Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Water Resources Planning Organization

FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

KALNI-KUSHIYARA RIVER MANAGEMENT PROJECT FEASIBILITY STUDY

ANNEX E ECONOMICS

Final Report
March 1998

SNC ♦ Lavalin International
Northwest Hydraulic Consultants

in association with

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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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
CCF	Commodity Conversion Factor
CDN	Canadian
CEA	Canadian Executing Agency
cft	cubic feet
CHC	Canadian High Commission (Dhaka)
CIDA	Canadian International Development Agency
cm	centimetre
COP	Cost of Production
CPI	Consumer price index
DCA	Development Credit Agreement
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
FPCO	Flood Plan Coordination Organization
FW	Future With Project
FWO	Future Without Project
GOB	Government of Bangladesh
ha	hectare
HH	Household
hr	hour
HYV	High Yielding Variety
IRR	Internal Rate of Return
kg	kilogram
km	kilometre
KKRIP	Kalni-Kushiyara River Improvement Project
KKRMP	Kalni-Kushiyara River Management Project
m	metre
MCA	Multi-criteria analysis
mm	millimetre
mt	metric tonne
NCA	Net Cultivable Area
NERP	Northeast Regional Water Management Project
NPV	Net Present Value
NSA	Navigation Survey Area
POL	Petroleum, Oil, Lubricants
SCF	Standard conversion factor
TA	Technical Assistance
TER	Total economic revenue
Tk	Taka (Bangladesh currency. $1 CDN = approx. Tk 30)
UNDP	United Nations Development Program
VP	Village Platform
WARPO	Water Resources Planning Organization

GLOSSARY

aman	monsoon rice crop
aus	pre-monsoon rice or rice grown in *kharif* I season.
b. *aman*	broadcast or deepwater *aman* rice grown in *Kharif* I and II seasons
bandhak	mortgage
beel	floodplain lake that may hold water perennially or dry up during the winter season
boro	rice grown during the winter season
chailla	a grass (Hemarthria protensa) grown in low-lying floodplains
class I channel	3.6 metre depth; 50 metre width perennial
class II channel	2.4 metre depth; 50 metre width perennial
class III channel	1.8 metre depth; 37 metre width perennial
class IV channel	1.5 metre depth; 37 metre width seasonal
country boat	wood hull boat of traditional design; capacity usually not more than 500 *maunds* (19 tonnes)
decimal	unit of land measure; 0.01 acre; 0.004 ha
dhaincha	leguminous plant (Sesbania sp.)
dry season	5 months: December-April inclusive
duar	scour hole in river bed which provides habitat for fish and river dolphins
golda chingri	giant freshwater prawn (Macrobrachium rosenbergii)
gur	mollasses
haor	depression on floodplain located between two or more rivers
IWT craft	steel-hull boat 350-500-tonne capacity; single screw
rabi	dry season
t. *aman*	transplanted *aman* rice grown in *Kharif* II season or monsoon season
taka (tk)	unit of currency, 1 US $ = 40 taka (approx.)
wet season	7 months: May-November inclusive

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1. INTRODUCTION

The Flood Action Plan (FAP 6) in the Northeast Regional Water Management Project (NERP) comprises a large number of studies and pilot projects which are expected to lead to improved water resources' management with an emphasis on flood control and drainage.

The overall goal of the proposed Kalni-Kushiyara River Management Project (KKRMP) is to enhance economic activities and the quality of life in the Kalni-Kushiyara River basin. The project's purpose is to:

- improve the river's long term stability and to create a more stable environment for development;
- reduce damage to agriculture by controlling pre-monsoon floods and improving post-monsoon drainage;
- improve living conditions along the floodplain by reducing erosion damage to villages and homesteads and by creating new flood-free village platforms, and
- improve navigation along the Kalni-Kushiyara River during the dry season.

These proposed project interventions would be carried out on the 168 km river reach between Fenchuganj on the Kushiyara River and the junction of the Dhaleswari-Bijna River channels just downstream of Madna (Figure E.1 and E.2). The affected project area would extend from the Upper Meghna River and Baulai River in the west, the Old Surma River in the north, Fenchuganj in the east, and the Bijna/Gangajuri/Sutang River systems in the south. The gross project area is 335,600 hectares.

Financial and economic cost-benefit analyses are key elements in the project evaluation process. The economic analysis must assess the socioeconomic viability of the project from a national perspective, while the financial analysis must assess the monetary impact of the project on both the beneficiaries and the Government of Bangladesh (GOB).

A pre-feasibility study of the (then)-proposed Kalni-Kushiyara River Improvement Project (KKRIP) (NERP, 1994 a)) was completed in November 1994, which included a preliminary Economic Analysis. It suggested that the proposed project should be feasible from an economic perspective.

The cost-benefit analysis of this feasibility analysis looks at the economic feasibility and financial impact of a revised Kalni-Kushiyara River Management Project implementation in more detail.

2. METHODOLOGY

The *Guidelines for Project Assessment* (FPCO, 1992 (a)) have been produced by the FPCO with the aim of standardizing 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 resources development projects and provide a good basis for achieving the degree of uniformity and comparability between FAP studies.

The FPCO *Guidelines for Project Assessment* outline the detailed costing procedures for capital, operation and maintenance (O&M) costs, the financial and economic prices to be used and areas for which benefits/disbenefits are to be analyzed. The FPCO *Guidelines* also illustrates the multi-criteria analysis which provides a comprehensive basis for conducting a comparison of expected impacts in economic, quantitative and qualitative terms.

For comparative purposes, all costs and benefits are valued in constant (non-inflated) 1995 prices for the duration of the analysis. The exchange rate assumed is Taka 41 = US$1.

Additionally, since commodity conversion factors (CCFs) are required to convert the (distorted) market value of specific commodities into (undistorted economic) border price equivalents, these are also provided in the *Guidelines*. NERP economists used the methodology outlined in the *"Special Study on Economics: Estimates of Economic Prices of Selected Commodities for Use in FAP Planning Studies"* (FPCO, 1992(b)) to subsequently determine the appropriate commodity conversion factors in terms of 1995 constant prices.

Other methodological procedures employed also generally adhere to the *Guidelines* and internationally-accepted principles. This requires the estimation of incremental benefit and cost streams over the entire economic life of the project. This is done by identifying and valuing all of the costs and benefits which will arise in the future with project (FW) scenario and comparing them with the situation as it would be in the future without project (FWO) scenario. The difference is the incremental net benefit arising from the proposed project investment (Gittinger, 1982). The economic life of the project is here considered to be 30 years including the pre-construction and construction periods.

The principal economic decision criteria employed are the net present value (NPV) and economic internal rate of return (EIRR), both calculated on the incremental net benefit resulting from the FW and FWO scenarios:

Net Present Value

Net Present Value (NPV) 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%/year excluding inflation).

Economic Internal Rate of Return

Economic Internal Rate of Return (EIRR) is that 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 of its costs and still break even. For a project to be economically feasible, the EIRR must be equal to or greater than the opportunity cost of capital (or "cut-off" rate) which in Bangladesh has normally to be greater than 12%/year, excluding inflation.

A sensitivity analysis was also conducted to measure the reliability and robustness of the 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 evaluated in the economic analysis include the following:

- Agricultural production and employment;
- Water Transportation;
- Fisheries, and
- Socioeconomic Infrastructure.

In each case, the impacts of 3 levels of flood protection were evaluated for the 1:2, 1:5 and 1:10 year pre-monsoon flood. The basic economic data used is drawn from NERP longitudinal and cross-sectional data, particularly the Land Use Survey and the Farm Household Survey (NERP, 1996 a) and b)).

3. PROJECT COST ESTIMATION

3.1 Capital Costs

Alternative 1
Alternative 1 includes the following components:

- Constructing loop cuts at Issapur and Katkhal;
- Re-excavating the reach between Kalma and Ajmiriganj by dredging;
- Constructing flood-resistant village platforms from the dredged spoil;
- Constructing bank protection works at various sites;
- Constructing levees along low banks to reduce spills;
- Constructing regulating structures for multi-purpose use, and
- Conducting maintenance dredging for improved navigation up to Fenchuganj.

Capital cost estimating procedures followed the FPCO *Guidelines*. Detailed quantity and cost estimates have been provided in Annex C - Engineering and Annex I - Environmental Impact Assessment. Physical contingencies equal to 15% of base construction costs as per the FPCO *Guidelines* were used to cover unforeseen costs. Engineering design and supervision costs were estimated at 12 % of base construction costs and physical contingencies. All capital costs are presented in terms of June 1995 constant prices using deflators determined by the Bangladesh Bureau of Statistics (BBS).

Table E.1 shows that total financial capital costs for Alternative 1 during Years 1 to 9 are estimated to be about Tk 2,788 million (1995 prices). These capital costs are inclusive of land costs and EMP costs (both mitigation and enhancement) programs, but exclusive of loan costs. A comparable economic capital cost estimate of about Tk 2,368 million was obtained by: a) excluding land compensation costs; and b) shadow pricing various construction costs using the updated conversion factors given in Appendix E.1, Table 3. A financial and economic capital cost summary, scheduled over 30 years, is provided in Appendix E.1, Tables 1 a), b) and c).

Table E.1: Direct Project Costs - Alternative 1

Costs	Capital (million Tk)	O&M Costs (million Tk/year)
	Years 1-9	Years 18-30
FINANCIAL COSTS	2,788	104.1
ECONOMIC COSTS	2,368	93.7

Source: Appendix E.1 Tables 1a), b) and c)

Table E.2 illustrates the percentage of total financial capital costs for the various project interventions for Alternative 1.

Table E.2: Relative Importance of the Various Project Interventions - Alterative 1

Interventions	Financial Costs (million Tk)	Percentage of Total Financial Costs (%)
Channel Dredging	603.36	0.2
Issapur Loop Cut	455.32	0.2
Katkhal Loop Cut	513.40	18.4
Channel Realignment	35.38	1.3
Homestead Platforms	298.45	10.7
River Training Works	110.67	4.0
Levees	10.86	0.4
Regulators	23.17	0.8
Madna Closures	1.45	0.1
EMP	57.60	2.0
BASE COST	**2,109.66**	75.6
Physical Contingency	316.45	11.4
SUB-TOTAL	2,426.11	87.0
Study Cost	291.80	10.5
Land Acquisition	70.02	2.5
TOTAL	**2,787.93**	**100.0**

The associated land use changes that are expected under Alternative 1 are summarized in Table E.3.

Table E.3: Changes in Land Use - Alternative 1

Land Use	Change in Area (ha)
Cultivated	-806
Settlements	+335
Village Vegetation	+330
Beels	0
Rivers	0
Channels	0
Fallow	-132
Infrastructure	0
NET CHANGE	**-273**

Land taken out of production by the project has been valued in terms of production foregone while lands created (i.e., raised village platforms and homestead gardens) help generate benefits directly attributable to the project.

Alternative 2

Alternative 2 proposes eliminating the Issapur loop cut but keeping all the other components, including river dredging between Madna and Ajmiriganj, channel realignment, local protective works and levees, navigation dredging and installation of structures at specific locations. Alternative 2 relies on more channel re-excavation and O&M dredging in the reach between Kalma and Kadamchal.

In this case, total financial capital costs (exclusive of loan costs) are estimated to be about Tk 2,366 million (1995 prices) while the equivalent economic capital cost (derived as per Alternative 1) is determined to be about Tk 2,030 million. A financial and economic project cost summary for Alternative 2, scheduled over 30 years, is provided in Appendix E.1, Tables 2(a), (b) and (c).

Table E.4: Direct Project Costs - Alternative 2

Costs	Capital (million Tk)	O&M Costs (million Tk/year)
	Years 1-9	Years 18-30
FINANCIAL COSTS	2,366	169.4
ECONOMIC COSTS	2,030	152.5

Source: Appendix E.1 Tables 2a), b) and c)

3.2 Operation & Maintenance Costs

The annual operation and maintenance (O&M) costs include:

- annual maintenance dredging;
- village platforms maintenance, and
- physical components maintenance.

The annual O&M costs, including 15% contingencies, for the annual dredging and platforms have been calculated based on the adapted estimating procedure for capital costs (Chapter 7 of the KKRMP Feasibility Study Main Report).

Following the FPCO *Guidelines*, O&M costs, for physical components including 15% contingencies, have been calculated as a percentage of capital cost, including 6% for embankment and drainage channels, 3% for structures, 10% for river bank protection and training and 3% for slope protection.

In Year 8, Alternative 1 O&M financial costs are Tk 134.5 million/year but then gradually drop to about Tk 104.1 million/year during Years 18-30. The corresponding annual economic Alternative 1 O&M costs at project maturity in Year 18 is about 93.7 million/year (Table E.1).

For Alternative 2, post-construction O&M costs are initially (in Year 8) relatively high at Tk 219.3 million/year but then gradually decline and stabilize at around Tk 169.4 million annually during Years 18-30 (Table E.4).

A Standard Conversion Factor (SCF) of 0.9 has been used to convert the financial O&M costs into economic O&M costs. Conversion factors for project inputs are presented in Appendix E.1, Table 3.

3.3 Phasing & Disbursement

There are essentially 4 proposed Phases for the implementation and O&M of the project intervention:

- Years 1-2: Pre-Construction, which includes cadastral surveys, topographic surveys, detailed engineering design, tender documentation, awarding of contracts, and land acquisition;
- Years 3-4: Construction, which focuses on the Loop Cuts, Dhaleswari Dredging and closely related activities;
- Years 5-7: Construction, which focuses on Channel Dredging and Channel Re-Alignments, River Training and Levees. This includes most dyking, platform development, slope protection, and EMP activities, and
- Years 8-30: O&M activities, including EMP construction and protection of homestead platforms, as well as additional dredging and platform development.

4. AGRICULTURE

4.1 Expected Flood Impacts on Cultivated Land

The largest beneficial impact of the proposed Kalni-Kushiyara River Management Project would accrue to the agricultural crops sector. Crop damage due to over-bank spills, inundation and breaches in the river banks during the pre-monsoon season would be reduced and flood free lands would be increased. The pre-monsoon flood impacts on cultivated land are shown in Table E.5.

Table E.5: Pre-Monsoon Flood Impacts on Cultivated Land

Depth of Flooding	1:2 year Pre-Monsoon Flood		1:5 year Pre-Monsoon Flood		1:10 year Pre-Monsoon Flood	
	FWO (ha)	FW[1] (ha)	FWO (ha)	FW[1] (ha)	FWO (ha)	FW[1] (ha)
Flood Free	200,988	265,405	61,336	116,862	6,007	50,767
0.3 - 0.9 m	39,808	485	56,249	49,098	30,886	19,247
0.9 - 1.8 m	28,140	7,000	104,751	71,070	112,370	111,465
>1.8 m	8,010	4,534	54,609	40,394	127,682	95,945
Total Flooded Area	**75,958**	**12,019**	**215,609**	**160,562**	**270,938**	**226,657**
Total Cultivated Area	**276,945**	**277,424**	**276,945**	**277,424**	**276,945**	**277,424**
Flooded/Cultivated (%)	27	4	78	58	98	82

Note 1: Alternative 1

Reduced spills in the pre-monsoon season would enable farmers to harvest more local and high-yielding varieties (HYV) of *boro* rice. As a result, production would be expected to increase at least to the level that other farmers are obtaining under damage-free conditions. This might also induce farmers to replace some of the local *boro* with HYV of *boro* rice. Pre-monsoon flooding, however, would not be eliminated from the project area, but flood damages would be reduced. Reduction in the depth of flooding during the pre-monsoon season would also modestly reduce the damage to local varieties of broadcast *aman* in the early growing stages of this early monsoon crop.

