product	Total	Main Product	By-Product	Total
Loc B Aus	10590	3313	13902	10580	3309	13889	10933	3420	14353
Loc T Aus	12487	3906	16393	12353	3864	16217	12755	3990	16745
HYV T Aus	23301	2685	25987	23376	2694	26070	23689	2730	26419
Loc B Aman	9066	1338	10403	9065	1338	10402	0	0	0
Loc T Aman	11138	3287	14425	10884	3212	14097	13297	3924	17221
HYV T Aman	17221	1872	19093	17564	1910	19473	21559	2344	23903
Loc/Imv L Boro	14861	4545	19407	14864	4546	19410	14909	4560	19469
HYV Boro	28310	3190	31500	28302	3189	31491	28575	3220	31795
Wheat	12813	1218	14031	14139	1344	15483	14139	1344	15483
Oilseeds	13466		13466	14813		14813	14813		14813
Jute	12018	7650	19668	12018	7650	19668	12018	7650	19668
Vegetables	47733		47733	54424		54424	54424		54424
Spice	31665		31665	45054		45054	45054		45054
Sugarcane	22264		22264	22264		22264	22264		22264

Table 11 : Revenue Earned Per Hectare of Land in Economic Prices; Present, FWO &amp; FW Scenario

(in taka)

Crop	Present			FWO			FW		
	Main Product	By-Product	Total	Main Product	By-Product	Total	Main Product	By-Product	Total
Loc B Aus	9319	2882	12201	9310	2879	12189	9621	2575	12597
Loc T Aus	10988	3398	14387	10870	3362	14232	11225	3471	14696
HYV T Aus	20505	2336	22841	20571	2344	22915	20846	2375	23221
Loc B Aman	7978	1164	9142	7977	1164	9141	0	0	0
Loc T Aman	9802	2860	12661	9578	2795	12373	11701	3414	15115
HYV T Aman	15154	1629	16783	15456	1661	17117	18972	2039	21011
Loc/Imv L Boro	13078	3955	17032	13080	3955	17035	13120	3967	17087
HYV Boro	24912	2775	27688	24905	2775	27680	25146	2801	27948
Wheat	16529	1072	17601	18239	1183	19422	18239	1183	19422
Oilseeds	11850		11850	13035		13035	13035		13035
Jute	12739	6656	19395	12739	6656	19395	12739	6656	19395
Vegetables	41527		41527	47349		47349	47349		47349
Spice	27548		27548	39197		39197	39197		39197
Sugarcane	21151		21151	21151		21151	21151		21151



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Table 12 : Inputs in Production; Present Scenario

Crop	Labour (person days/ha)	Bullock (bullock days/ha)	Seed (kg/ha)	Fertilizer			Pesticide (kg/ha)	Irrigation	
				Urea (kg/ha)	TSP (kg/ha)	MP (kg/ha)		Traditional (ha)	Modern (ha)
Loc B Aus	96	41	67.2	39.1					
Loc T Aus	93	38	48.0	30.8	8.0	3.0	0.2		
HYV T Aus	128	60	61.8	194.6	108.1		0.6		
Loc B Aman	75	29	100.0						
Loc T Aman	108	64	39.2	50.7			0.1		
HYV T Aman	133	68	54.1	142.1	4.6		0.2		
Loc/Imv L Boro	110	28	58.8	72.1	17.3	8.7	0.3	1050	160
HYV Boro	153	38	61.2	173.9	41.4	10.2	0.9	980	6580
Wheat	87	34	148.3	76.2	8.6	34.6	0.4	10	60
Oilseeds	91	41	6.1	✓24.6	✓58.1	✓15.3			
Jute	165	40	10.7	42.2	8.4	37.8	0.6		
Vegetables	232	71	30.0	84.6	50.8	16.9		20	120
Spice	172	49	22.8	14.8	24.7	9.9			
Sugarcane	140	42	5000.0	✓90.0	✓42.0	✓28.0			

Source: Farm Household Survey

Table 13 : Inputs in Production; FWO Scenario

Crop	Labour (person days/ha)	Bullock (bullock days/ha)	Seed (kg/ha)	Fertilizer			Pesticide (kg/ha)	Irrigation	
				Urea (kg/ha)	TSP (kg/ha)	MP (kg/ha)		Traditional (ha)	Modern (ha)
Loc B Aus	96	41	67.2	39.1					
Loc T Aus	93	38	48.0	30.8	8.0	3.0	0.2		
HYV T Aus	128	60	62.0	194.6	108.1		0.6		
Loc B Aman	75	29	100.0						
Loc T Aman	108	64	39.2	50.7			0.1		
HYV T Aman	133	68	54.1	142.1	4.6		0.2		
Loc/Imv L Boro	110	28	58.8	72.1	17.3	8.7	0.3	1100	160
HYV Boro	153	38	61.2	173.9	41.4	10.2	0.9	950	6390
Wheat	87	34	163.1	83.8	9.4	38.1	0.4	10	80
Oilseeds	91	41	6.7	27.0	63.9	16.8			
Jute	165	40	10.7	42.2	8.4	37.8	0.6		
Vegetables	232	71	36.0	101.6	60.9	20.3		20	120
Spice	172	49	29.6	19.3	32.1	12.8			
Sugarcane	140	42	5000.0	90.0	42.0	28.0			

Source: Table 12, adjusted for seed use.