But there would be no change in monsoon flooding conditions after implementation of the project. Therefore, these cropping patterns would remain similar to those under the FWO scenario.

Finally, drainage improvements in the post-monsoon season should make more land available for cultivation early in the *rabi* season, thus facilitating more timely planting of *rabi* crops. Farmers are expected to utilize residual soil moisture by growing more *rabi* crops and, thus, the area under rabi crop cultivation is also expected to increase. This would include fodder crops to meet cattle feed requirements.

Briefly, then, it is expected that the pre-monsoon flood control benefits to agriculture would essentially derive from the following changes:

- the proportion of damage-free to damaged area will increase and thereby reduce pre-monsoon flood losses which, in turn, will increase the overall average yield per hectare of land, and
- changes in the area under a particular crop will arise due to a shift in production from one crop to another.

This is the general scenario that was simulated and presented in the following sections:

- Cropping Patterns;
- Crop Yields;
- Crop Prices;
- Crop Revenue;
- Crop Costs of Production;
- Net Return;
- Incremental Flood Control Benefits;
- Phasing of Benefits, and
- Summary of Production Impacts.

4.2 Cropping Patterns

Cropping patterns in the project area are largely determined by the topography in relation to flooding regimes during the pre-monsoon and monsoon periods, in conjunction with the frequency and availability of moisture and irrigation water during the *rabi* (dry) season. Flood regimes for each of the 3 "seasons" are defined in terms of their frequency, duration, and depth. The cropping pattern actually selected is also affected by the level of risk farmers are both willing and able to assume. However, cropping patterns are expected to remain relatively insensitive to potential future changes in the market place.

The composite (or average) project area cropping pattern over the course of a calendar year (i.e. 3 seasons) is made up of numerous crop rotations. The cumulative crop composition (or mix) determines the cropping intensity. In total, 15 principal crop rotations were identified, although all of the major rotations are based on paddy rice. (Annex F - Agriculture). These account for more than 95% of the net cultivated area. Irrigated HYV *boro* rice-fallow is the major rotation covering more than two-thirds of the total cropped area. Irrigated local *boro* rice is the second major crop occupying more than 15% of the net cultivated area. Single deep water *aman* rice occupies about 8% of the net cultivated area while broadcast *aus*-transplanted HYV *aman* occupies about 3%. The non-rice crops—including groundnut, sweet potato, vegetables and spices—are grown on less than 2% of the net cultivated area. The crops impacted by pre-monsoon floods (which occur at the end of the *rabi* season) are the crops actually being grown during that specific time period.

Summary tabulations of the actual and expected cropping patterns under different hydrological conditions are provided in Appendix E.1, Table 5. Additional details can be found in Annex F - Agriculture.

4.3 Crop Yields

Present & FWO Yield

Overflow from the Kalni-Kushiyara River system coupled with heavy rainfall submerges *boro* rice at its reproductive or ripening stage almost every year. Analysis of the agro-ecological characteristics and agricultural production system in the project area indicates that crop production in the monsoon season is limited because of deep flooding and variable flood depths. Almost the entire cultivated land area remains under flood water throughout the monsoon season.

In relatively high lands *boro* rice is transplanted as soon as the temperature permits and in low lands, as soon as the land is drained, and the crop remains in the field until the pre-monsoon season. *Boro* crop production is limited and highly variable because of the ever-present risk of pre-monsoon flash floods. Unstable food production and low average crop yields are common in the project area. It is unlikely that the situation will improve in the absence of the project.

FW Average Yields

The FW scenario will have a positive and relatively large impact on the *boro* rice crop and the *t. aus* rice crop, mainly because it will reduce pre-monsoon flood spills into the adjacent floodplain (at the end of the *rabi* season) and, to some extent, improve post-monsoon drainage (at the beginning of the *rabi* season).

Under the FW scenario, average yields of the agricultural land are weighted average yields calculated as follows:

Weighted Average Yields = **[Percentage of Damage-free Area * Damage-free Yield] + [Percentage of Flood-Damaged Area * Flood-Damaged Yield]**

Thus, with additional flood control, the percentage of damage-free land would increase and average yields for impacted crops would also increase.

The results of these calculations are provided for the Present conditions, FWO, and FW scenarios for the 1:2; 1:5; and 1:10 year floods (i.e 9 situations) in Appendix E.1, Table 6.

4.4 Economic Crop Prices

Both the financial and economic product prices are updated following the FPCO *Guidelines*. The economic prices are equal to financial prices times commodity conversion factors (CCF's) where the CCF's have been calculated to reflect the difference between distorted domestic prices and undistorted border (or shadow) prices. All the prices are expressed in terms of constant 1995 price levels (Appendix E.1, Table 4 a)).

4.5 Total Economic Crop Revenue

Total (gross) economic revenue (TER) is calculated as follows:

TER = Cultivated Area [Section 4.2] * Average Yield [Section 4.3] * Economic Price [Section 4.4]

The total physical cultivated areas are: 279,850 hectares, 276,945 hectares, and 277,424 hectares for the Present conditions, FWO, and FW scenarios, respectively. This represents over 80% of the total project area.

Total production estimates of main products and by-products are indicated in Appendix E.1, Tables 7 (a) and 7 (b), respectively.

Total economic revenue estimates for each individual crop under different situations are summarized in Appendix E.1, Table 8. The weighted average gross revenue per cropped hectare in the project area under each of these situations is presented in Table E.6.

Table E.6: Agriculture Weighted Average Gross Economic Revenue

Scenario	Agriculture Average Gross Economic Revenue (Tk/ha)		
	1:2 year	1:5 year	1:10 year
Present	28,240	22,222	19,308
FWO	27,090	21,420	19,171
FW	29,948	23,852	21,134

4.6 Costs of Crop Production

The input requirements per hectare are determined for each crop for the Present conditions, FWO and FW scenarios (Appendix E.1, Table 9). The production inputs include labour, fertilizer (i.e., nitrogen, phosphorus and potassium but excludes minor nutrient elements, including sulphur, zinc, magnesium, etc.), traditional and modern irrigation methods, draught animals, seeds and pesticides.

For the economic analysis, all labour is included in the analysis, whether this is family labour or hired labour. At the same time, loan interest costs for borrowed working capital and miscellaneous expenses are not included in the economic tabulations. Miscellaneous expenses are assumed to be equal to 10% of the cash costs. Loan interest is calculated following the FPCO *Guideline*; 17.5% interest per annum for a period of 6 months in a year and for 80% of the cash cost of production.

All inputs are costed according to the FPCO *Guidelines* where:

Economic Input Cost = Financial Input Cost * CCF for crop input
(Appendix E.1, Table 4(b))

Total costs-of-production are then calculated as:

Per-Hectare Input Requirements * Cultivated Area * Economic Input Prices

On this basis, the total costs-of-production for each individual crop under the 9 different situations have been prepared, and they are summarized in Appendix E.1, Table 10. The weighted average economic cost-of-production per cropped hectare in the project area under each of these situations is presented in Table E.7.

Table E.7: Weighted Average Economic Agriculture Cost of Production

Scenario	Weighted Average Economic Cost of Production (Tk/ha)		
	1:2 year	1:5 year	1:10 year
Present	14,439	14,439	14,439
FWO	14,474	14,474	14,474
FW	14,636	14,636	14,636

4.7 Net Return

The net return (sometimes called a gross margin) for each crop has been determined for the same 9 situations by subtracting the respective costs-of-production (Section 4.6) from the expected gross revenue (Section 4.5), and they are summarized in Appendix E.1, Table 11. On this basis, the weighted average economic gross margin per cropped hectare in the project area under each of these situations has been estimated and they are presented in Table E.8.

Table E.8: Weighted Average Economic Agriculture Gross-Margin

Scenario	Weighted Average Economic Agriculture Gross Margin (Tk/ha)		
	1:2 year	1:5 year	1:10 year
Present	13,801	7,783	4,869
FWO	12,616	6,946	4,697
FW	15,312	9,216	6,498

4.8 Agriculture Incremental Flood Control Benefits (Annual)

Expected net returns under different hydrological regimes for the FWO and FW scenarios have been determined for the 1:2, 1:5 and 1:10 year pre-monsoon floods. The difference between these 2 scenarios (Appendix E.1, Table 11 and 12) is an estimate of the incremental agriculture flood economic control benefits under these particular regimes. These are summarized in Table E.9.

Table E.9: Annual Agriculture Flood Control Economic Benefits

Scenario	Agriculture Flood Control Economic Benefits (million Tk)		
	1:2 year	1:5 year	1:10 year
FW	4,324	2,602	1,835
FWO	3,518	1,937	1,310
Difference	806	665	525

Note: Economic Benefits are calculated as Net Return times Total Areas.

It is assumed that the expected net annual agricultural benefits are zero for pre-monsoon flood return periods less than 1:1.4 year (present river bankfull) and for return period greater than 20 years (complete inundation).

The estimated annual agriculture economic benefits expressed as a function of pre-monsoon flood frequency is illustrated in Graph E.1.

Using Graph E.1, the expected average annual agriculture benefits can be calculated using one of the two following methods:

- Method 1: Average of interpolated/extrapolated midpoint for the entire range of flood frequency, and
- Method 2: Summation of (trapezoidal) areas between discrete flood frequency intervals.

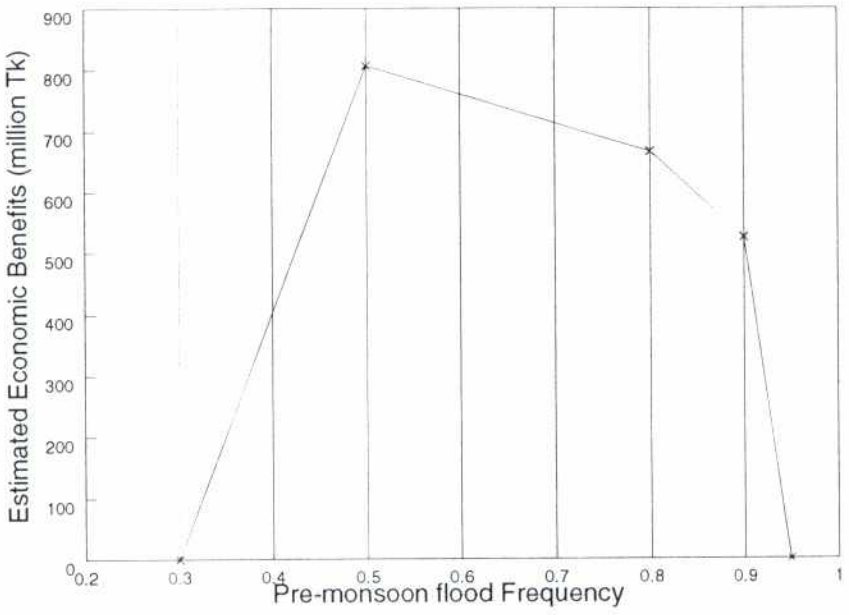
The results of these calculations, using both the methods, are presented in Table E.10.

Table E.10: Calculated Expected Average Annual Agriculture Economic Benefits

Return Period (years)	Flood Frequency[1] (Non-Exceedence)	Calculated Expected Average Annual Agriculture Benefits (million Tk)	
		Method 1	Method 2
	0.25	0.0	0.0
1:1.4	0.30	0.0	0.0
	0.35	201.5	5.0
	0.40	402.9	15.1
	0.45	604.4	25.2
1:2	0.50	805.9	35.3
	0.55	782.4	39.7
	0.60	758.9	38.5
	0.68	735.4	37.4
	0.70	711.8	36.2
	0.75	688.3	35.0
1:5	0.80	665.3	33.8
	0.85	594.8	31.5
1:10	0.90	525.1	28.0
1:20	0.95	0.0	13.1
1:100	0.99	0.0	0.0
Sub Total		**7,475.8**	
Average Expected Annual Agriculture Benefits		373.8[2]	373.8

Notes: 1. Frequency = [1-(1/r)] where "r" =return period.
2. Average Expected Benefits = Sub-total method 1 divided by 20 flood frequency intervals of 0.05.

Graph E.1 : Annual Agriculture Expected Economic Benefits



These calculations indicate that the average expected annual agriculture economic benefit amounts to about Tk 374 million. On a per-hectare basis, this translates into about Tk 1,348/year (or, at the current exchange rate, about $US 33/year ha). As a point of reference, this would be about 14%of a typical gross margin/year ha. (Section 4.7)

4.9 Phasing of Benefits

The two loop cuts are scheduled to be completed in January-February of Year 4, before the possible occurrence of pre-monsoon floods. The immediate effect will be a lowering of water levels in the Kalni River below Ajmiriganj, offering partial flood protection. The proposed KKRMP project will then provide 40% of the pre-monsoon flood protection benefits immediately after the completion of the loop cuts. Consequently, 40% of agricultural benefits are expected to accrue beginning in Year 4. These benefits would then climb at about 20%/year and reach their maximum in Year 7. This is a relatively quick start-up and maturation of the anticipated agricultural benefit stream (Table E.11).

Table E.11: Phasing of Annual Agricultural Expected Economic Benefits

Year	Years 1-3	Year 4	Year 5	Year 6	Years 7-30
Annual Agriculture Expected Economic Benefits (million Tk)	0	150	224	299	374
Phasing Regime (%)	0	40	60	80	100

4.10 Summary of Production Impacts

Under FW scenario, the production of HYV *boro* rice is expected to increase as it will displace local varieties in the new flood free lands. Also, as a result of the construction of the Koyer Dhala regulator, supplementary surface water will become available and some land presently fallow will be brought under cultivation. The project is expected to increase rice production from 615,000 tonnes in the FWO scenario to 697,900 tonnes in the FW scenario (Alternative 1) which represents a 13.4% increase. Conversely, it is expected that non-cereal crop production will actually decrease from about 34,900 tonnes in the FWO scenario to only 29,000 tonnes in the FW scenario representing about a 6% decrease. However, the potential for producing more *boro* rice will alleviate the current pressure for growing this crop and it is likely that farmers will in time switch some of the production to non rice crops. At the same time, the cropping intensity is largely unaffected.

The project will also impact employment in the region. Largely due to crop production increases, labour requirements will climb approximately proportionally (10%) for harvest and post-harvest activities. This translates into perhaps a 2.4% overall increase in agricultural employment. This is particularly important in two respects: 1) under-utilization of labour during the *boro* (winter) season is reduced; and 2) this would affect women disproportionately more because they conduct most post-harvest activities at the homestead.

The sources of incremental agricultural production are provided in Table E.12.

Table E.12 Sources of Incremental Agricultural Production

ITEM	Agricultural production[1] ('000 tonnes)				
	Present	FWO	FW	FW-FWO	FW- FWO (%)
Boro Paddy Production	877.6	828.5	949.9	121.4	14.7
Aus Paddy Production	52.6	54.9	53.9	-1.0	-1.9
Aman Paddy Production	22.1	21.1	22.1	1.0	4.9
TOTAL PADDY HYV/TOTAL (%)	**952.3** 84.3	**904.5** 85.0	**1,025.9** 86.7	121.4	13.4
TOTAL RICE (2)	**647.6**	**615.1**	**697.9**	**82.8**	**13.4**
TOTAL NON-CEREAL PRODUCTION	29.2	34.9	29.0	-5.9	-16.9

Notes: 1. Calculated as a weighted average of three flood probability distributions: 1:2; 1:5; and 1:10.
2. Conversion factor = 0.68 tonne of rice/tonne of paddy.

5. WATER TRANSPORTATION

Since the early 1960's, the Kalni-Kushiyara river navigation channel between Fenchuganj and Astagram has deteriorated from a Class I perennial navigation river to a Class IV seasonal river route. Silting and shoaling is now so extensive it is creating serious draft problems for navigation during the dry season (December-April). This is equally true of the various tributaries, especially the Manu River, Khowai River, and the Kalni-Baulai connecting channel.

The proposed project would provide for a Class II navigation channel (defined as 2.4 m LAD and 50 m wide) throughout the *rabi* (dry) season between Fenchuganj and Astagram.

5.1 Baseline Data

A detailed traffic survey was undertaken within the 110 km reach between Madna and Sherpur. It concentrated on a 5 km band on each side of the river. The full river reach includes a section of the south bank of the Kalni-Kushiyara that is outside the project area.

A general profile of existing water transport in the region (12 stations, NERP, 1995) is indicated in Table E.13.

Table E.13: Kalni-Kushiyara River Transportation Profile, 1995

Item	Dry Season	Monsoon Season	Annual
No. of Boat Trips	147,680	675,207	822,887
Total Cargo ('000 tonnes)	179	292	441
Passengers ('000)	3,333	6,355	9,688

Of the total cargo, the important traffic items are: paddy & milled rice (21.4%), fertilizer (19.0%), building materials (rock, sand, cement, rod, etc.), fruits and vegetables (10.3%), and consumer goods (3.8%).

5.2 Cargo Benefit Calculations

The potential navigation benefits for cargo movements are based on estimated cost savings and projected cargo volumes. The summation of the cost savings generated from different types of cargo movement is considered to be the total navigational impact of the project.

Cost Savings
The expected cargo movement cost savings are mostly based on estimates of the differences between wet and dry season freight rates. This is calculated as the differences between IWT type craft rates operating at 2.4 m LAD versus dry season rates for country boats. The cargo cost savings are estimated to be as shown on Table E.14.

Table E.14: Cargo Cost Savings

Commodity	Savings (Tk/tonne)
Fertilizer:	
Project area use	67.5
Rehandled	12.5
Trans-shipment	122.5
Through-traffic	36.0
All Other Commodities	**64.5**

Possible cost savings also include the increase in the dry-season traffic movement on the Kalni-Kushiyara river which would be diverted from other channels and roads.

Cargo Profiles and Forecasts

For the purposes of projecting cargo traffic movements, commodities have been grouped into 6 main headings: rice/paddy, fertilizer, building materials, petroleum/oil/lubricants (POL), other food items, and consumer goods/miscellaneous. Each one is briefly profiled below.

Fertilizer

Fertilizer is the main industrial traffic on the river. It consists of an internal demand component, internal rehandle, trans-shipment, and through-shipments.

Much of the project area is dedicated to paddy production. Thus, the *internal* (i.e. project area) *demand* for fertilizer is largely determined by paddy fertilizer requirements. The initial fertilizer demand under the FW project situation is estimated from cropping pattern projections (see Agriculture preceding), the total cultivated area within 5 km band on each side of the river, and estimated fertilizer application rates (Table E.15).

Table E.15: Fertilizer Application Rates and Cultivated Area

Fertilizer	HYV *Boro* (kg/ha)	Local *Boro* (kg/ha)	B *Aus* (kg/ha)	Origin
Urea	134.7	42.4	7.0	Fenchuganj
TSP	73.3	19.1	0	Bhairab Bazar
MP	26.3	2.1	0	Bhairab Bazar
Net Cultivated Area within the 5 km band each side of the River:				**138,900 hectares**

Fertilizer is assumed to be transported during the dry season to meet the planting schedules of these winter-sown crops. The resulting estimate of 21,760 tonnes is then expected to increase at the same rate as national fertilizer consumption growth rates during the last five years which is about 3%/year during the life time of the project .

Since commodities tend to move from the wholesale market to the local market and then to the village, there is also an *internal rehandled* component. The NSA traffic survey estimated that this was presently about 7.5% of net inbound cargo during the dry season, over 20% in the monsoon season. Therefore, a 10% rehandling factor was assumed. The resulting estimate of 2,176 tonnes is also expected to increase at a rate of 3%/year during the life time of the project.

Additionally, there are fertilizer *trans-shipments* because of the presence of major fertilizer wholesalers (at Kakailseo and Ajmiriganj) within the project area. These wholesalers buy large quantities of urea from the Fenchuganj plant and then retail it to farmers in the project area. At present the merchants in Kakailseo and Ajmiriganj ship some 28,000 tonnes in excess of local needs and they have indicated that with a more effective dry season navigation channel they could increase their business about 30%. Based on this, it is assumed that fertilizer trans-shipments during the dry season should amount to about 36,000 tonnes and it is assumed it will remain constant at that level during the life time of the project.

Finally, fertilizer *through-shipments* through the project area must also be considered. It is expected that this will involve 10,000 tonnes from the existing fertilizer plant at Fenchuganj and 150,000 tonnes from the Shah Jalal plant when it commences operations in about the Year 2000. Therefore, the resulting estimate of 160,000 tonnes is assumed to remain constant during the life time of the project.

Rice/Paddy

Most smaller farmers in the project area typically consume or sell most of their *boro* (dry-season) paddy during the monsoon season and then subsequently buy milled rice in the local market during the dry season. This rice comes from either larger local farmers who retain part of their *boro* production through the wet season or imports from Bhairab Bazaar through the Kalni-Kushiyara river channel.

The NERP navigation survey shows that for the existing population within the 5 km band on each side of the river, during the dry season (5 months), the demand for rice exceeds the rice production by 30,000 tonnes.

Therefore, this KKRMP project area presently imports about 30,000 tonnes of rice equivalent to 44,000 tonnes of paddy, during each dry season of which 24,000 tonnes come from Bhairab Bazar and 6,000 tonnes from Habiganj. Thus, by further assuming that the ratio of imported rice to the total rice demand in the area remains the same for the entire life of the project, future rice import estimates are tied to population growth projections (Table E.17; Appendix E.1, Table 13).

Building Materials

This commodity group covers materials such as cement, reinforcing rods, sand, stone, shingles and bricks, and is largely an urban demand. Virtually all building takes place in the dry season. Survey data indicates that the urban per capita consumption of building materials is about 0.97 tonnes, implying a present use-level of about 72,690 tonnes. About 62% of the building materials are estimated to presently move in the wet season while the remaining 38% move in the dry season. As a result, the price of building materials moved in the wet season is inflated by storage costs while the price of building materials moved during the dry season is inflated by higher transport costs.

In the future it is expected that the total demand for building materials will increase by 3%/year during Years 2-10, 4%/year during Years 11-20, and 5%/year during Years 21-30.

Petroleum, Oil & Lubricants (POL)

The demand for petroleum, oil, and lubricants largely depends on irrigation and urbanization in the area. Shipments to the region during the dry season are much greater than during the monsoon season because fuel is required for *boro* rice/paddy irrigation pumps. The traffic survey

conducted indicated that the current movement was about 7,300 tonnes for rural use and 3,100 tonnes for urban use, giving a total movement of about 10,400 tonnes in the full river reach.

In the future, it is expected that the demand for POL by the urban population in the area will increase (like building materials) by 3%/year during Years 2-10; 4%/year during Years 11-20; and 5%/year during Years 21-30. Traffic movements of POL to meet the demand for the rural population are expected to increase at a slightly slower rate: 3%/year during Years 2-10 but only 3.5/year during Years 11-30.

Other Food Items

This includes fruits and vegetables, wheat and flour, salt, molasses/*gur*, and spices. The current dry season movements are shown in Table E.16.

Table E.16: Other Food Items - Current Dry Season Freight Traffic

Other Food Items	Traffic ('000 tonnes)
Vegetables & Fruit	8.9
Wheat & Flour	7.1
Salt	1.6
Molasses/Gur	1.6
Spices	0.4
TOTAL	**19.6**

Assuming per capita consumption of these items remains the same in the future, future cargo movements during the dry season are similarly tied to population trends.

Other Consumer Goods/Miscellaneous

This category includes consumer goods and other unidentified items such as timber, clothing, shoes, etc.. The traffic survey indicates that the net inbound cargo movements of these items during the dry season presently amounts to about 30,800 tonnes on the full river reach. It is expected that per capita consumption of these items will also remain the same over the life time of the project.

Rehandling Factor

The NSA traffic survey for the dry season indicates a rehandling percentage of 7.5% of net inbound cargo. It is expected that the rehandle percentage will increase to 10% after the project is implemented.

Phasing

It is expected that the navigation economic benefits from the proposed initiative (project) would be gradually phased in from 0% during Years 1-4; 20% during Year 5; 40% during Year 6; and 100% during Years 7-30.

Summary

A summary of the base data employed to project future cargo transportation benefits, for the proposed intervention, is provided in Table E.17. The economic unit navigation cost savings are calculated by applying the Standard Conversion Factor (SCF=0.9) to the Financial unit cost saving.

Table E.17: Navigation Benefits Parameters for Economic Analysis

ITEM	Unit Cost Saving (Tk/tonne)		Dry Season Baseline Quantity (tonnes) Year 1	Annual Growth of Cargo Movement Years 2-30 (FW) (%)		
	Financial	Economic		2-10	11-20	21-30
Fertilizer Demand	67.5	60.8	21,760	3%		
Fertilizer (Rehandled)	12.5	11.3	2,176			
Fertilizer (Trans-Ship.)	122.5	110.3	36,000	constant		
Fertilizer (Through-Ship)	36.0	32.4	160,000			
Rice	64.5	58.1	30,000	function of population		
Bldg. Materials	64.5	58.1	72,690	3%	4%	5%
POL Items	64.5	58.1				
Urban			3,123	3%	4%	5%
Rural			7,287	3%	3.5%	3.5%
TOTAL			**10,410**			
Other Food Items	64.5	58.1	19,600	function of population		
Consumer Goods & Miscellaneous	64.5	58.1	30,820			
Rehandling Factor	64.5	58.1	10% non-fertilizer			

The detailed economic simulations are provided in Annex G - Navigation, and indicate that the following expected cargo transportation annual economic benefits should arise (Table E.18).

Table E.18: Expected Cargo Transportation Economic Benefits

Year	Navigation Benefits (million/Tk)	Year	Navigation Benefits (million/Tk)
1-4	0.0	17	25.9
5	(20%) 4.3	18	26.4
6	(40%) 8.6	19	26.9
7	(100%) 21.9	20	27.4
8	22.2	21	28.1
9	22.6	22	28.7
10	22.9	23	29.4
11	23.3	24	30.1
12	23.7	25	30.8
13	24.1	26	31.5
14	24.6	27	32.3
15	25.0	28	33.1
16	25.5	29	34.0
		30	34.9

Source: Appendix E.1, Tables 14, 15 and 16

5.3 Passenger Benefits

Although passengers should realize some savings, most of these are likely to be time-related rather than actual reduced travel costs. For example, a passenger might reduce his travel time from 5 hours to 4 hours and this time-saving could have an opportunity cost (or implied benefit) similar to his/her hourly wage rate. Additionally, improved access to more remote areas during the *rabi* season will inevitably generate additional commercial activity which would then translate into more direct and indirect (i.e. spin-off) employment opportunities. This includes additional employment for boat crews.

For example, if dry season passenger traffic was equal to even 75% of monsoon season passenger traffic, this would suggest that passenger traffic could climb by 800,000 people. Thus, even if each passenger saved or generated just 20 additional Takas from this economic activity (which is about 50% of a farm labourers daily wage), it could amount to some Tk 16 million/year. However, this benefit is not included in the economic assessment, because the available data does not distinguish between passengers on purely local routes and those on longer runs where savings may be achieved.

5.4 International Traffic Benefits

The proposed project would also make it physically possible to accommodate additional international *transit traffic* through the Kalni-Kushiyara River reach.

Recent traffic volume is only 24,000 tonnes/year but could climb over 250,000 tonnes/year (Annex G—Navigation). This may increase the benefit from Tk 2.4 million to Tk 25.0 million per year or even more, assuming a freight rate of Tk 100/tonne. However, this benefit is not included in the project's economic assessment since it is dependent on future political decisions.

6. FISHERIES

6.1 Physical Impacts

The project is expected to impact on fisheries in the following ways:

- it will facilitate migration by increasing the depth and wetted surface area of the main river during the dry season and reducing the rate of beel siltation;
- loop cuts will eliminate 6 *duars* which will have an adverse affect on fish populations (although these *duars* are in the process of natural siltation anyway);
- although there will be no reduction in the seasonally-flooded area, the hectare-months of inundation could be reduced by a few weeks during the pre-monsoon season and, in turn, this could have a marginally adverse impact on fish biodiversity, and
- installation of a fishpass at Koyer Dhala will enhance fish production in the Kodalia Fishery.

The Present conditions, FWO and FW scenario analyses are based on primary data, including data from the NERP Fishing Effort Survey and the Catch Assessment Survey conducted in the Kalni-Kushiyara River system area over a two-year period.

Production projections for each habitat for both the FWO and FW scenarios were obtained by multiplying the area of each habitat with the corresponding production per hectare of area. Total capture represents the aggregate of riverine, floodplain and beel in terms of catch per unit of effort (ie., kilograms per hectare per year). In the FWO scenario, a dramatic decline (12%) in the Kalni-Kushiyara is expected due to the sedimentation process as well as lesser decreases of 3% in other flowing rivers, closed or dead rivers, and distributaries. Additionally, in the floodplain habitats a gradual decrease of 2% in fish production is expected while the beel areas could see dramatic declines in fish production in the order of 15% (Annex H - Fisheries).

The incremental production represents the difference in total fisheries' production in the FW and FWO scenarios, as presented in Table E.19.

Table E.19: Projected Changes in Fish Production

Habitat Group	Present Production (tonnes)	FWO Production (tonnes)	FW Production (tonnes)	Impact FW vs Present (tonnes)	Impact FW vs FWO (tonnes)
Riverine	2,251	2,141	2,748	497	607
Floodplain and Beels	48,265	46,407	46,523	(1,742)	116
Floodplain culture Ponds	4,036	3,834	4,440	404	606
TOTAL	**54,552**	**52,382**	**53,711**	**(841)**	**1,329**

6.2 Financial and Economic Prices

Fish species' market prices were taken from the Fish Market Price Survey (NERP, 1996 c)). This information was obtained from a two-year survey conducted by NERP fisheries' specialists. The available species of fish have been grouped into carp species, catfish and other large species, *golda chingri* and small fish. Fish market prices have been converted to 1995 constant prices using the fisheries sector deflator determined by the Bangladesh Bureau of Statistics (BBS). The updated standard conversion factor (SCF) has been used to reflect the fish market prices in terms of their economic price, (i.e. SCF = 0.90). The estimated weighted average market price is Tk 50/kg liveweight for open access capture fish; Tk 75/kg for pond culture fish (Annex H).

6.3 Harvest Costs

Harvest costs have been determined for open access capture in both the river and floodplain (floodplain plus *beels*) and pond cultures. Costs have been converted from a per hectare basis to a per kilogram basis using the same methodology than the one adopted in the Dampara Water Management Project, Feasibility Study (NERP, 1997). These costs take into account the amortized cost of gears and boats, other material costs such as bamboo and rope, lease costs, guarding, maintenance, and labour. The fisheries harvest cost estimates are summarized in Table E.20.

Table E.20: Fisheries Harvest Cost Estimates

Habitat Group	Financial Harvest Costs (Tk/kg)	Economic Harvest Costs (Tk/kg)
Riverine	6.8	5.9
Floodplain and Beels	20.3	17.7
Ponds	45.6	39.7

6.4 Revenue, Incremental Benefits, and Phasing

Applying the economic prices to the projected production change provides an estimate of the additional net revenue earned from fisheries production when the project is implemented (Table E.21).