Table 14 : Inputs in Production; FW Scenario

Crop	Labour (person days/ha)	Bullock (bullock days/ha)	Seed (kg/ha)	Fertilizer			Pesticide (kg/ha)	Irrigation	
				Urea (kg/ha)	TSP (kg/ha)	MP (kg/ha)		Traditional (ha)	Modern (ha)
Loc B Aus	96	41	67.2	39.1					
Loc T Aus	93	38	48.0	30.8	8.0	3.0	0.2		
HYV T Aus	131	60	62.0	194.6	108.1		0.6		
Loc B Aman	75	29	100.0						
Loc T Aman	123	64	43.1	63.3			0.2		
HYV T Aman	152	68	59.5	163.4	5.0		0.7		
Loc/Imv L Boro	110	28	58.8	72.1	17.3	8.7	0.3	1050	160
HYV Boro	154	38	61.2	182.5	43.5	10.7	0.9	970	6470
Wheat	87	34	163.1	83.8	9.4	38.1	0.4	10	80
Oilseeds	91	41	6.7	27.0	63.9	16.8			
Jute	165	40	10.7	42.2	8.4	37.8	0.6		
Vegetables	232	71	36.0	101.6	60.9	20.3		30	190
Spice	172	49	29.6	19.3	32.1	12.8			
Sugarcane	140	42	5000.0	90.0	42.0	28.0			

Source: Table 13, adjusted for labour requirements.

Table 15 : Cost of Production Per Hectare of Land; Present, FWO & FW Scenarios  
(in taka)

Crops	In Market Prices			In Economic Prices		
	Present	FWO	FW	Present	FWO	FW
Loc B Aus	7987	7987	7987	6066	6066	6066
Loc T Aus	7606	7606	7606	5817	5817	5817
HYV T Aus	12389	12392	12532	10340	10342	10447
Loc B Aman	6479	6479	6479	4840	4840	4840
Loc T Aman	9598	9598	10510	7291	7291	8007
HYV T Aman	11739	11739	13150	9156	9156	10269
Loc/Imv L Boro	8871	8871	8871	6976	6976	6976
HYV Boro	13921	13921	14080	11223	11223	11377
Wheat	9980	10252	10252	8630	8947	8947
Oilseeds	7432	7503	7503	5996	6094	6094
Jute	11438	11438	11438	8923	8923	8923
Vegetables	31850	34843	34843	24340	26668	26668
Spice	27667	32581	32581	20769	24467	24467
Sugarcane	15995	15995	15995	12895	12895	12895

Source: Calculated from Tables 12,13,14 and Table 3.

Table 16 : Net Margin Per Hectare of Land; Present, FWO & FW Scenarios  
(intaka)

Crops	In Market Prices			In Economic Prices		
	Present	FWO	FW	Present	FWO	FW
Loc B Aus	5916	5902	6367	6135	6123	6530
Loc T Aus	8787	8611	9139	8570	8415	8879
HYV T Aus	13598	13678	13887	12502	12573	12775
Loc B Aman	3924	3923		4302	4301	
Loc T Aman	4827	4499	6711	5370	5082	7108
HYV T Aman	7355	7734	10753	7627	7961	10742
Loc/Imv L Boro	10536	10538	10598	10056	10059	10111
HYV Boro	17578	17570	17716	16465	16457	16570
Wheat	4052	5231	5231	8971	10475	10475
Oilseeds	6034	7309	7309	5854	6941	6941
Jute	8230	8230	8230	10472	10472	10472
Vegetables	15883	19582	19582	17188	20681	20681
Spice	3997	12473	12473	6779	14730	14730
Sugarcane	6269	6269	6269	8256	8256	8256

Source: Table 10 minus Table 15 and Table 11 minus Table 15.



Table 17: Market & Economic Fisheries' Prices and Harvest Cost

Item	Market Price 1991	Conversion Factor	Economic Prices
<b>Wholesale Prices (Tk/kg)</b>			
Floodplain & Beel Fisheries, and River/Channel Fisheries	45	0.87	39.15
Cultivated Pond Fisheries	70	0.87	60.90
<b>Harvest Cost (Tk/ha)</b>			
Floodplain & Beel Fisheries, and River/Channel Fisheries	710.76	0.87	618.36
Pond Culture Fisheries	39,405.00	0.87	34,282.40

210 Tk  
3000/kg  
12000/ha

Table 18: Habitat Area and Unit Production by Habitat; Present, FWO & FW

Habitat		Present		FWO		FW	
		Area (ha)	Production (kg/ha)	Area (ha)	Production (kg/ha)	Area (ha)	Production (kg/ha)
Floodplain and Beel	F0	6000	10.0	6000	Decreases	9000	Decreases
	F1	3179	29.2	3179	by 3 percent	1042	by 3 percent
	F2	2250	107.0	2250	per year in	603	per year in
	F3	681	44.3	681	all habitats	487	all habitats
	Total	12110	35.0	12110	for 30	11132	for 30
River		220	104.3	220	years	220	years
Pond	Flood Free	85	929.1	Increases by 1.6 per cent per year for 10 years	929.1	Increases by 4.1% per year for 10 years	929.1
	Flood Prone	35	706.4		706.4	0.0	706.4



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Table 19: Open Access Capture Fisheries; Present and Future Without Project

Scenario	Habitat : Area & Production	Year	Floodplain & Beel Fisheries					River Fisheries	Total Capture Fisheries
			F0	F1	F2	F3	Total/ Average		
Present	Area (ha)	0	6000	3179	2250	681	12110	220	12330
	Production (kg/ha)	0	10.0	29.2	107.0	44.3	35.0	104.3	36.2
FWO	Area (ha)	1 to 30	6000	3179	2250	681	12110	220	12330
	Production (kg/ha)	1	9.7	28.3	103.8	43.0	33.9	101.2	35.1
		2	9.4	27.4	100.7	41.7	32.9	98.1	34.1
		3	9.1	26.6	97.7	40.4	31.9	95.2	33.1
		4	8.9	25.8	94.8	39.2	31.0	92.3	32.1
		5	8.6	25.0	91.9	38.1	30.0	89.6	31.1
		6	8.3	24.3	89.2	36.9	29.1	86.9	30.2
		7	8.1	23.6	86.5	35.8	28.3	84.3	29.3
		8	7.8	22.8	83.9	34.7	27.4	81.8	28.4
		9	7.6	22.2	81.4	33.7	26.6	79.3	27.5
		10	7.4	21.5	78.9	32.7	25.8	76.9	26.7
		11	7.2	20.9	76.6	31.7	25.0	74.6	25.9
		12	6.9	20.2	74.3	30.7	24.3	72.4	25.1
		13	6.7	19.6	72.0	29.8	23.5	70.2	24.4
		14	6.5	19.0	69.9	28.9	22.8	68.1	23.6
		15	6.3	18.5	67.8	28.1	22.2	66.1	22.9
		16	6.1	17.9	65.7	27.2	21.5	64.1	22.2
		17	6.0	17.4	63.8	26.4	20.8	62.2	21.6
		18	5.8	16.8	61.9	25.6	20.2	60.3	20.9
		19	5.6	16.3	60.0	24.8	19.6	58.5	20.3
		20	5.4	15.9	58.2	24.1	19.0	56.7	19.7
		21	5.3	15.4	56.5	23.4	18.5	55.0	19.1
		22	5.1	14.9	54.8	22.7	17.9	53.4	18.5
		23	5.0	14.5	53.1	22.0	17.4	51.8	18.0
		24	4.8	14.0	51.5	21.3	16.8	50.2	17.4
		25	4.7	13.6	50.0	20.7	16.3	48.7	16.9
		26	4.5	13.2	48.5	20.1	15.8	47.2	16.4
		27	4.4	12.8	47.0	19.5	15.4	45.8	15.9
		28	4.3	12.4	45.6	18.9	14.9	44.5	15.4
		29	4.1	12.1	44.2	18.3	14.5	43.1	15.0
		30	4.0	11.7	42.9	17.8	14.0	41.8	14.5

Table 20: Open Access Capture Fisheries; Present and Future With Project

Scenario	Habitat : Area & Production	Year	Floodplain & Beel Fisheries					River Fisheries	Total Capture Fisheries
			F0	F1	F2	F3	Total/ Average		
Present	Area (ha)	0	6000	3179	2250	681	12110	220	12330
	Production (kg/ha)	0	10.0	29.2	107.0	44.3	35.0	104.3	36.2
FW	Area (ha)	1 to 30	9000	1042	603	487	11132	220	11352
	Production (kg/ha)	1	9.7	28.3	103.8	43.0	33.9	101.2	35.1
		2	9.4	27.4	100.7	41.7	32.9	98.1	34.2
		3	9.1	26.6	97.7	40.4	16.9	85.5	18.3
		4	8.9	25.8	94.8	39.2	16.4	82.9	17.7
		5	8.6	25.0	91.9	38.1	15.9	80.4	17.2
		6	8.3	24.3	89.2	36.9	15.5	78.0	16.7
		7	8.1	23.6	86.5	35.8	15.0	75.6	16.2
		8	7.8	22.8	83.9	34.7	14.5	73.4	15.7
		9	7.6	22.2	81.4	33.7	14.1	71.2	15.2
		10	7.4	21.5	78.9	32.7	13.7	69.0	14.8
		11	7.2	20.9	76.6	31.7	13.3	67.0	14.3
		12	6.9	20.2	74.3	30.7	12.9	65.0	13.9
		13	6.7	19.6	72.0	29.8	12.5	63.0	13.5
		14	6.5	19.0	69.9	28.9	12.1	61.1	13.1
		15	6.3	18.5	67.8	28.1	11.7	59.3	12.7
		16	6.1	17.9	65.7	27.2	11.4	57.5	12.3
		17	6.0	17.4	63.8	26.4	11.1	55.8	11.9
		18	5.8	16.8	61.9	25.6	10.7	54.1	11.6
		19	5.6	16.3	60.0	24.8	10.4	52.5	11.2
		20	5.4	15.9	58.2	24.1	10.1	50.9	10.9
		21	5.3	15.4	56.5	23.4	9.8	49.4	10.6
		22	5.1	14.9	54.8	22.7	9.5	47.9	10.2
		23	5.0	14.5	53.1	22.0	9.2	46.5	9.9
		24	4.8	14.0	51.5	21.3	8.9	45.1	9.6
		25	4.7	13.6	50.0	20.7	8.7	43.7	9.3
		26	4.5	13.2	48.5	20.1	8.4	42.4	9.1
		27	4.4	12.8	47.0	19.5	8.2	41.1	8.8
		28	4.3	12.4	45.6	18.9	7.9	39.9	8.5
		29	4.1	12.1	44.2	18.3	7.7	38.7	8.3
		30	4.0	11.7	42.9	17.8	7.4	37.5	8.0



Table 21: Culture Fisheries; Present, Future Without and Future With Project

Scenario	Habitat : Area & Production	Year	Pond Fisheries		
			Flood Free	Flood Prone	Total
Present	Production (kg/ha)	0	929.1	706.4	864.1
	Area (ha)	0	85	35	120
FWO	Production (kg/ha)	1 to 30	929.1	706.4	
	Area (ha)	1	86.4	35.0	121.4
		2	87.8	35.0	122.8
		3	89.2	35.0	124.2
		4	90.7	35.0	125.7
		5	92.2	35.0	127.2
		6	93.7	35.0	128.7
		7	95.2	35.0	130.2
		8	96.8	35.0	131.8
		9	98.4	35.0	133.4
		10	100.0	35.0	135.0
		11	100.0	35.0	135.0
		12	100.0	35.0	135.0
		13 +	100.0	35.0	135.0
FW	Production (kg/ha)	1 to 30	929.1	706.4	
	Area (ha)	1	86.4	35.0	121.4
		2	87.8	35.0	122.8
		3	89.2	35.0	124.2
		4	127.9	0.0	127.9
		5	133.2	0.0	133.2
		6	138.7	0.0	138.7
		7	144.5	0.0	144.5
		8	150.5	0.0	150.5
		9	156.7	0.0	156.7
		10	163.2	0.0	163.2
		11	169.9	0.0	169.9
		12	177.0	0.0	177.0
		13 +	184.3	0.0	184.3