Table E.21: Expected Fisheries Net Economic Revenue Benefits

Habitat Group	Production Increase (tonnes)	Economic Price (Tk/kg)	Economic Harvest Cost (Tk/kg)	Net Economic Revenue Benefits (million Tk)
Riverine	607	45.0	5.9	23.7
Floodplain and *Beels*	116	45.0	17.7	3.2
Ponds	606	67.5	39.7	16.8
TOTAL	**1,329**			**43.7**

In Summary, the annual fisheries production is expected to increase when the project is implemented. The annual expected net economic revenue benefits for fisheries will be Tk 43.7 million at maturity (Year 9).

It is expected that the fisheries economic benefits would be gradually phased in from 0% during Years 1 to 5; 20% during Year 6; 40% during Year 7; 80% during Year 8 and 100% during Years 9 to 30.

7. SOCIOECONOMIC INFRASTRUCTURE

The expected benefits of the proposed project to the socioeconomic infrastructure of the region are numerous and varied. They include the following:

- Kalni-Kushiyara river bank flood protection;
- Additional river bank protection & related land development;
- Village platform (VP) flood and wave protection;
- VP homestead gardens, fruit trees and slope protection;
- VP homestead grain drying;
- Quality of life improvement (e.g. drinking water, sanitation, security), and
- Reduction of O&M for existing projects.

Some of these expected benefits represent a "package" of attributes and therefore are only very imperfect proxy variables. Other variables are those which knowingly do not account for all of the expected benefits being quantified. The quantitative socioeconomic infrastructure benefits should only be treated as order-of-magnitude indicators.

7.1 Kalni-Kushiyara River Bank Flood Protection

The Kalni-Kushiyara River bank flood protection cost savings specifically refer to protection benefits from channel stabilization to existing villages within 100 metres of the present Kalni-Kushiyara River channel.

A profile of existing villages within 100 metres of the present Kalni-Kushiyara river channel indicates (Table E.22) that there are about 13,271 households (HH) in 50 villages which would directly benefit from channel stabilization. This represents about 4% of the total population in the project area.

Table E.22: Profile of the Kalni-Kushiyara River Bank Villages

River	Reach	No. Villages	No. Households
Kushiyara	Sherpur-Markuli	21	3,910
Kalni	Markuli-Ajmiriganj	10	1,477
Kalni	Ajmiriganj-Katkhal	6	1,445
Kalni	Katkhal-Shibpur	13	6,439
T O T A L	**Sherpur-Shibpur**	**50**	**13,271**

Source: Village Information (Annex D - Social) and NERP Community Organization Programs for 1994-95.

These preventable costs (i.e. expected benefits) are all estimated according to flood damage estimates obtained through Kalni-Kushiyara River survey data which is summarized in Tables E.23 and E.24.

Table E.23: Average Annual Flood Damage Estimate - River Bank Households

Sample Village	No. of Households	Total House Damages (Tk)	Average Households Damage (Tk/HH)
Dhighalbak	425	194,964	459
Alampur Balishree	220	42,188	192
Markuli	100	84,091	841
Nadipur	75	23,250	310
Pirojpur	185	22,525	122
Kadamchal	700	14,000	200
Ajmiriganj	382	41,333	108
Anawarpur	46	13,889	302
Hilalnagar	138	22,667	164
Raniganj	318	685,417[1]	2,155
Beradhar	283	32,813	116
Shantipur	91	23,969	263
Charkatkhal	145	7,000	48
Katkhal	300	108,182[1]	361
TOTAL and AVERAGE	**3,408**	**1,442,288**	**423**

Note: 1. Includes damage to shops in the Bazar.
Source: Kalni-Kushiyara River Social Survey

Table E.24: Average Annual Flood Damage Estimates - Homestead Land

Sample Village	No. of Households	Bank Erosion (ha)	Land Prices (Tk/ha)	Total Land Damage (Tk)	Average Household Damage (Tk/HH)
Dhighalbak	425	0.85	691,600	587,860	1,383
Alampur Balishree	220	0.61	222,300	135,603	616
Markuli	100	0.40	247,000	98,800	988
Nadipur	75	0.00	195,130	7,806	104
Pirojpur	185	0.32	741,000	237,120	1,282
Kadamchal	700	0.20	247,000	49,400	71
Ajimganj	382	0.12	247,000	29,640	78
Anawarpur	46	0.32	247,000	79,040	1,718
Hilalnagar	138	0.36	271,700	97,812	709
Raniganj	318	1.00	1,235,000[1]	654,550	2,058
Beradhar	283	0.65	494,000	321,000	1,135
Shantipur	91	0.61	197,600	120,356	1,325
Charkatkhal	145	0.32	395,200	126,464	872
Katkhal	300	0.16	802,750[1]	128,440	428
TOTAL and AVERAGE	**3,408**	**5.5 (0.0016 ha/HH)**	**481,706**	**2,649,383**	**777**

Note: 1. Includes land in the Bazar area.
Source: Kalni-Kushiyara River Social Survey for 1994-95.

Assuming a 50% reduction in the estimated current rate of damage, the expected economic benefits (at project maturity) would be:

Riverbank Households:	13,271 (HH)	*	423 (Tk/ HH) * 50%	=	Tk 2.8 million
Riverbank Land Losses:	13,271 (HH)	*	777 (Tk/HH) * 50%	=	Tk 5.2 million
TOTAL			**1,200 (Tk/HH) (including land)**		**Tk 8.0 million**

The expected net benefit stream from the Kalni-Kushiyara River Bank flood protection is presented in Table E.25.

Table E.25: Expected Annual Net Benefit Stream from Kalni-Kushiyara River Flood Protection

Benefits Group	Expected Net Benefits (million Tk)				
	Years 1-4	Year 5	Year 6	Year 7	Years 8-30
River Bank HH Phasing (%)	0	1.1 40	1.7 60	2.2 80	2.8 100
River Bank Land Phasing (%)	0	2.1 40	3.1 60	4.2 80	5.2 100
SUB-TOTAL #1	**0**	**3.2**	**4.8**	**6.4**	**8.0**

7.2 Additional River Bank Protection and Related Land Development

The Additional River Bank Protection and Related Land Development expected benefits have 5 components:

a) protection against enlargement of the Cherapur Khal (i.e the Kalni-Baulai connecting channel);
b) increase channel stability outside of village areas to better protect agricultural land;
c) increased agricultural land via the Madna fill in the Dhaleswari River;
d) increased agricultural land between the bank and dyke at the Issapur and Katkhal loop cuts, and
e) increased agricultural land on two large platforms which will not be used for homesteads.

a) Cherapur Khal House Damage

About 20% of the Kalni river flow is already being diverted through the Kalni-Baulai connecting channel. If this increases further, contiguous homes and property will ultimately be destroyed. Diversion of the Kalni River across the Baulai River would cut a channel almost equal in size to the Kalni River across this entire 13.5 km long connector. It would widen the channel from about 35 m on average to 200 m (Annex C-Engineering) and in the process, ultimately destroys 150 of 570 homesteads along the existing channel. (The simultaneous loss of 280 ha of cultivatable land is considered under Crop Benefits-Disbenefits.) Assuming an approximate loss of Tk 100,000/ homestead, this would amount to about a Tk 15 million cost-savings.

If this loss is then assumed to arise during Years 8-11, the annual cost savings anticipated would be as shown in Table E.26.

Table E.26: Annual Cost Savings - Cherapur Khal House Damage

Benefit Group	Expected Annual Damage Cost Savings (million Tk)					
	Years 1-7	Year 8	Year 9	Year 10	Year 11	Years 12-30
Cherapur Khal House Damage Phasing (%)	0	2.6 17	3.1 22	4.1 27	5.2 34	0

b) ***River Bank Erosion - Agriculture***

The proposed project would similarly affect channel stability outside of village areas; areas which are generally used for rice production. The extent of this historical erosion is indicated in Table E.27.

Table E.27: Historical Land Erosion Due to Channel Shifting & Widening

Source	1963-1995 Total (ha)	Average Loss (ha/year)
Due to Channel Shifting	1,581	49.4
Due to Channel Widening	207	6.5
Sub-Total	**1,788**	55.9
Less Village Area @ 0.0016 ha/year HH * 13,271 HH = 21.2 ha/year		21.2
Net Agricultural Area Lost		34.7

Source: Annex A - Sedimentation and Section C.7.1 above.

Assuming a 50% reduction in the current rate of bank erosion and that the net (economic) return to non-cereal production/year is about Tk 12,680/ha (similar to rice), this translates into an annual net agricultural production saving of about:

34.7 ha/year * 50% * Tk 12,680/ha = Tk 0.22 million

c) ***Madna Land Reclamation***

The proposed Madna land reclamation on the Dhaleswari River should actually add 58 ha of agricultural land. This should generate annually about:

58 ha * Tk 12,680/ha = Tk 0.74 million

d) ***Channel - Dyke Area***

It is also expected that the set-back areas at both loop cuts can be made available for non-cereal crops. This set-back distance is 100 m between the bank of the new channel and the toe of the dyke (on both sides). This translates into about 99 ha. of land which can be utilized for non-cereal crops.

The annual value of this anticipated net benefit is therefore expected to be about:

99 ha * Tk 12,680/ha = Tk 1.26 million

e) Platform Areas

There will be 2 large platforms (some 61 ha) which will probably not be used for homestead development. Instead, these will likely be used for non-cereal crop production. Thus, this is yet another annual net benefit which should amount to approximately:

61 ha * Tk 12,680/ha = Tk 0.77 million

The expected net benefit stream from the Additional River Bank Protection is presented in Table E.28.

Table E.28: Expected Annual Net Benefit Stream from Additional River Bank Protection

Item	Expected Net Benefit (million Tk)							
	Years 1-4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Years 11-30
Cherapur Khal House Damage Phasing (%)	0.00	0.00	0.00	2.60 17	3.10 22	4.10 27	5.20 34	5.20
Additional Bank Protection Phasing (%)	0.00	0.09 40	0.13 60	0.18 80	0.22 100	0.22	0.22	0.22
Madna Reclamation Phasing (%)	0.00	0	0.37 50	0.52 70	0.74 100	0.74	0.74	0.74
Channel-Dyke Area Phasing (%)	0	0	0.63 50	0.88 70	1.26 100	0.74 100	0.74 100	0.74 100
Platform Areas (2) Phasing (%)	0	0	0.39 50	0.54 70	0.77 100	1.26	1.26	1.26
SUB-TOTAL #2	**0.00**	**0.1**	**1.5**	**4.7**	**6.1**	**7.1**	**8.2**	8.2

7.3 Village Platform (VP) Flood & Wave Protection

It is expected that 47 platforms will be built during Years 1-8, of which 44 will provide for village development. The total additional area of these 44 platforms is about 247 ha (Annex C). Out of these 44 new village platforms, however, 31 are an extension of an already existing platform and, therefore, some wave protection will also be provided to them. There are about 5,000 households on these existing 31 village platforms. The total number of households (existing + new) involved is estimated to be about 6,250 HH.

During the proposed operation and maintenance phase of the project, it is anticipated that additional platform areas would be constructed. This is expected to amount to about 200 ha in total, an area which should support about 5,000 additional household.

Consequently, the 3 principal quantifiable impacts are:

- Flood protection benefits to new platforms established during both the construction and O&M periods. The platform height is sufficient to decrease the probability of them being flooded from 1:5 to 1:20 year;
- Additional wave protection benefits to new platforms established during both the construction and O&M periods. This primarily arises because hard and soft armour will give added protection to the platform banks (Flood and wave events have independent probabilities), and
- Wave protection benefits to the banks of the 31 existing platforms; about 50% of total potential protection to platform land.

New Platforms Flood Protection

The estimate of the annual flood protection benefits provided by the new platforms is dependent upon a damage-frequency relationship estimated from data in Section 7.1. An iterative process was utilized to obtain damage estimates for specific flood frequencies assuming that the flood frequency/flood damage curve is an exponential function and that an average annual damage estimate of Tk 1,200/HH (Section 7.1) represents virtually no flood protection. These calculations are provided in Table E.29.

Table E.29: Damage-Frequency Estimate for Village Platforms

Flood Return Period (year)	Flood Frequency[1] (non-exceedence)	Damage[2] (Tk)	Annualized Total Damage[3] (Tk/HH)	Cumulative Total Damage (Tk/HH)
	0.10	17.5	0.9	0.9
1:2	0.50	82.5	168.5	169.4
1:5	0.80	2,308.0	470.0	639.3
1:10	0.90	2,970.0	263.9	903.2
1:20	0.95	3,333.0	157.6	1,060.8
1:100	0.99	3,637.0	139.4	1,200.2
TOTAL			**1,200.2**	
DIFFERENCE	**(1:20 and 1:2)**			**891.4**

Notes:
1. Frequency (F) = [1-(1/r)] where "r" = return period. Flood probability=(1-r)*100.
2. Imputed by assuming a quadratic functional relationship $D = a + bF + cF^2$ and assuming the cumulative total (Col. (4)) = Tk 1,200/year.
3. Calculated as the integral of Col. (3). (re: area under the curve)

The expected annual level of flood protection provided by the new platforms (Table E.29) is thus determined to be:

Tk 1,061/HH - Tk 170/HH = Tk 891/HH.
[1:20 year] - [1:2 year]

The flood protection benefits provided by the new platforms at the end of the construction period (Year 8) and at the end of the O&M period (Year 17) is given by:

Construction Period (at Year 8): 6,250 HH * Tk 891/HH = Tk 5.6 million
O&M Period (at Year 17): 5,000 HH * Tk 891/HH = Tk 4.5 million
TOTAL =Tk 10.1 million

The flood protection benefits from the new platform during the construction period (Year 1-8) is phased-in as follows:

- 0% during Years 1-4, 40% during Year 5; 60% during Year 6; 80% during Year 7 and 100% during Years 8-30.

The flood protection from the new platforms during the O&M period (Year 9-17) is phased-in as follows:

- 0% during Years 1-8; 10%/year (Tk 0.45 million/year) during Years 9-17 and 100% during Years 18-30.

New Platforms Wave Protection

Besides being subjected to periodic flood damage (as discussed above), many existing villages on the edge of *haors* are affected by severe wave erosion. A particularly bad year can reduce the homestead area by 15% or 20% (NERP, 1994 b)). In very bad flood years (such as 1974 and 1988), survey information (Annex C) indicates that this could be as high as 30%. This destruction from high winds and waves is independent of flood events and is an event which seems to have about a 5% (or 1:20) probability of occurring in any given year.

In this case, based on an imputed land value of Tk 20,000/HH, the estimated annual cost/HH due to wave damage alone is found to be about:

Tk 20,000/HH * 30% land loss * 5% probability = Tk 300/HH

The wave erosion protection benefits provided by the new platforms at the end of the construction period (Year 8) and at the end of the O&M period (Year 17) are given by:

Construction Period (at Year 8): 6,250 HH * Tk 300/HH = Tk 1.9 million
O&M Period (at Year 17): 5,000 HH * Tk 300/HH = Tk 1.5 million
TOTAL = Tk 3.4 million

The wave protection benefits from the new platforms during the construction period (Year 1-8) is phased-in as follows:

- 0% during Years 1-4; 40% during Year 5; 60% during Year 6; 80% during Year 7 and 100% during Years 8-30.

The wave protection benefits from the new platforms during the O&M period (Years 9-30) is phased-in as follows:

- 0% during Years 1-8; 10%/year (Tk 0.15 million/year) during Years 9-17 and 100% during Years 18-30.

Old Platforms
For the additional wave protection afforded to the 31 old village platforms, assuming a 50% reduction of the estimated benefits, the expected old platform wave erosion protection benefits would be (Table E.24):

5,000 HH * Tk 777/HH * 50% = Tk 1.9 million

The old platform wave protection benefits are phased-in as follows:

- 0% during Years 1-4; 40% during Year 5; 60% during Year 6; 80% during Year 7 and 100% during Years 8-30.