Table 22 : Fisheries Production in FWO &amp; FW Scenario ( in metric ton)

Year	Captured Fisheries						Cultured Fisheries						TOTAL FISHERIES		Incremental Production
	Floodplain & Beel		River		Total		Flood Free		Flood Prone		Total		FWO	FW	FW - FWO
	FWO	FW	FWO	FW	FWO	FW	FWO	FW	FWO	FW	FWO	FW			
0 (Present)	423.7	423.7	22.9	22.9	446.6	446.6	79.0	79.0	24.7	24.7	103.7	103.7	550.3	550.3	
1	411.0	411.0	22.3	22.3	433.2	433.2	80.3	80.3	24.7	24.7	105.0	105.0	538.2	538.2	0.0
2	398.6	398.6	21.6	21.6	420.2	420.2	81.6	81.6	24.7	24.7	106.3	106.3	526.5	526.5	0.0
3	386.7	188.5	20.9	18.8	407.6	207.3	82.9	82.9	24.7	24.7	107.6	107.6	515.3	314.9	-200.3
4	375.1	182.8	20.3	18.2	395.4	201.0	84.3	118.9	24.7	0.0	109.0	118.9	504.4	319.9	-184.5
5	363.8	177.3	19.7	17.7	383.5	195.0	85.7	123.8	24.7	0.0	110.4	123.8	493.9	318.8	-175.1
6	352.9	172.0	19.1	17.2	372.0	189.2	87.1	128.9	24.7	0.0	111.8	128.9	483.8	318.1	-165.7
7	342.3	166.8	18.5	16.6	360.9	183.5	88.5	134.2	24.7	0.0	113.2	134.2	474.1	317.7	-156.3
8	332.0	161.8	18.0	16.1	350.0	178.0	89.9	139.8	24.7	0.0	114.7	139.8	464.7	317.8	-146.9
9	322.1	157.0	17.4	15.7	339.5	172.6	91.4	145.6	24.7	0.0	116.1	145.6	455.7	318.2	-137.4
10	312.4	152.3	16.9	15.2	329.3	167.5	92.9	151.6	24.7	0.0	117.6	151.6	447.0	319.1	-127.9
11	303.0	147.7	16.4	14.7	319.5	162.4	92.9	157.9	24.7	0.0	117.6	157.9	437.1	320.3	-116.8
12	294.0	143.3	15.9	14.3	309.9	157.6	92.9	164.4	24.7	0.0	117.6	164.4	427.5	322.0	-105.5
13	285.1	139.0	15.4	13.9	300.6	152.8	92.9	171.2	24.7	0.0	117.6	171.2	418.2	324.1	-94.2
14	276.6	134.8	15.0	13.4	291.6	148.3	92.9	171.2	24.7	0.0	117.6	171.2	409.2	319.5	-89.7
15	268.3	130.8	14.5	13.0	282.8	143.8	92.9	171.2	24.7	0.0	117.6	171.2	400.4	315.0	-85.4
16	260.2	126.8	14.1	12.7	274.3	139.5	92.9	171.2	24.7	0.0	117.6	171.2	392.0	310.7	-81.3
17	252.4	123.0	13.7	12.3	266.1	135.3	92.9	171.2	24.7	0.0	117.6	171.2	383.7	306.5	-77.2
18	244.9	119.3	13.3	11.9	258.1	131.2	92.9	171.2	24.7	0.0	117.6	171.2	375.8	302.5	-73.3
19	237.5	115.8	12.9	11.5	250.4	127.3	92.9	171.2	24.7	0.0	117.6	171.2	368.0	298.5	-69.5
20	230.4	112.3	12.5	11.2	242.9	123.5	92.9	171.2	24.7	0.0	117.6	171.2	360.5	294.7	-65.8
21	223.5	108.9	12.1	10.9	235.6	119.8	92.9	171.2	24.7	0.0	117.6	171.2	353.2	291.0	-62.2
22	216.8	105.7	11.7	10.5	228.5	116.2	92.9	171.2	24.7	0.0	117.6	171.2	346.1	287.4	-58.7
23	210.3	102.5	11.4	10.2	221.7	112.7	92.9	171.2	24.7	0.0	117.6	171.2	339.3	283.9	-55.4
24	204.0	99.4	11.0	9.9	215.0	109.3	92.9	171.2	24.7	0.0	117.6	171.2	332.6	280.5	-52.1
25	197.8	96.4	10.7	9.6	208.6	106.0	92.9	171.2	24.7	0.0	117.6	171.2	326.2	277.3	-48.9
26	191.9	93.5	10.4	9.3	202.3	102.9	92.9	171.2	24.7	0.0	117.6	171.2	319.9	274.1	-45.8
27	186.1	90.7	10.1	9.1	196.2	99.8	92.9	171.2	24.7	0.0	117.6	171.2	313.9	271.0	-42.9
28	180.6	88.0	9.8	8.8	190.3	96.8	92.9	171.2	24.7	0.0	117.6	171.2	308.0	268.0	-40.0
29	175.1	85.4	9.5	8.5	184.6	93.9	92.9	171.2	24.7	0.0	117.6	171.2	302.3	265.1	-37.2
30	169.9	82.8	9.2	8.3	179.1	91.1	92.9	171.2	24.7	0.0	117.6	171.2	296.7	262.3	-34.4
AVERAGE	273.5	147.1	14.8	13.4	288.3	160.6	90.8	153.1	24.7	2.5	115.5	155.5	403.8	316.1	-87.7

Source: Calculated from Tables 19 to 21



Table 23 : Gross Revenue from Fisheries Production in Market and Economic Prices in FWO & FW Scenarios(million Taka)