Table E.30 summarizes the Annual Expected Benefits from the Village Platforms Flood and Wave Protection.

Table E.30: Expected Annual Net Benefits from Village Platforms Flood and Wave Protection

Benefits Group	Expected Net Benefits (million Tk)						
	Years 1-4	Year 5	Year 6	Year 7	Year 8	Year 9	Years 18-30
New Platforms Flood Protection Phasing (%)	0	2.2 40	3.4 60	4.5 80	5.6 100	5.6+0.45/year	10.1
New Platforms Wave Protection Phasing (%)	0	0.8 40	1.1 60	1.5 80	1.9 100	1.9+0.15/year	3.4
Old Platforms Phasing (%)	0	0.8	1.1 60	1.5 80	1.9 100	1.9	1.9
SUB-TOTAL #3	**0**	**3.8**	**5.6**	**7.5**	**9.4**	**9.4+0.60/year**	**15.4**

7.4 Village Platform Homestead Gardens, Fruit Trees, and Platform Slope Protection

The 3 village-based incremental crop production benefits considered here are: a) homestead vegetable gardening; b) fruit tree production; and c) slope plantations.

Homestead Vegetable Gardening
Pilot project experience has shown that homestead vegetable gardening will expand rapidly on the newly-developed platforms and may occupy about 25% of the area. This will, however, have to be accompanied by fertility enhancement of the 15 cm clay overlay (by straw/water hyacinth). Gradually, however, vegetable production should generate a net annual economic return of about Tk 20,000/ha (farm budgets).

The Homestead Gardens on new platforms are 247 ha and those of the platforms constructed during O&M are 200 ha (smaller platforms). The Homestead Garden expected benefits during the construction period and O&M period, are given by:

Construction Period (at Year 8):	247 ha * 25% *	Tk 20,000/ha = 1.24 million
O&M Period (at Year 17):	200 ha * 25% *	Tk 20,000/ha = 1.00 million
		TOTAL= 2.24 million

The Homestead Garden benefits are phased-in as follows:

- For construction period; 0% during Years 1-5; 40% during Year 6; 60% during Year 7; 80% during Year 8; and 100% during Years 9-30.

- For O&M period; 0% during Years 1-10; 10%/year (Tk 0.10 million/year) during Years 11-17 and 100% during Years 18-30.

This development process would parallel village platform housing development schedules.

Fruit Tree Production

Some fruit tree development is also expected. At present, about 90% of homestead trees are vulnerable to flood damage (NERP, 1994 b)). As a result, local people are reluctant to plant fruit trees in their homestead area. More secure homestead platforms and better living space will encourage the planting of more fruit trees around their homes and gardens. This would arise during Years 8 - 17 and also involve a total of 247 ha during the construction phase and about 200 ha during the O&M phase. Then, by again assuming that 25% of the land is allocated to household gardens and 75% is allocated to houses, yards, fruit trees, etc., it is estimated that each household should eventually be able to at least generate an additional Tk 1,000/year of income (whether marketed or consumed). However, this level of output can only be expected after nutrient enhancement of the 15 cm clay overlay (again see farm budgets). Gradually, though, this should generate aggregate net benefits approximately as follows:

Construction Period (at Year 8):	6,250 HH *	Tk 1,000/HH = Tk 6.3 million
O&M Period (at Year 17):	5,000 HH *	Tk 1,000/HH = Tk 5.0 million
		TOTAL = Tk 11.3 million

The Fruit Trees expected benefits are phased-in as follows:

- For construction period; 0% during Years 1-7; 40% during Year 8; 60% during Year 9 and 100% during Years 10-30.

- For O&M period; 0% during Years 1-10; 10%/year (Tk 0.5 million/year) during Years 11-20 and 100% during Years 21-30.

Slope Plantations

Finally, it is expected that the relatively flood-free homestead platforms will also facilitate the planting of an estimated 120,000 water-resistant saplings during construction and 95,000 during O&M, at the toe of the confinement dykes of each homestead platform. It is expected that these trees can be harvested annually starting in Year 8 and that their economic value should be about Tk 50 per tree.

In total, therefore, this should generate an additional annual benefits, for the construction and O&M periods, or:

Construction Period (at Year 8): 120,000 trees * Tk 50/tree = Tk 6.0 million
O&M Phase (at Years 25): 95,000 trees * Tk 50/tree = Tk 4.8 million
TOTAL =Tk 10.8 million

The slope Plantation expected benefits are phased-in as follows:

- For construction period; 0% during Years 1-8 and 100% during Years 9-30.
- For O&M period; 0% during Years 1-18; 12.5%/year (Tk 0.60 million/year) for Years 18-25 and 100% during Years 26-30.

Table E.31 summarizes the net expected benefits from the Homestead Garden, Fruit Trees and Platform Slope Protection.

Table E.31: Expected Annual Net Benefits for Homestead Gardens, Fruit Trees and Platform Slope Protection Saplings

Benefits Group	Expected Net Benefit (million Tk)									
	Years 1-5	Year 6	Year 7	Year 8	Year 9	Year 10	Years 11-17	Years 18-20	Years 21-25	Years 26-30
Gardens	0	0.5	0.70	1.0	1.24	1.24	1.24+0.14/yr	2.24	2.24	2.24
Fruit Trees	0	0.0	0.00	2.5	5.0	6.3	6.3+0.5/yr	9.8+0.5/yr	11.30	11.30
Slope Plantation	0	0.0	0.00	6.0	6.0	6.0	6.0	6.0+0.6/yr	7.8+0.6/yr	10.80
SUB-TOTAL #4	**0**	**0.5**	**0.70**	**9.5**	**12.2**	**13.5**	**13.5+0.6/yr**	**18.0+1.1/yr**	**21.3+0.6/yr**	**24.3**

7.5 Village Platform Homestead Grain Drying

Under existing conditions, threshing operations are often impeded by excessively wet homestead conditions. Harvest and transport losses reportedly average about 10% of gross production (Annex G). With the village platforms being proposed, there would be more and better space to do this threshing at home; either on a concrete pad or just on a hard clay surface. As a result, transport losses would be reduced and less hired field labour would be required.

The estimate of the annual Homestead Grain Drying benefits is dependant upon a damage frequency relationship. An iterative process was utilized to obtain estimates for specific flood frequencies assuming that the frequency-flood damage curve is an exponential function and that the average annual damage estimate is Tk 271/HH. These calculations are provided in Table E.32.

Table E.32: Damage-Frequency Estimate for Grain Drying on Village Platforms

Flood Return Period (year)	Flood Frequency[1] (non-exceedence)	Harvest Affected (%)	Damage[2] (Tk)	Annualized Total Damage[3] (Tk/HH)	Cumulative Total Damage (Tk/HH)
1:2	0.50	2	280	56	56
1:5	0.80	5	700	147	203
1:10	0.90	6	480	77	280
1:20	0.95	7.5	1,050	47	327
1:100	0.99	8	1,120	44	371
TOTAL				**371**	
DIFFERENCE	**(1:20 and 1:2)**				**271**

Notes: 1. Frequency (F) = [1-(1/r)] where "r" = return period. Flood probability=(1-r)*100.
2. Assuming total economic rice value = Taka 14,000/HH year (see budgets)
Source: Basic data from FEAVDEP pre-Feasibility Study/FAP 6, January 1994.

The Homestead Grain Drying benefits at the end of the construction and O&M periods are given by:

Construction Period (at Year 8): 6,250 HH * Tk 271/HH = Tk 1.7 million
O&M Period (at Year 17): 5,000 HH * Tk 271/HH = Tk 1.4 million
TOTAL = Tk 3.1 million

The Homestead Grain Drying benefits are phased-in as follows:

- For construction period; 0% during Years 1-4; 40% during Year 5; 60% during Year 6; 80% during Year 7 and 100% during Years 9-30.
- For O&M period; 0% during Years 1-8; 10%/year (Tk 0.14 million/year) during Years 9-30.

Table E.33 summarizes the annual expected benefits from the Homestead Grain Drying.

Table E.33: Expected Annual Net Benefits for Homestead Grain Drying

Benefits Group	Expected Net Benefit (million Tk)						
	Years 1-4	Year 5	Year 6	Year 7	Year 8	Years 9-17	Years 18-30
Grain Drying **SUB-TOTAL #5**	0	0.7	1.0	1.4	1.7	1.7+0.14/yr	3.1

7.6 Quality of Life Improvement

There are numerous quality-of-life attributes which are also expected to qualitatively improve with project implementation. These include such "intangibles" as improved sanitation, water supply, public health and safety, and security. A lower-risk environment also accelerates investment.

The global impact of all of these micro-changes is difficult to assess. One such baseline, however, is the fact that nation-wide per-capita government expenditures on health are presently about Tk 115/person (BBS, 1994). This amounts to about 1.5% of per capita income in the project area (Income = Tk 7,470/capita year as per Social Household Survey). Thus, if this direct project intervention eventually made even this same impact on direct project recipients considered under this Section (i.e. Socioeconomic Infrastructure), the scale of this benefit would be approximately as follows:

Directly Impacted Households (Section 7.1):	13,271
Directly Impacted Households (Section 7.2):	230
Directly Impacted Households (Section 7.3):	6,250
Directly Impacted Households (Section 7.5):	5,000
TOTAL Households	**24,751**

At 5.7 people per household (Annex D), this totals some 140,000 persons, about 7% of the population in the entire project area. And at Tk 115/person, the implied benefits at project maturity (Year 20) would be expected to be (Appendix E.1, Table 17):

140,000 persons * Tk 115/person = Tk 16 million (SUB-TOTAL #6)

Thus, even though this expected per capita benefit is relatively minute and only assumed to be very gradually realized by direct project recipients, the total is still quite significant. The general magnitude of the estimate at least underlines the importance of explicitly considering this type of "social" benefits throughout the analyses. It is important both socially and economically.

Another way to interpret this data would be to recognize that the reduced threat of flood (and related) damage in the project area will reduce the uncertainty associated with virtually all economic activity which, in turn, will irrefutably augment investment levels. Increased investment levels then translate into further increases in local employment and income. This alone could augment the real income of directly impacted recipients by 1.5% over a 17 year period.

7.7 Reduction of O&M for Existing Projects

Finally, there are 6 submersible embankment projects on the right bank of the Kushiyara River around Markuli that would benefit from the KKRMP interventions. These project have a gross area of about 37,000 ha and a net cultivable area of about 32,000 ha. For these projects, O&M costs are funded by GOB.

It is expected that the proposed project interventions will reduce the annual maintenance cost of these submersible embankment projects as well as reduce the cost of repeatedly closing breached sections.

The general extent of this cost saving is calculated as follows:

Cost of Closure Construction	=	Tk 0.25 million
5%O&M for Submersible Embankments	=	Tk 1.00 million
TOTAL	=	**Tk 1.25 million**

This would gradually be realized, beginning with 0% during Years 1-4; 40% during Year 5; 60% during Years 6 and 100% during Year 7-30 (Table E.34).

Table E.34: Expected Annual Net Benefits for Reduction of O&M for Existing Projects

Benefits Group	Expected Net Benefits (million/Tk)					
	Years 1-4	Year 5	Year 6	Year 7	Year 8	Years 9-30
Reduction of O&M for Existing Projects **SUBTOTAL #7**	0	0.38	0.75	1.25	1.25	1.25
Phasing (%)		30	60	100		

7.8 Summary

Adding up the 7 respective Sub-Totals for the socioeconomic infrastructure expected benefits over the 30 year projected life of the project, this provides the following monetary estimate of the annual incremental socioeconomic infrastructure economic benefits (Table E.35 and Appendix E.1, Table 17):

Table E.35: Summary of Expected Annual Socioeconomic Infrastructure Economic Benefits

Year	Net Benefits (million Tk)	Year	Net Benefits (million Tk)
1-4	0.00	17	65.87
5	9.06	18	68.61
6	16.04	19	70.97
7	24.42	20	73.00
8	39.65	21	73.61
9	45.13	22	74.14
10	49.27	23	74.67
11	51.57	24	75.20
12	53.95	25	75.73
13	56.33	26	76.29
14	58.71	27	76.29
15	61.09	28	76.29
16	63.47	29	76.29
		30	76.29

Highlights are the following:

- The projected annual incremental benefit from the proposed project for socioeconomic infrastructure and homesteads gradually climbs over the life of the project, ultimately plateauing in Year 26 at about Tk 76.29 million/year. As such, this would be the second largest direct benefit of the project; about 9.7% of total benefits. It is much smaller than the projected agricultural benefit but larger than the projected fishery and navigation benefits (at 6.9% and 4.5% respectively) (Section 8.6).

- There are 7 principal component benefits and they are expected to contribute to the aggregate estimate approximately as follows (based on 12% NPV streams):

• Kalni-Kushiyara urban river bank flood protection	16%
• Additional river bank protection & related land development	14%
• Village platform flood & wave protection	23%
• Homestead gardens fruits, fruit trees and slope plantation	26%
• Homestead grain drying	4%
• Quality of life improvement	15%
• Reduction of O&M for existing projects	2%
TOTAL	**100%**

Even this listing (irrespective of the monetary values assigned to each) has considerable utility as a project design and implementation tool.

The methodology employed is such that it is highly unlikely that the general order-of-magnitude of these estimated infrastructure/homestead benefits are greatly in error. This is mainly due to 2 reasons: Firstly, there are a total of 16 underlying benefits quantified to reflect the socioeconomic value of this projected bundle of attributes. The final estimate is not highly dependent upon a small set of crucial assumptions or databases. And secondly, much of the underlying data has been cross-checked through supporting documentation and found to be realistic.

8. ECONOMIC ANALYSIS

8.1 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 economic analysis, costs and benefits are identified which arise from the future with (FW) project scenario compared to the future without (FWO) project scenario. 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 scenarios once the project has been implemented.

The economic decision-making criteria employed are:

- Net Present Value (NPV), and
- Economic Internal Rate of Return (EIRR).

8.2 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* (FPCO, 1992) indicates the economic analysis should use a real discount rate of 12% 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% 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% would likewise be considered an economically viable project.

8.3 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 economic analysis team have stipulated Year 1 as the initial implementation year rather than Year 0. Gittinger (1982) 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.

8.4 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 scenario are ignored in this economic analysis because their discounted residual value is minimal by the end of the project (i.e., Year 30).

8.5 Land Acquisition Cost

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

8.6 Economic Cost-Benefit Stream

The economic cost-benefit stream of the proposed project is given in Table E.36 and is illustrated in Graphs E.2 to E.5.

The cost stream consisting of capital and O&M costs for the proposed project is taken from Appendix E.1, Tables 1 a), b) and c).

The benefit stream for Agriculture has been developed from Table E.11. The expected economic benefit stream for Navigation (Water Transportation) and Fisheries have been developed from Tables E.18 and E.21 respectively. The expected Socioeconomic Infrastructure economic benefits Stream has been developed from Table E.35.

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

8.7 Net Present Value and Economic Internal Rate of Return

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

Σ(Discounted Annual Incremental Benefits) less Σ(Discounted Annual Incremental Costs)

= Tk 531 million (Table E.36)

At a 12%/year discount rate, the positive and relatively large NPV of Tk 531 million indicates that the Kalni Kushiyara River Management Project proposal should be a feasible economic investment opportunity for Bangladesh.

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

Σ(Discounted Annual Incremental Benefits) = Σ(Discounted Annual Incremental Costs).

The imputed EIRR is determined to be about 17.2%/year; considerably higher than the designated "cut-off" rate of 12%/year (Table E.36). This EIRR estimate once again emphasizes that the Kalni-Kushiyara River Management Project appears to be an attractive economic investment opportunity.