Year	Captured Fisheries				Cultured Fisheries				Incremental Gross Revenue	
	Market		Economic		Market		Economic		Market	Economic
	FWO	FW	FWO	FW	FWO	FW	FWO	FW		
0 (Present)	20.10	20.10	17.48	17.48	7.26	7.26	6.32	6.32		
1	19.49	19.49	16.96	16.96	7.35	7.35	6.39	6.39	0.00	0.00
2	18.91	18.91	16.45	16.45	7.44	7.44	6.47	6.47	0.00	0.00
3	18.34	9.33	15.96	8.11	7.54	7.54	6.56	6.56	-9.02	-7.84
4	17.79	9.05	15.48	7.87	7.63	8.32	6.64	7.24	-8.05	-7.01
5	17.26	8.78	15.01	7.63	7.73	8.67	6.72	7.54	-7.54	-6.56
6	16.74	8.51	14.56	7.41	7.83	9.02	6.81	7.85	-7.03	-6.12
7	16.24	8.26	14.13	7.18	7.92	9.40	6.89	8.18	-6.51	-5.66
8	15.75	8.01	13.70	6.97	8.03	9.79	6.98	8.51	-5.98	-5.20
9	15.28	7.77	13.29	6.76	8.13	10.19	7.07	8.87	-5.45	-4.74
10	14.82	7.54	12.89	6.56	8.23	10.61	7.16	9.23	-4.91	-4.27
11	14.38	7.31	12.51	6.36	8.23	11.05	7.16	9.62	-4.25	-3.70
12	13.94	7.09	12.13	6.17	8.23	11.51	7.16	10.01	-3.58	-3.11
13	13.53	6.88	11.77	5.98	8.23	11.99	7.16	10.43	-2.90	-2.52
14	13.12	6.67	11.41	5.80	8.23	11.99	7.16	10.43	-2.70	-2.35
15	12.73	6.47	11.07	5.63	8.23	11.99	7.16	10.43	-2.50	-2.18
16	12.34	6.28	10.74	5.46	8.23	11.99	7.16	10.43	-2.32	-2.02
17	11.97	6.09	10.42	5.30	8.23	11.99	7.16	10.43	-2.13	-1.86
18	11.62	5.91	10.11	5.14	8.23	11.99	7.16	10.43	-1.96	-1.70
19	11.27	5.73	9.80	4.98	8.23	11.99	7.16	10.43	-1.79	-1.55
20	10.93	5.56	9.51	4.83	8.23	11.99	7.16	10.43	-1.62	-1.41
21	10.60	5.39	9.22	4.69	8.23	11.99	7.16	10.43	-1.46	-1.27
22	10.28	5.23	8.95	4.55	8.23	11.99	7.16	10.43	-1.30	-1.13
23	9.97	5.07	8.68	4.41	8.23	11.99	7.16	10.43	-1.15	-1.00
24	9.68	4.92	8.42	4.28	8.23	11.99	7.16	10.43	-1.00	-0.87
25	9.38	4.77	8.16	4.15	8.23	11.99	7.16	10.43	-0.86	-0.75
26	9.10	4.63	7.92	4.03	8.23	11.99	7.16	10.43	-0.72	-0.63
27	8.83	4.49	7.68	3.91	8.23	11.99	7.16	10.43	-0.59	-0.51
28	8.57	4.36	7.45	3.79	8.23	11.99	7.16	10.43	-0.46	-0.40
29	8.31	4.22	7.23	3.68	8.23	11.99	7.16	10.43	-0.33	-0.29
30	8.06	4.10	7.01	3.57	8.23	11.99	7.16	10.43	-0.21	-0.18

Source: Table 22 and Table 17

Table 24 : Market and Economic Net Returns & Incremental Net Benefits/Disbenefits to Fisheries, FWO and FW Scenarios(million Taka)

Year	Captured Fisheries				Cultured Fisheries				Total Fisheries				Incremental Net	
	Market		Economic		Market		Economic		Market		Economic		Benefits/Disbenefits	
	FWO	FW	FWO	FW	FWO	FW	FWO	FW	FWO	FW	FWO	FW	Market	Economic
0 (Present)	11.33	11.33	9.84	9.84	2.53	2.53	2.20	2.20	13.86	13.86	12.04	12.04		
1	10.73	10.73	9.32	9.32	2.57	2.57	2.23	2.23	13.30	13.30	11.55	11.55	0.00	0.00
2	10.15	10.15	8.81	8.81	2.60	2.60	2.26	2.26	12.75	12.75	11.07	11.07	0.00	0.00
3	9.58	1.26	8.31	1.07	2.64	2.64	2.30	2.30	12.22	3.90	10.61	3.37	-8.32	-7.24
4	9.03	0.98	7.83	0.83	2.68	3.28	2.33	2.85	11.70	4.26	10.16	3.68	-7.45	-6.48
5	8.49	0.71	7.37	0.59	2.71	3.42	2.36	2.97	11.21	4.12	9.73	3.57	-7.09	-6.17
6	7.98	0.44	6.92	0.37	2.75	3.56	2.40	3.09	10.73	4.00	9.32	3.46	-6.73	-5.86
7	7.47	0.19	6.48	0.14	2.79	3.70	2.43	3.22	10.27	3.89	8.91	3.37	-6.38	-5.55
8	6.99	-0.06	6.06	-0.07	2.83	3.86	2.46	3.36	9.82	3.80	8.52	3.28	-6.02	-5.24
9	6.51	-0.30	5.65	-0.28	2.87	4.02	2.50	3.49	9.39	3.72	8.15	3.21	-5.67	-4.93
10	6.06	-0.53	5.25	-0.48	2.91	4.18	2.54	3.64	8.97	3.65	7.78	3.15	-5.32	-4.63
11	5.61	-0.76	4.86	-0.68	2.91	4.36	2.54	3.79	8.53	3.60	7.40	3.11	-4.93	-4.29
12	5.18	-0.98	4.49	-0.87	2.91	4.54	2.54	3.95	8.10	3.56	7.02	3.07	-4.54	-3.95
13	4.76	-1.19	4.12	-1.06	2.91	4.72	2.54	4.11	7.68	3.53	6.66	3.05	-4.14	-3.61
14	4.36	-1.40	3.77	-1.24	2.91	4.72	2.54	4.11	7.27	3.33	6.31	2.87	-3.94	-3.43
15	3.96	-1.60	3.43	-1.41	2.91	4.72	2.54	4.11	6.88	3.13	5.96	2.70	-3.75	-3.26
16	3.58	-1.79	3.10	-1.58	2.91	4.72	2.54	4.11	6.50	2.93	5.63	2.53	-3.56	-3.10
17	3.21	-1.98	2.77	-1.74	2.91	4.72	2.54	4.11	6.13	2.74	5.31	2.37	-3.38	-2.94
18	2.85	-2.16	2.46	-1.90	2.91	4.72	2.54	4.11	5.77	2.56	5.00	2.21	-3.21	-2.79
19	2.50	-2.34	2.16	-2.06	2.91	4.72	2.54	4.11	5.42	2.38	4.69	2.05	-3.03	-2.64
20	2.17	-2.51	1.86	-2.21	2.91	4.72	2.54	4.11	5.08	2.21	4.40	1.90	-2.87	-2.49
21	1.84	-2.68	1.56	-2.35	2.91	4.72	2.54	4.11	4.75	2.05	4.11	1.76	-2.71	-2.35
22	1.52	-2.84	1.30	-2.49	2.91	4.72	2.54	4.11	4.43	1.88	3.84	1.62	-2.55	-2.22
23	1.21	-3.00	1.03	-2.63	2.91	4.72	2.54	4.11	4.13	1.73	3.57	1.48	-2.40	-2.09
24	0.91	-3.15	0.77	-2.76	2.91	4.72	2.54	4.11	3.83	1.57	3.31	1.35	-2.25	-1.96
25	0.62	-3.30	0.52	-2.89	2.91	4.72	2.54	4.11	3.54	1.43	3.06	1.22	-2.11	-1.83
26	0.34	-3.44	0.28	-3.01	2.91	4.72	2.54	4.11	3.25	1.28	2.81	1.10	-1.97	-1.71
27	0.07	-3.58	0.04	-3.13	2.91	4.72	2.54	4.11	2.98	1.15	2.57	0.98	-1.84	-1.60
28	-0.20	-3.71	-0.19	-3.25	2.91	4.72	2.54	4.11	2.72	1.01	2.34	0.86	-1.71	-1.48
29	-0.46	-3.84	-0.42	-3.36	2.91	4.72	2.54	4.11	2.46	0.88	2.12	0.74	-1.58	-1.37
30	-0.70	-3.97	-0.63	-3.47	2.91	4.72	2.54	4.11	2.21	0.75	1.90	0.63	-1.46	-1.27

Sources: Table 23 and Table 17



**Table 25: Flood Damage Estimates for Socio-Economic  
Infrastructure in the Project Area  
(million Taka 1991)**

Flood Damage Item	1995 1:10	1993 1:20	1991 1:2	1988 1:25
<b>Public Property Damage</b>				
Roads, Embankments, Railways	1.822	2.319	0.802	2.500
Culverts & Bridges	2.498	1.005	0.924	3.831
Hydraulic Structures	0.087	0.202	0.271	0.260
Schools & Colleges	0.138	0.200	0.120	0.303
Hats & Bazaars	0.052	0.055	0.024	0.084
Sub-Total	4.597	3.781	2.142	6.978
<b>Economic Valuation Sub-Total</b>	3.999	3.289	1.863	6.071
<b>Household/Homestead Damage</b>				
Household Unit	0.958	0.112	0.137	1.900
Household Assets	0.828	0.200	0.000	0.936
Homestead Garden	0.000	0.000	0.000	0.046
Sub-Total	1.787	0.312	0.137	2.882
<b>Economic Valuation Sub-Total</b>	1.143	0.199	0.088	1.848
Total Stock Resources Flood Damage in Financial Prices	6.384	4.094	2.279	9.861
Total Stock Resources Flood Damage in Economic Prices	5.142	3.488	1.951	7.916

Sources: LGED, DAE/MOA, BR, BWDB, and Thana Union offices in project study area. Adjusted to constant 1991 Taka using BBS indices. Adjusted to economic prices using FPCO' Guideline conversion factors.



Table 26 : Farm Budget Analysis, Small Farm (Taka 1991)