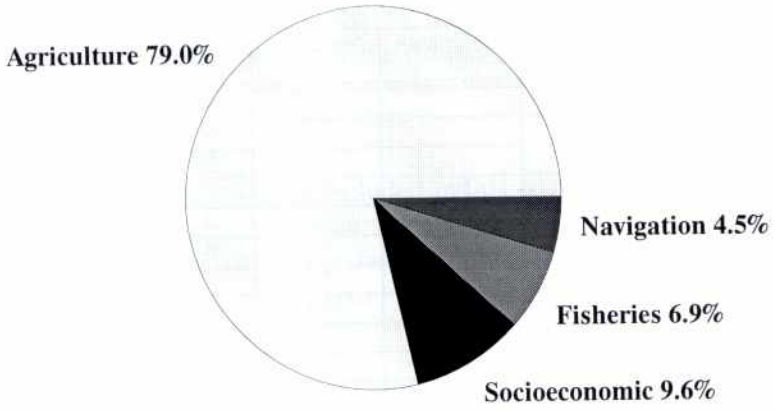
Table E.36: Summary of Annual Cost and Benefit Streams and Discounted Cash Flow Analysis

Year	Capital &O&M COSTS (million Tk)	BENEFITS (million Tk)					NET CASH FLOW (million Tk)
		Agriculture	Navigation	Fisheries	Socioeconomic Infrastructure	TOTAL	
1	38.92		0	0	0		(38.9)
2	62.60		0	0	0		(62.6)
3	489.8		0	0	0		(489.8)
4	495.3	150	0	0	0	150.00	(345.8)
5	557.0	224	4.3	0	9.06	237.36	(319.4)
6	588.8	299	8.6	8.7	16.04	332.46	(256.5)
7	128.6	374	21.9	17.5	24.42	437.61	309.0
8	145.1	374	22.2	35.0	39.65	470.6	325.5
9	127.5	374	22.6	43.7	45.13	485.2	357.7
10	121.0	374	22.9	43.7	49.27	489.7	368.6
11	111.3	374	23.3	43.7	51.57	492.4	381.1
12	111.3	374	23.7	43.7	53.95	495.14	385.9
13	111.3	374	24.1	43.7	56.33	497.94	386.7
14	101.6	374	24.6	43.7	58.71	500.75	399.2
15	101.6	374	25.0	43.7	61.09	503.58	402.0
16	101.6	374	25.5	43.7	63.47	506.43	404.9
17	101.6	374	25.9	43.7	65.87	509.30	407.7
18	93.7	374	26.4	43.7	68.61	512.52	418.8
19	93.7	374	26.9	43.7	70.97	515.38	421.7
20	93.7	374	27.4	43.7	73.00	517.42	424.2
21	93.7	374	28.1	43.7	73.61	519.15	425.4
22	93.7	374	28.7	43.7	74.14	520.52	426.6
23	93.7	374	29.4	43.7	74.67	521.52	427.8
24	93.7	374	30.1	43.7	75.20	522.74	429.0
25	93.7	374	30.8	43.7	75.73	524.00	430.3
26	93.7	374	31.5	43.7	76.29	525.31	431.6
27	93.7	374	32.3	43.7	76.29	526.09	432.4
28	93.7	374	33.1	43.7	76.29	526.91	433.2
29	93.7	374	34.0	43.7	76.29	527.76	434.0
30	93.7	374	34.9	43.7	76.29	528.64	434.9
NPV(12%)	1,808.5	1,847.9	104.3	161.4	225.9	2,339.5	
Distribution (%)		79	4.5	6.9	9.6		
NPV(12%)							**531.0**
EIRR (%)							**17.2**

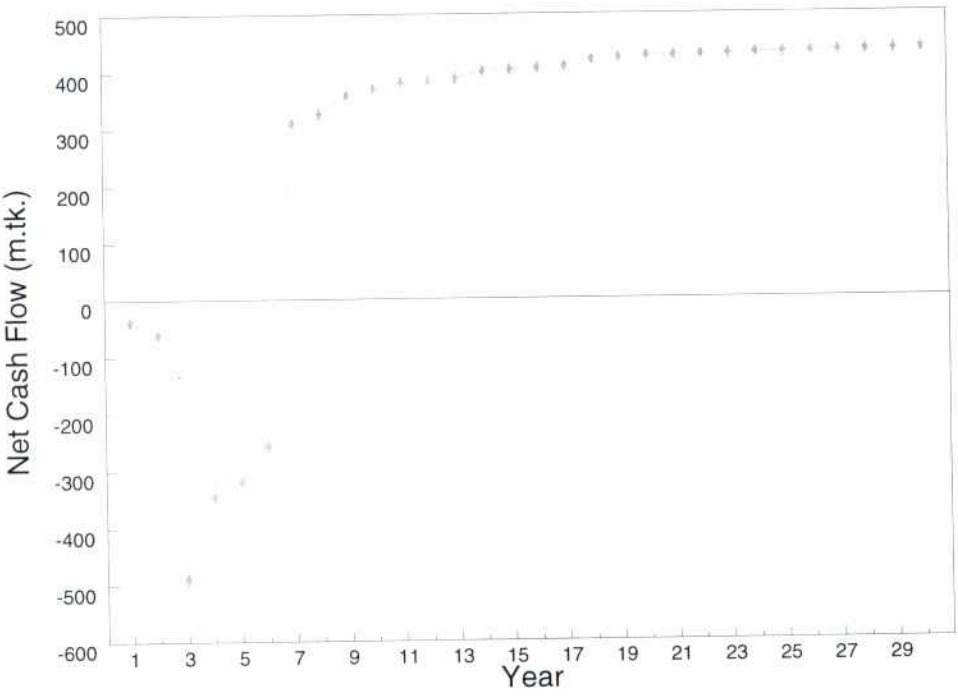
8.8 Capacity and Community Development

The project will incur an additional cost of Tk 194.2 million in the way of capacity and community development which has not been included in the economic analysis. It has been assumed that EIRR and NPV are not applicable to these activities. They are part of Canada's contribution to the development of Bangladesh and the experience gained may be used elsewhere.

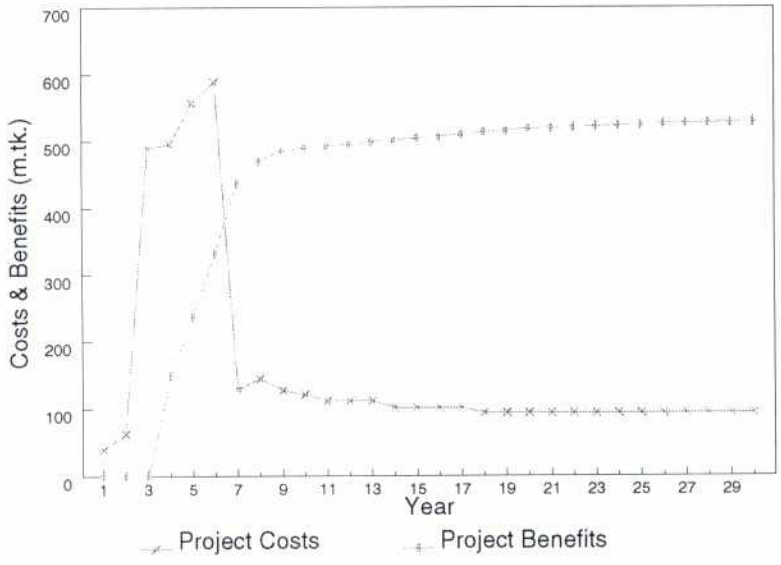
Graph E.2: Relative Contribution of Sector Benefits to Total Kalni-Kushiyara Economic Benefits Projections



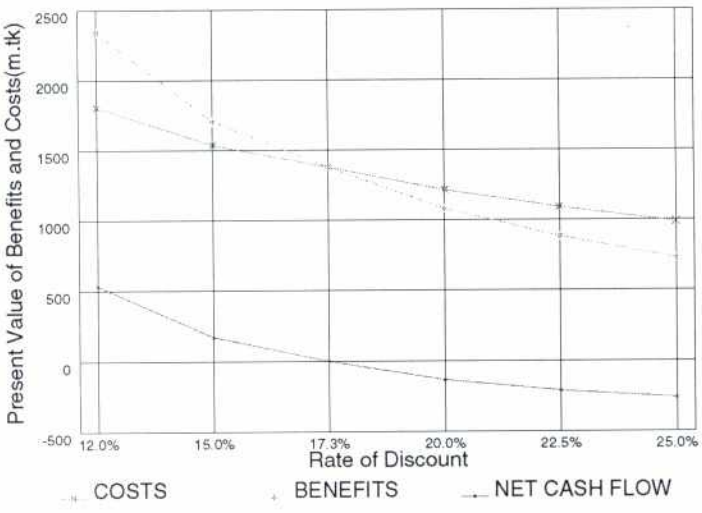
Graph E.3: Net Cash Flow Over Project Life Time



Graph E.4: Project Costs and Benefits Over Project Life Time



Graph E.5: Present Value of Benefits and Costs at Various Rates of Discount



8.9 Long-Term Benefits Monitoring

The cost of long-term benefits monitoring (Tk 62.4 million) is not part of the financial capital costs, and has, therefore, not been considered in this economic analysis.

8.10 Sensitivity Analysis

The economic analysis preceding is based on uncertain future events and imperfect data. Consequently, a sensitivity analysis must be conducted to assess systematically the reliability and robustness of the Base Case estimates calculated in Section 8.7. 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. There are really 4 reasons why the Base Case should be subjected to extensive sensitivity testing:

- Predicting the future is always somewhat speculative;
- Inaccurate and incomplete data;
- "Intangibles" are very difficult to quantify, and
- Inherent methodological limitations.

The implications on the NPV and EIRR regarding some of the most significant sensitive analyses are summarized in Table E.37.

Each sensitivity analysis is briefly discussed following:

1. If capital and O&M costs all increase by 20%, an approximately 1:1 relationship means that the EIRR would also drop by about 20%; from 17.2% to about 13.4%. If capital cost increases by 20%, EIRR drops to 14.1%. A 20% increase in the O&M cost would drop the EIRR to 16.5%.

2. The extent to which dredging will be required during the post-construction period is also somewhat ambiguous. The construction phase work could make the river more self-cleaning and actually decrease subsequent dredging requirements. Or, conversely, these requirements could be even higher than presently expected. A doubling of post-construction dredging costs would drop the EIRR to 14.5%; a 50% decrease in these same costs would increase the EIRR to about 18.2%. As shown in Graph E.6, an increase in dredging cost by 10% would drop the EIRR by 0.25%. The EIRR reaches the break even point (12%) if post-construction dredging cost increases by 180%.

3. It is particularly difficult to accurately quantify all of the costs and benefits associated with the proposed village platforms; particularly the so-called "intangibles" like "quality of life", security, space, and so on. Our efforts to do so are, knowingly, inaccurate and incomplete. Thus, exclusion of all costs and benefits associated with village platforms leaves the EIRR almost unchanged at 17.1%. Conversely, if estimated village platform benefits were actually two times of current estimated value (which is possible), the EIRR would jump to 19.0%.

4. With agriculture making up some 79% of total projected net benefits, one would also expect the EIRR to be very sensitive to any change in these realized benefits. Thus, a 20% decrease in projected agricultural benefits would decrease the EIRR to about 13.6% while a 20% increase in these benefits would increase the EIRR to about 20.8%. If net agricultural benefits drop by 28%, the EIRR touches the break-even point at 12.1%. Like project costs (Item 1 above), the relationship between EIRR and net agricultural benefits is found to be linear (Graph E.7). This 1 to 1 relationship also approximately applies to the variables which are used to determine net benefits: the area, yield and crop price.

Table E.37: Summary of Sensitivity Analysis

VARIABLE	NPV @ 12% (million Tk '95)	EIRR (%/year)
BASE CASE (most likely)	531.0	17.2
1.a Capital costs increase by 20%	253.6	14.1
1.b O&M costs increase by 20%	453.7	16.5
1.c Capital & O&M costs increase by 20%	169.3	13.4
2.a Post-construction dredging costs increase by 100%	237.3	14.5
2.b Post-construction dredging cost increase by 180%	2.4	12.0
2.c Post-construction dredging costs decrease by 50%	574.6	18.2
3.a Costs and Benefits of village platform development excluded	451.4	17.1
3.b Village platform "social" benefits increase by 100%	747.0	19.0
4.a Net agricultural benefits decrease by 20%	161.5	13.6
4.b Net agricultural benefit decrease by 28%	13.6	12.1
4.c Net agricultural benefits increase by 20%	900.6	20.8
5. Rare flood event in Year 10 (<5% probability of exceedence)	408.7	16.0
6.a Agricultural benefits do not mature until Year 10	377.0	15.5
6.b All benefit streams delayed 2 years	26.7	12.2
6.c Only net agricultural benefits delayed 2 years	104.9	12.9
7.a Study costs are excluded from analyses	702.3	20.0
7.b Exclude two-year preparation period	731.0	17.5
8. Passengers and trans-shipments included in navigation benefits	637.5	18.0
9.a Fishery benefits based on Present and not FWO	260.2	14.9
9.b Agriculture benefits based on Present and not FWO	(143.0)	10.5
9.c Agriculture & fisheries benefits based on Present versus FW	(325.6)	7.9
10.a Capital costs increase by 20% and net agricultural benefits decrease by 20%	(200.3)	10.3
10.b Capital costs increase by 20% and agricultural benefits do not mature until Year 10	15.0	12.1
10.c Capital costs increase by 20% and agriculture benefits based on Present and not FWO	(290.5)	8.2
10.d Capital costs increase by 20% and fishery benefits based on Present and not FWO	(52.2)	11.6
11. No Issapur Loop Cut (denoted "Alternative 2")	254.5	15.2

5. It has also been suggested that a rare flood event (with a very low probability of occurrence) could greatly affect the EIRR. But eliminating all the agricultural benefits for 1 year in mid-stream (about Year 10) does not suggest that this would be a catastrophic occurrence over the life time of the project. Consequently, the EIRR would drop to about 16.0%. At the same time, this does not consider the cumulative impact if structures were actually destroyed or huge amounts of sediment were deposited by such an event.

6. If projected benefit streams were delayed, the impact on the EIRR would also be seriously affected. If agricultural benefits did not mature until Year 10 (instead of Year 7), the EIRR would drop to about 15.5%. And if all benefits were delayed 2 years (agriculture, fishing,

navigation, and social infrastructure), then the EIRR would drop to as low as 12.2% per annum. If only net agricultural benefits are delayed by 2 years, EIRR would drop to 12.9%. Again, this is typical of a project of this nature and simply underlines the importance of employing a realistic time-line in these projections.

7. Scheduling, what is or is not considered as a "sunk cost", and the time frame employed also all impact on the EIRR calculations. For example, if additional "study costs" had been excluded from the economic analysis, the EIRR would jump to 20.0% and the NPV@12% over 30 years would jump to Tk 702.3 million. On the other hand, if the two-year preparation period had not been considered the first two years of "the project", then the NPV@12% over 30 years would have been expected to jump even further (to Tk 731.0 million). In general, with a fixed total time frame of 30 years (as per *Guidelines*), the longer the construction period the more a proposed project will be penalized since the projected benefit streams are then truncated even more severely.

8. Additionally, it has been suggested that projected navigation benefits in the Base Case may well be under-estimated. For example if dry season passenger traffic was equal to even 75% of monsoon season passenger traffic, then this would suggest that passenger traffic would climb by 800,000 people. Thus, even if each passenger saved or generated (e.g. through crew salaries) just 20 additional Tk from this economic activity, it would amount to Tk 16 million/year (Twenty taka is about 50% of a farm labourers daily wage.). If in-transit cargo traffic also doubled (from 24,000 to 48,000 tonnes/year) @ Tk 180/tonne, this would amount to yet another Tk 4.4 million/year. When all of these potential economic benefits are considered the EIRR increases to about 18% and the NPV to about Tk 637.5 million.

9. Yet another issue is sustainability. In the absence of the project, it is anticipated that the FWO scenario will see deteriorating conditions vis-a-vis the Present conditions. This is particularly true of some fisheries and some aspects of agricultural production. Thus, if the fisheries benefits evaluation was conducted in terms of the FW scenario and the Present conditions, the EIRR would drop to about 14.9%. And, similarly, if the same FW versus Present methodology was employed to project agricultural benefits, the EIRR would drop to a relatively low 10.5%. Considered together, the EIRR plummets to 7.9%. This really underlines the point that a "do-nothing" approach is not a viable long-term option.

10. Combinations of adverse events have also been considered. In particular an increase in capital and O&M cost of 20% coupled with a 20% decrease in agricultural benefits cause the EIRR to drop below 12%, to 10.3%. The same increase in capital and O&M cost but assuming that the agricultural benefits do not materialize before Year 10 causes the EIRR to drop to 12.1%, still making the project feasible.

11. Finally, initial studies suggested that an alternative project design which did not construct the proposed Issapur loop cut might be a better socioeconomic option (denoted Alternative 2). This Alternative proposes eliminating the Issapur loop cut but keeping all the other components; including river dredging between Madna and Ajmiriganj, channel realignment, local protective works and levees, navigation dredging and installation of structures at specific locations. Alternative 2 would rely on more channel re-excavation and maintenance dredging in the reach between Issapur and Kadamchal, as well as some additional dredging to keep the Dhaleswari River channel.

In this case, the economic capital cost (Section 3.1) is determined to be about Tk 2,030 million. A financial and economic project cost summary for Alternative 2, scheduled over 30 years, is provided in Appendix E.1, Tables 2a), b) and c).

At the same time, expected annual net agricultural benefits are expected to drop by Tk 48.5 million. This is about a 13% drop. The results of this analysis show that EIRR drops to 15.2% and the NPV@12% over 30 years drops substantially; down to Tk 254.5 million. What this essentially says, however, is that from an economic perspective the Base Case (Alternative 1) is better because it will generate a larger total net return. From economic perspective, the base case can be considered as a better alternative.

Overall, these sensitivity analyses underline the fact that the degree of imprecision typical of this type of analysis is approximately ± 15%. (See Various UN, ADB, and World Bank documents). This means that the resulting EIRR should be within the following range:

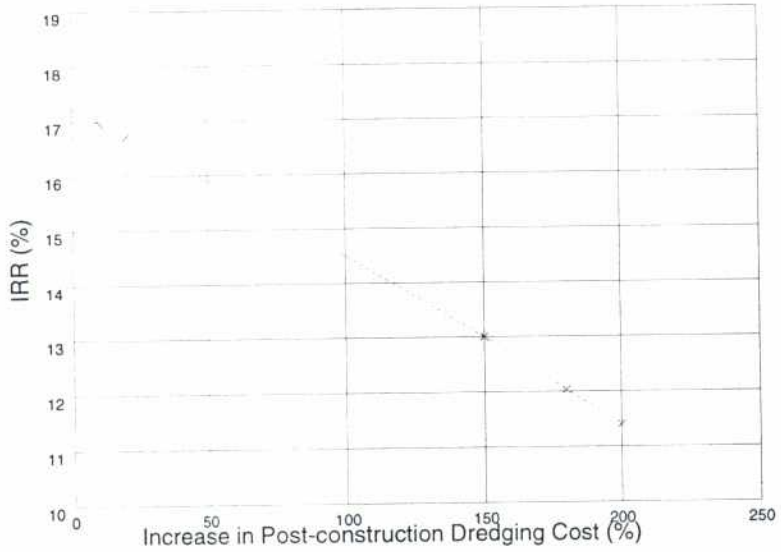
Real EIRR =17.2% ± 2.6%

14.6% < EIRR < 19.8%
LOW <EIRR < HIGH

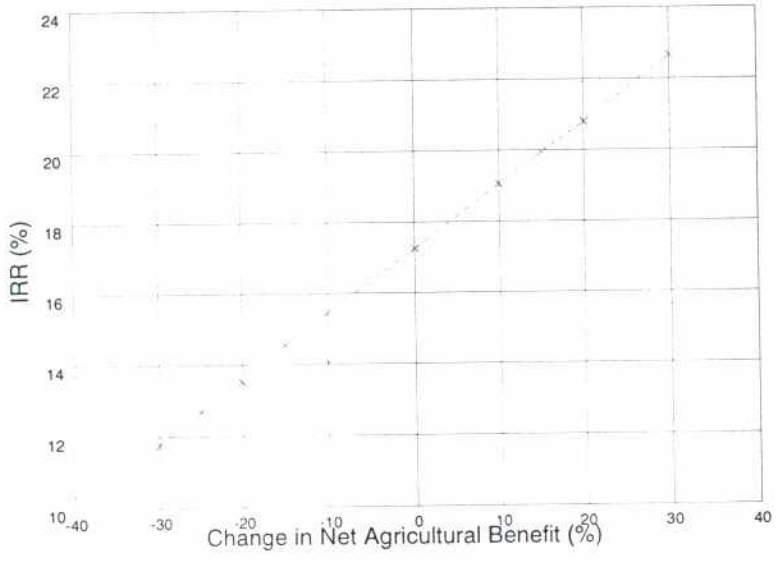
These sensitivity analyses, therefore, generally reinforce the principal conclusion of the economic analysis. That is:

"From an economic perspective, the proposed Kalni-Kushiyara River Management Project appears to be a very feasible economic investment opportunity for the Government of Bangladesh".

Graph E.6: Post-construction Dredging Cost - EIRR Relationship



Graph E.7: Net Agricultural Benefits - EIRR Relationship



9. FINANCIAL ANALYSIS

There are 3 particularly important financial considerations:

- Financial Impact on Project Beneficiaries;
- Poverty Alleviation Impact, and
- Financial Impact on Government.

9.1 Project Beneficiaries

Table E.38 present the profile of the KKRMP study area.

Table E.38: Kalni-Kushiyara River Management Project Study Area Profile

Project Area	3356 km^2 (335,600 ha.)
% of Bangladesh	2.27
Total Cultivated Area	279,850 ha
Population (1995 est.)	1,890,000
% of Bangladesh	1.58
Population Rate of Growth (av./yr.)	1.77%/year
% Urban and % Rural	8. 9% and 91.1% respectively
No. of Villages	2,412
Population/Village	783
No. of Households	286,683
Rural Households (est.)	257,620
Households/Village	119
Average No. of persons /Household	5.7
Average Farm Size	1.1 ha.
Average Per Capita Income/year	Tk 7,470
Farm Wage Rate/Day (approx.)	Tk 40
Absolute Poverty (<2,122 cal./day)	65% of population
Hard Core Poverty (<1,805 cal./day)	50% of population
Level of Schooling ≥ Primary	27.7%
Persons/Tubewell	112
Income Distribution	Bottom 20% : 6%; Top 10% : 40%
Employment Structure (person-year equivalents):	Agriculture 700,000 Fisheries 100,000 Water Transportation 20,000 Earthwork/Construction 60,000 Process/Trade 85,000 Services/Other 35,000 **TOTAL 1,000,000**
Average Annual Rate of Inflation (Rural CPI, 90-95)	4.5%/year
Project Capital Cost per Beneficiary Household	Tk 10,822

Agriculture

Potential project beneficiaries in the agricultural sector in the project area are profiled in Table E.39.

Table E.39: Agriculture Beneficiaries Profile

Class	Percent of Households (%)	Percent of Land (%)	Average Farm Size Owned (ha)	Average Annual HH Income (Tk)
Landless	42.6	0		22,371
Small Farms	35.7	14.3	0.4	32,943
Medium Farms	13.9	23.0	1.8	55,491
Large Farms	7.8	62.7	8.8	174,977
TOTAL	**100%**	**100%**	**1.1**	**42,577**

Source: Kalni-Kushiyara Farm Household Survey (Annex D)

The estimated total number and average farm size actually cultivated (i.e. hectares owned + rented) is presented in Table E.40.

Table E.40: Farm Size Profile

Class	Total Rural Households	Owned Land (ha/HH)	Rented Land (ha/HH)	Total Land (ha/HH)
Landless	109,760	0.00	0.21	0.21
Small	92,075	0.43	0.00	0.70
Medium	35,830	1.80	0.08	1.88
Large	19,955	8.80	(2.53)[1]	6.27
TOTAL	**257,620**	**1.10**		**1.10**

Note: 1. Figures in parenthesis are for land rented out to smaller landless farmers.

The total cultivated area is 279,850 hectares; about 83% of the total project area (Table E.38).

The principal project beneficiaries will be these 257,600 rural households (Table E.38) who cultivate owned and owned+rented land. Small and "landless" farms cultivate on average about 0.2 ha; small farms 0.7 ha; medium-sized farms 1.9 ha; and larger farms 6.3 ha. These are average physical size; with a cropping intensity of about 1.0, the area actually cropped/year is approximately the same. Farm budgets for each of these 4 farm types have been prepared in Appendix E.1 Tables 18 to 20 and summarized in Table E.41.

The following presents the farm budget highlights comparing the FW scenario and FWO scenario at project maturity (Year 30):

- The proposed project should make a significant difference to gross farm income (at project maturity): Tk 359 (21% increase over FWO) for landless farms; Tk 1,916 (18%) for small farms; Tk 6,495 (19%) for medium-sized farms and Tk 23,270 (20%) for large farms (Table E.41);

- The project overall impact on total farm family income is a function of how dependent they are on the farm as a source of total family income. Smaller farmers generally have a greater dependence on non-farm sources of income. Thus, we find that the estimated change in the family income of "landless" farmers is a minute 1.6%, but this climbs very considerably as farm size increases: a 5.9% increase for small farmers; a 12.2% increase for medium-sized farmers; and a 14.4% increase for large farmers;

- Incremental gross farm income per person would, at the same time, be highly skewed in favour of larger farmers. For the landless, it is only Tk 63 whereas for small farms it climbs to Tk 336; Tk 1,139 for medium-sized farms; and Tk 4,083 for large farms. This is essentially due to 2 main factors: 1) simply the scale of the operation; and 2) degree of owner-equity and land rental requirements;

- The overall change in the family labour required is almost negligible: 1 day/year for landless and small farms; 6 days/year for medium-sized farms; and 10 days/year for large farms. It is anticipated that 30% of this change will be a female labour requirement;

- These farm budgets clearly reveal the impact of scale, equity, and the existence of relatively onerous land rental agreements on resulting gross farm incomes. Given the acute wealth and income inequities that already exist, this simply reflects the on-going transfer of income from the poor to the relatively wealthy;

- This budgeting also reflects an almost universal characteristic of public investment projects which focus (at least in part) on the rehabilitation or enhancement of privately-owned natural resources, e.g. irrigation and drainage. Part of this public investment is invariably capitalized into private wealth, the distribution of which is already skewed in favour of the wealthier land owners in the FWO scenario. This is why complimentary initiatives often act as a counterweight, and

Finally, although not illustrated in this static farm financial balance sheet, it must be emphasized that the proposed project will also significantly reduce income variability and thus enhance seasonal food security and longer-term investment opportunities. Despite not being quantified, this too is a very real on-farm financial benefit, specially for the small and medium-sized farms which represent 50% of the total households in the project area.

Table E.41: Annual Farm Budget Analysis

Item	Landless(0.2ha)			Small Farm(0.7 ha)			Medium Farm(1.9 ha)			Large Farm(6.3 ha)		
	Present	FWO	FW	Present	FWO	FW	Present	FWO	FW	Present	FWO	FW
GROSS VALUE OF PRODUCTION (Tk)	6,330	6,146	6,833	22,154	21,511	23,915	57,748	55,324	62,454	176,265	168,973	190,311
TOTAL CASH COSTS (Tk)	2,011	2,059	2,057	7,039	7,207	7,200	20,989	20,857	21,492	81,236	80,796	82,905
COST OF RENT (Tk)	2,528	2,401	2,754	8,849	8,402	9,637	0	0	0	17,063	17,021	17,500
GROSS FARM INCOME (Tk)	1,820	1,692	2,051	11,368	10,712	12,628	36,760	34,467	40,962	128,018	114,646	137,916
INCREMENTAL GROSS FARM INCOME[1] (Tk)			359			1,916			6,495			23,270
TOTAL FAMILY INCOME[2] (Tk)	22,371	22,243	22,602	32,943	32,288	34,203	55,491	53,198	59,693	174,977	161,605	184,875
PERCENT CHANGE IN FAMILY INCOME (%)		-0.6%	1.6%		-2.0%	5.9%		-4.1%	12.2%		-7.6%	14.4%
RETURN PER FAMILY MEMBER												
Average No. in Family	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Gross Farm Income/Person (Tk)	319	297	360	1,994	1,879	2,215	6,449	6,047	7,186	22,459	20,113	24,196
Incremental Gross Farm Income/Person (Tk)			63			336			1,139			4,083
RETURN TO FAMILY LABOUR												
Family Labour (person days)	37	37	38	114	115	116	245	245	251	390	391	401
Gross Farm Income/Person Day (Tk)	**49**	**45**	**55**	**100**	**93**	**109**	**150**	**141**	**163**	**328**	**293**	**344**
Incremental Gross Farm Income/Person Day (Tk)			10			16			26			58
Percent of Households (%)		42			36			14			8	
Percent of Cultivable Land (%)		0			14			23			63	

Notes:
1. Based Data from Appendix E.1, Tables 18 to 20.
2. Based Data from Kalni-Kushiyara River Household Survey

Fisheries
In the project area a relatively large number of households depend on fishing and fish trading as a source of primary and secondary income (Annex D - Social). Two-thirds of all households report at least some income (sales or consumption) from fishing and the fish trade. This is generally very small-scale production which often serves as an important source of protein for the family. An estimated 100,000 full-time employment equivalents are involved; approximately 10% of the total labour force in the region. Thus, if the proposed project eventually augments fish production by 2.4% (as projected), this should effectively increase employment and incomes by a similar percentage. This is, effectively, a livelihood for an additional 2,000 or so families.

Navigation
In the project area, there are approximately 20,000 full-time employment equivalents involved in the water transportation sector. Projected increases in cargo and passenger movements (plus cost savings) with the project could effectively increase this number by 5 to 10% or about 1,000 people. This, of course, is the long-term change over and above the short-term construction-related employment and income impacts.

Socioeconomic Infrastructure
It is estimated that up to 25,000 households and related infrastructure could be directly affected by the proposed project just in terms of less flood damage, additional village platforms, and so on. The direct impact of this in terms of income/household is estimated to be about 10% or about Tk 3,000/year. This should be particularly beneficial to women, both in terms of quality of life in the home (nutrition, sanitation, etc.) and in terms of greater economic empowerment, (rice harvesting, gardens, fruits, etc.).

Conversely, the extension of existing or the creation of new platforms has financial implications for the platform beneficiaries who will incur expenses for the protection and maintenance of these platforms. It is proposed that in the first three years after completion of a platform, the Project pays for material required for platform protection and beneficiaries contribute by providing labour. The fourth year after completion, the platform will be handed over to the beneficiaries who will then be fully responsible for its protection and maintenance, including annual protection by traditional methods and maintenance of hard protection as required. The cost of protection varies from site to site, depending on original protection method (traditional or hard), platform exposure and length of exposure per plot. The average expenditure is estimated as Tk 1,500/HH/year. The global cost of platform maintenance is expected to range from Tk 5.60 million in Year 8 to reach Tk 17.25 million by Year 20.