Item	Present					FWO					FW				
	LT Aman	HYV Aman	L Boro	HYV Boro		LT Aman	HYV Aman	L Boro	HYV Boro		LT Aman	HYV Aman	L Boro	HYV Boro	
1 REVENUE															
2 Yield:Damage Free(mt/ha)	2.40	3.60	2.41	4.66		2.40	3.60	2.41	4.66		2.40	3.60	2.41	4.66	
3 Area:Damage Free(%)	21.7	9.4	98.7	92.7		15.1	16.0	98.8	92.7		77.6	93.6	100.0	100.0	
4 Yield:Damaged(mt/ha)	1.58	2.61	1.90	4.10		1.58	2.61	1.90	4.10		1.58	2.61	1.90	4.10	
5 Area:Damaged(%)	78.3	90.6	1.3	7.1		84.9	84.0	1.2	7.3		22.4	6.4	0.0	0.0	
6 Average Yield(mt/ha)	1.76	2.70	2.40	4.62		1.70	2.77	2.40	4.62		2.22	3.54	2.41	4.66	
7 By Product Factor(mt/mt)	2.0	1.0	2.0	1.0		2.0	1.0	2.0	1.0		2.0	1.0	2.0	1.0	
8 Prices of Main Product(Tk)	6438.00	6438.00	6212.00	6212.00		6438.00	6438.00	6212.00	6212.00		6438.00	6438.00	6212.00	6212.00	
9 Prices of By Product(Tk)	950.00	700.00	950.00	700.00		950.00	700.00	950.00	700.00		950.00	700.00	950.00	700.00	
10 Value of Production(Tk)	14657.70	19294.44	19496.14	31934.55		14206.45	19760.84	19500.27	31927.36		18479.68	25244.54	19549.92	32209.92	
11 COSTS (Tk)															
12 Labour Costs(Hired)	547.62	1343.82	828.05	1933.81		543.22	1349.71	828.04	1933.85		578.31	1404.59	827.68	1932.38	
13 (% Hired)	10%	20%	15%	25%		10%	20%	15%	25%		10%	20%	15%	25%	
14 Bullock	2944.38	3086.74	1285.81	1724.46		2920.69	3100.27	1285.79	1724.50		3109.36	3226.34	1285.25	1723.19	
15 Seeds	398.27	492.06	590.71	620.44		395.07	494.22	590.70	620.45		420.59	514.31	590.45	619.98	
16 Fertilizers	235.71	683.02	461.11	1075.63		233.82	686.02	461.11	1075.66		248.92	713.91	460.91	1074.84	
17 Pesticides	53.85	107.10	166.77	447.08		53.42	107.57	166.76	447.09		56.86	111.95	166.69	446.75	
18 Irrigation	0.00	0.00	467.15	1824.83		0.00	0.00	467.14	1824.87		0.00	0.00	466.94	1823.48	
19 Others	643.13	772.95	440.02	684.31		637.96	776.34	440.01	684.32		679.19	807.91	439.82	683.80	
20 Cost of Production	4823.06	6485.89	4219.77	8310.81		4784.28	6514.33	4219.70	8310.99		5093.33	6779.21	4217.89	8304.67	
21 MARGIN/HECTARE	9834.64	12808.55	15276.37	23623.74		9422.17	13246.51	15280.57	23616.37		13386.35	18465.33	15332.03	23905.25	
22 Cropped Area(%)	34.0	15.0	6.0	42.0		31.9	16.5	6.4	41.5		22.7	27.3	5.9	40.5	
23 Weighted Average Margin/ha(Tk)					16333.61					16200.88					18944.69
24 Cropping Intensity					2.06					2.06					2.14
25 Margin/hectare/year(Tk)					33647.24					33373.81					40541.64
26 Actual Farm Size(ha)					0.30					0.30					0.30
27 Actual Margin/ha/year(Tk)					10094.17					10012.14					12162.49

Notes

2. Dampara(follow-up) Farm Household Survey.
- 3.5. Percentages assumed to be the same as for the whole region for all farm sizes(see main text).
- 7.8.9. FPCO, Guidelines for Project Assessment. Dhaka, 1992.
11. Variable costs assumed to have a linear relationship to average yields.
13. Dampara (follow-up) Farm Household Survey.
19. Includes loan interest for short term credit and miscellaneous expenses (see main text).
22. From Dampara(follow up) Farm Household Survey.
23. Assumes excluded crops have the same average gross margin for all farm sizes.



Table 27 : Farm Budget Analysis, Medium Farm (Taka 1991)

Item	Present				FWO				FW			
	LT Aman	HYV Aman	L Boro	HYV Boro	LT Aman	HYV Aman	L Boro	HYV Boro	LT Aman	HYV Aman	L Boro	HYV Boro
1 REVENUE												
2 Yield: Damage Free (mt/ha)	2.36	3.40	2.42	4.61	2.36	3.40	2.42	4.61	2.36	3.40	2.42	4.61
3 Area: Damage Free (%)	21.7	9.4	98.7	92.9	15.1	16.0	98.8	92.7	77.6	93.6	100.0	100.0
4 Yield: Damaged (mt/ha)	1.59	2.57	1.75	4.00	1.59	2.57	1.75	4.00	1.59	2.57	1.75	4.00
5 Area: Damaged (%)	78.3	90.6	1.3	7.1	84.9	84.0	1.2	7.3	22.4	6.4	0.0	0.0
6 Average Yield (mt/ha)	1.76	2.65	2.41	4.57	1.71	2.70	2.41	4.57	2.19	3.35	2.42	4.61
7 By Product Factor (mt/mt)	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0
8 Prices of Main Product (Tk)	6438.00	6438.00	6212.00	6212.00	6438.00	6438.00	6212.00	6212.00	6438.00	6438.00	6212.00	6212.00
9 Prices of By Product (Tk)	950.00	700.00	950.00	700.00	950.00	700.00	950.00	700.00	950.00	700.00	950.00	700.00
10 Value of Production (Tk)	14650.62	18901.57	19560.38	31564.96	14226.88	19292.59	19565.82	31556.53	18239.54	23890.03	19631.04	31864.32
11 COSTS (Tk)												
12 Labour Costs (Hired)	1368.41	2303.84	1661.57	3058.22	1360.00	2306.00	1681.60	3058.21	1427.00	2326.16	1662.24	3058.64
13 (% Hired)	25%	35%	30%	40%	25%	35%	30%	40%	25%	35%	30%	40%
14 Bullock	2942.98	3023.94	1289.98	1704.47	2924.89	3026.79	1270.01	1704.56	3068.97	3053.25	1270.50	1704.70
15 Seeds	398.08	482.05	592.66	613.25	395.64	482.50	592.67	613.24	415.13	486.72	592.90	613.33
16 Fertilizers	235.60	669.13	462.64	1063.16	234.15	669.76	462.65	1063.16	245.69	675.61	462.83	1063.31
17 Pesticides	53.82	104.92	167.32	441.90	53.49	105.02	167.32	441.90	56.13	105.94	167.38	441.96
18 Irrigation	0.00	0.00	468.69	1803.67	0.00	0.00	468.69	1803.66	0.00	0.00	468.87	1803.91
19 Others	642.82	757.22	441.47	676.38	638.87	757.93	441.48	676.37	670.34	764.56	441.85	676.46
20 Cost of Production	5641.96	7341.45	5084.63	9361.45	5607.29	7348.35	5084.72	9361.50	5883.51	7412.59	5066.87	9362.71
21 MARGIN/HECTARE	9008.66	11560.12	14475.75	22203.51	8619.59	11944.24	14481.10	22195.03	12356.03	16477.44	14564.17	22501.61
22 Cropped Area (%)	32.0	14.0	15.0	23.0	30.1	15.4	16.1	22.7	21.4	24.5	14.8	22.2
23 Weighted Average Margin/ha (Tk)				13013.56								15326.75
24 Cropping Intensity				2.00								2.08
25 Margin/hectare/year (Tk)				26027.12								31879.64
26 Actual Farm Size (ha)				1.50								1.50
27 Actual Margin/ha/year (Tk)				39040.68								47819.46

Notes

- Dampara (follow-up) Farm Household Survey.
- Percentages assumed to be the same as for the whole region for all farm sizes (see main text).
- 7.8.9. FPCO, Guidelines for Project Assessment, Dhaka, 1992.
- Variable costs assumed to have a linear relationship to average yields.
- Dampara (follow-up) Farm Household Survey.
- Includes loan interest for short term credit and miscellaneous expenses (see main text).
- From Dampara (follow-up) Farm Household Survey.
- Assumes excluded crops have the same average gross margin for all farm sizes.



Table 28 : Farm Budget Analysis, Large Farm (Taka 1991)

Item	Present					FWO					FW				
	LT Aman	HYV Aman	L Boro	HYV Boro		LT Aman	HYV Aman	L Boro	HYV Boro		LT Aman	HYV Aman	L Boro	HYV Boro	
1 REVENUE															
2 Yield:Damage Free(mt/ha)	1.90	3.15	2.35	4.60		1.90	3.15	2.35	4.60		1.90	3.15	2.35	4.60	
3 Area:Damage Free(%)	21.7	9.4	98.7	92.9		15.1	16.0	98.8	92.7		77.6	93.6	100.0	100.0	
4 Yield:Damaged(mt/ha)	1.62	2.56	1.80	4.00		1.62	2.56	1.80	4.00		1.62	2.56	1.80	4.00	
5 Area:Damaged(%)	78.3	90.6	1.3	7.1		84.9	84.0	1.2	7.3		22.4	6.4	0.0	0.0	
6 Average Yield(mt/ha)	1.68	2.62	2.34	4.56		1.66	2.65	2.34	4.56		1.84	3.11	2.35	4.60	
7 By Product Factor(mt/mt)	2.0	1.0	2.0	1.0		2.0	1.0	2.0	1.0		2.0	1.0	2.0	1.0	
8 Prices of Main Product(Tk)	6438.00	6438.00	6212.00	6212.00		6438.00	6438.00	6212.00	6212.00		6438.00	6438.00	6212.00	6212.00	
9 Prices of By Product(Tk)	950.00	700.00	950.00	700.00		950.00	700.00	950.00	700.00		950.00	700.00	950.00	700.00	
10 Value of Production(Tk)	14014.18	18669.15	19005.20	31500.75		13860.09	18947.11	19009.66	31492.45		15319.24	22215.17	19063.20	31795.20	
11 COSTS (Tk)															
12 Labour Costs(Hired)	3141.72	4551.18	3497.88	5722.50		3179.77	4529.36	3497.85	5722.50		2876.69	4326.20	3497.34	5722.50	
13 (% Hired)	60%	70%	65%	75%		60%	70%	65%	75%		60%	70%	65%	75%	
14 Bullock	2815.31	2986.86	1233.94	1701.00		2848.41	2872.55	1233.93	1701.00		2577.82	2839.21	1233.75	1701.00	
15 Seeds	380.81	476.14	575.84	612.00		385.43	473.86	575.83	612.00		348.69	452.60	575.75	612.00	
16 Fertilizers	225.38	660.92	449.51	1061.00		228.11	657.75	449.50	1061.00		206.37	628.25	449.44	1061.00	
17 Pesticides	51.49	103.64	162.57	441.00		52.11	103.14	162.57	441.00		47.14	98.51	162.54	441.00	
18 Irrigation	0.00	0.00	455.38	1800.00		0.00	0.00	455.38	1800.00		0.00	0.00	455.31	1800.00	
19 Others	614.94	747.94	428.94	675.00		622.39	744.35	428.94	675.00		563.06	710.99	428.87	675.00	
20 Cost of Production	7230.25	9527.38	6804.71	12013.25		7316.82	9381.71	6804.65	12013.25		6620.37	9056.46	6803.65	12013.25	
21 MARGIN/HECTARE	6783.93	9141.77	12200.49	19487.50		6543.27	9565.40	12205.01	19479.20		8698.87	13158.71	12259.55	19781.95	
22 Cropped Area(%)	27.0	13.0	11.0	4.0		25.4	14.3	11.8	39.5		18.0	22.7	10.8	38.6	
23 Weighted Average Margin/ha(Tk)				12849.95						12842.67					14349.61
24 Cropping Intensity				1.76						1.76					1.83
25 Margin/hectare/year (Tk)				22615.91						22603.10					26259.79
26 Actual Farm Size/ha				4.00						4.00					4.00
27 Actual Margin/ha/year (Tk)				90463.65						90412.40					105039.15

Notes

2. Dampara(follow-up) Farm Household Survey.
- 3.5. Percentages assumed to be the same as for the whole region for all farm sizes (see main text).
- 7.8.9. FPCO, Guidelines for Project Assessment, Dhaka, 1992
11. Variable costs assumed to have a linear relationship to average yields.
13. Dampara (follow-up) Farm Household Survey.
19. Includes loan interest for short term credit and miscellaneous expenses (see main text).
22. From Dampara(follow up) Farm Household Survey.
23. Assumes excluded crops have the same average gross margin for all farm sizes.