9.2 Poverty Alleviation Impact

9.2.1 Introduction

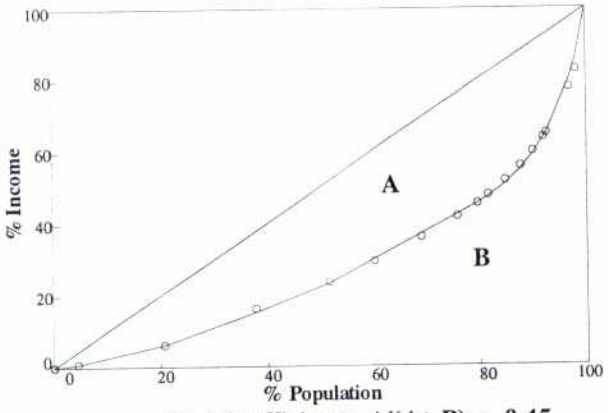
National and international development agencies are particularly concerned about how proposed interventions will impact on poverty alleviation. To track these impacts, various macro-indicators of poverty and income distribution characteristics at given points in time are typically employed and include the following (BBS, 1996; ADB, 1994; UNDP, 1997):

Head Count Ratio
Fraction of the people who are poor. The Absolute Poverty Line in Bangladesh (as defined by WHO/UNICEF) is a calorie intake of 2,122 calories per capita per day. The Hard Core Poverty Line is defined as 85% of the required level, that is 1,805 calories per capita per day.

Poverty Gap Ratio
Average income shortfall of the poor expressed as a percentage of the poverty line.

Gini Coefficient
A measure of the degree of income inequity which compares the percentage of income with the percentage of the population. The value of the coefficient ranges from zero to one. If the coefficient is zero, the income distribution is equal while one indicates perfect inequity (Graph E.8).

Graph E.8: Gini Coefficient of Project Area



Gini Coefficient= A/(A+ B) = 0.45

Sen Index
A distributionally sensitive poverty measure that takes into account all 3 of the above measures: the poverty head count ratio, poverty gap ratio, and Gini coefficient.

Human Development Indicators
Various indices developed using measures of life expectancy, adult literacy, school enrollment ratios, and real GDP in purchasing power terms.

9.2.2 Existing Situation

Average per capita annual income in the Kalni-Kushiyara River region has been estimated at Tk 7,470/year (US$ 187/year). Household income is not sufficient to maintain a decent life for most of the households. As much as 65% of the households are below the "absolute poverty line" in terms of caloric intake while the extent of the "hard core poor" is estimated at 50%. These rates are much higher than that of the country as a whole (Table E.42).

Table E.42: Percentage of Households below Poverty Line

Poverty Live	Households Below Poverty Line (%)	
	K-K Region	Bangladesh
Absolute	65	48
Hard Core	50	28

At the same time, the income distribution is highly skewed and this is highly correlated to land ownership patterns. It is estimated that the bottom 20% of households only have an income share of 6% while the top 10% have an income share of 40%. And, again, this degree of income inequity is much higher than for the country as a whole. The Gini Coefficient, for the Kalni-

Kushiyara River region, is estimated to be 0.45 compared to 0.39 in Bangladesh and 0.37 in rural Bangladesh, based on 1991-92 data (Annex D - Social).

Other analyses (Hossain, 1994) identify the principal determinants of this poverty and help identify sustainable poverty-alleviating interventions, namely:

- Land Ownership/agricultural technology;
- Number/education of household members;
- Non-agricultural employment opportunities, and
- Infrastructure (transportation & electricity).

But these constraints, in turn are made more acute by the existing environmental conditions. Existing annual flood conditions accentuate (and perpetuate) existing poverty levels in the Kalni-Kushiyara region. Measurable sustainable development in the Kalni-Kushiyara River region is practically precluded without changing the over-arching socioeconomic and physical environment (Jalal, 1993).

The KKRMP is designed to specifically address these prevailing bottlenecks.

9.2.3 Project Initiatives

The proposed Kalni-Kushiyara River Management Project is a multi-faceted Project which would establish the pre-requisite socioeconomic and physical conditions required to initiate a sustainable development process for the targeted population. The objectives, scope, sectors benefiting, and major thrust are summarized in the Input-Output Matrix shown in Table E.43.

Table E.43: Input-Output Matrix

Project	Physical Intervention	Objective	Scope	Benefit	Major Thrust
River Management Project	Dredging	Mending the river	Flood confinement	Crops, Homestead	Growth
			Drainage	Crops	Growth
			Navigation	Transportation	Growth
	Disposal of dredged spoil	Creating new platforms	Settlement	Landless settlement	Equity
			Community use	School, Growth centre, Recreation	Equity
		Improving existing platforms	Liveability	All strata of population	Equity
	Loop cut	Channel improvement	Flood confinement	Crops, Homestead	Growth
			Drainage	Crops	Growth
			Navigation	Transportation	Growth
	River training	River stabilization	Channel	Transportation	Growth
			Liveability	All strata of population	Equity

In this context, Project-specific *a priori* measures which indicate the extent to which the relatively poor will directly benefit from the Project are the following: a) food availability; b) agriculture employment; c) non-agricultural employment; d) land tenure; e) transportation infrastructure ; f) community infrastructure; and g) overall impact. Each of these anticipated impacts is briefly summarized in Section 9.2.4.

9.2.4 Principal Impacts

Food Availability
There are at least four element to this; crops, fisheries, garden and fruit trees, and livestock. The expected change in crop food availability per person with and without the project has been calculated and is presented in Table E.44.

Table E.44: Per Capita Crop Food Availability

Crop type	Per Capita Crop Food Availability (kg/day)			
	Present	FWO Year 15	FW Year 15	Change (%)
Rice/Cereal	0.94	0.66	0.75	+13.5
Non-Cereal	0.04	0.04	0.03	-16.9

By comparison, the average per capita daily intake at the national level in rural areas for 1991-92 was 0.52 kg/day for cereals including 0.48 kg/day for rice, and 0.19 kg/day for non-cereals (BBS, 1995). This indicates that the area produces a rice surplus but suffers a deficit for non-cereal crops. However the study area is both an exporter (wet season) and importer (dry season) of rice (section 5.2; Appendix E.1, Table 13).

With respect to fisheries, the FWO scenarios suggest a gradual decline of about 12%. Most of this loss would be prevented in the FW situation. This is very significant in that an estimated 60% of all households in the Kalni-Kushiyara River region (and these are often relatively poor households) are fish-dependent. For 28% of all households, fish is their primary source of income.

Up to 90% of homestead trees and gardens are also presently vulnerable to flood damage. Proposed platform development will enhance these production opportunities for an estimated 6,250 families in the first 10 years of Project development, 11,250 families by Year 20. Kitchen gardens and fruits increase both nutritional standards and flood security. They typically contribute about 7% to total farm family income (Hossain, 1994).

Finally, additional flood protection will also provide additional security and encourage additional growth of the livestock sector. Assuming this was proportional to projected crop production changes, the net value of this incremental production could increase by about 10%. Livestock production already accounts for about 11% of farm household income (Hossain, 1994).

Agricultural Employment Opportunities

Largely due to crop production increases, labour requirements will climb by approximately 10% for harvest and post-harvest activities (including drying). This translates into a 2.4% overall increase in agricultural employment. This is particularly important in three respects; 1) under-utilization of labour during the *boro* (winter) season is reduced; 2) it would affect women disproportionately more because they conduct most post-harvest activities at the homestead, and 3) it would be particularly beneficial to the landless and the relatively poor (often one and the same).

According to the Household Survey (Annex D), the poor mainly depend on wage labour for their survival. Nearly one-half of all farm households secure at least some income from farm labour.

Non-Agricultural Employment Opportunities

This includes employment in the fisheries and water transportation sectors, as well as additional activities at the village level. Assuming the 1995 population of 1.89 million increases by 1.77%/year, the general magnitude of this expansion is expected to be as Table E.45.

Table E.45: Non-Agricultural Employment Opportunities

Sector	Existing (person year)	Expansion (person year)	Change (%)
Fishing	100,000	2,400	2.4
Water Transportation	20,000	1,000-2,000	5 to 10

Land Tenure

This has two elements which are relatively beneficial to the poor. a) FW will reduce the rate of land concentration and increasing landlessness, and b) some landless will be specifically targeted for homestead land access.

Bandhak is the traditional and widespread credit and mortgage system. Under this system, the lender (usually larger farmers and traders) holds the right to cultivate the mortgaged land and get all 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. Improved flood management will reduce the loss of land due to the forfeiting of mortgaged collateral.

Approximately 1,250 destitute and landless households will also be specifically targeted for resettlement on the new platforms proposed for Abdullahpur Dokkhin Char (12) and Anandapur (1). It is expected that activities related to children's schooling, women's vocational training, micro-credit and intensive horticulture programs will be developed for these landless households to supplement the income they earn as agricultural labourers (Annex I - EIA).

Transportation Infrastructure

Aside from additional direct employment in navigation (see above), there are 3 additional impacts which could provide a very substantial impetus to growth and sustainable development in the region: a) enhanced marketing and commercial activities during the *boro* season; b) potential passenger benefits, and c) potential international traffic benefits. (Sections 5.2, 5.3 and 5.4). During the *boro* season, a Class II waterway will allow for the improved movement of both inputs (e.g. fertilizer) and outputs (e.g. rice and fish). Consistent with the international literature on feeder roads, this could alone increase production and long-term income opportunities in the hinterland (defined as a 10 km river band) by about 10%.

Community Infrastructure
Numerous enhancement measures are proposed in conjunction with the village platform development, tree plantations, bamboo fencing, straw soil enhancement, *Dhaincha* soil enhancement, a plantation of water-tolerant shrubs and grasses, *Chailla* grass production, potable water tubewells (1/10 HH), and latrines. These are progressive measures which will further help empower the relatively powerless, particularly women and the relatively poor.

Overall Impact
The proposed KKRMP would reduce risk and uncertainty; thus gradually changing attitudes and giving more hope and opportunity to the region (particularly the less-empowered). The immediate result will be additional private capital investment and growth. The attitudinal change itself, however, is the most important single ingredient in the gradual development of a more sustainable regional economy in a very fragile and unforgiving physical environment. This can become well-engrained during the very pro-active initial construction and employment period. It sends a message "Somebody cares; we can do it." And then they will.

9.3 Government Receipts and Expenditures

Table E.46 shows the tentative GOB expenditures and net impact on foreign exchange components for capital and O&M costs, including an ADB service charge of 1% on the loan. The table has been prepared based on the available information from ADB, BWDB and ERD and could be modified during the finalization of Development Credit Agreement (DCA) and TA.

There are two particular government concerns:

- Government Expenditures and Net Impact on Foreign Exchange, and
- Cost Recovery Potential.

Government Expenditures and Net Impact on Foreign Exchange
The portion of capital and O&M costs attributed to GOB includes:

- GOB contribution to study costs (Tk 28.85 million) in terms of personnel and expenses;
- land acquisition (Tk 70.02 million);
- construction of confinement dykes and soft protections (Tk 162.54 million including 15% physical contingency), and
- O&M, excluding the cost of platform protection and maintenance assumed to be covered by the beneficiaries.

The total capital cost of KKRMP is estimated to be Tk 2,787.93 million of which GOB contribution is about Tk 261.41 million. The Technical Assistance (TA) cost is estimated to be Tk 329.16 million and mainly includes the study costs excluding the GOB share, EMP process and construction. The remaining Tk 2,197.36 million (79%) is attributed to the ADB loan. The loan repayment schedule has been calculated by dividing the loan in 60 instalments to be repaid over a 40-year period with a grace period of 10 years. The ADB Service Charge of 1% has been added to the twice-yearly payments.

Table E.46: GOB and Platform Beneficiaries Expenditures

Years	GOB Capital Cost (Local Currency)	O&M Costs (Local Currency)			Total GOB Capital & O&M (Local Currency)	GOB (Foreign Currency)			GOB Cost Recovery (Local Currency)		GOB Net Cash Flow (Capital+O&M+ADB Loan with Service Charge-GOB Cost Recovery)					
											Scenario 1			Scenario 2		
	(mTk)	GOB Costs (mTk)	Platform Beneficiaries Costs (mTk)	Total O&M Costs (mTk)	(mTk)	ADB Loan (mTk)	Loan Repayment Schedule (mTk)	Loan With Service Charge (mTk)	Scenario 1 (mTk)	Scenario 2 (mTk)	Local Currency (mTk)	Foreign Currency (mTk)	Total (mTk)	Local Currency (mTk)	Foreign Currency (mTk)	Total (mTk)
1	58.90				58.90						58.90		58.90	58.90		58.90
2	19.77				19.77						19.77		19.77	19.77		19.77
3	4.33				4.33	494.70					4.33		4.33	4.33		4.33
4	18.60				18.60	512.58					18.60		18.60	18.60		18.60
5	64.06				64.06	543.36					64.06		64.06	64.06		64.06
6	66.25				66.25	577.21					66.25		66.25	66.25		66.25
7	13.68	26.17		26.17	39.85	66.57					39.85		39.85	39.85		39.85
8	8.63	128.89	5.60	134.49	137.52	2.94			11.10	11.10	126.42		126.42	126.42		126.42
9	7.19	125.11	9.38	134.49	132.30				14.90	14.90	117.40		117.40	117.40		117.40
10		125.11	9.38	134.49	125.11				16.00	16.00	109.11		109.11	109.11		109.11
11		113.71	9.94	123.65	113.71				53.70	16.60	60.01		60.01	97.11		97.11
12		112.89	10.76	123.65	112.89				54.60	17.50	58.29		58.29	95.39		95.39
13		112.06	11.59	123.65	112.06				56.40	19.30	55.66		55.66	92.76		92.76
14		100.42	12.42	112.84	100.42		73.22	94.64	57.30	20.20	43.12	94.64	137.76	80.22	94.64	174.86
15		99.59	13.25	112.84	99.59		73.22	93.91	58.20	21.10	41.39	93.91	135.30	78.49	93.91	172.40
16		98.76	14.08	112.84	98.76		73.22	93.19	60.10	22.90	38.66	93.19	131.85	75.86	93.19	169.05
17		97.94	14.90	112.84	97.94		73.22	92.47	60.90	23.80	37.04	92.47	129.51	74.14	92.47	166.61
18		88.39	15.73	104.12	88.39		73.22	91.74	61.80	24.70	26.59	91.74	118.33	63.69	91.74	155.43
19		87.56	16.56	104.12	87.56		73.24	91.00	63.70	26.60	23.86	91	114.86	60.96	91.00	151.96
20		86.87	17.25	104.12	86.87		73.24	90.27	64.50	33.51	22.37	90.27	112.64	53.36	90.27	143.63
21		86.87	17.25	104.12	86.87		73.24	89.54	65.50	33.51	21.37	89.54	110.91	53.36	89.54	142.90
22		86.87	17.25	104.12	86.87		73.24	88.81	65.60	33.51	21.27	88.81	110.08	53.36	88.81	142.17
23		86.87	17.25	104.12	86.87		73.24	88.07	66.60	33.51	20.27	88.07	108.34	53.36	88.07	141.43
24		86.87	17.25	104.12	86.87		73.24	87.34	66.70	33.51	20.17	87.34	107.51	53.36	87.34	140.70
25		86.87	17.25	104.12	86.87		73.24	86.61	67.80	33.51	19.07	86.61	105.68	53.36	86.61	139.97
26		86.87	17.25	104.12	86.87		73.24	85.88	67.90	33.51	18.97	85.88	104.85	53.36	85.88	139.24
27		86.87	17.25	104.12	86.87		73.24	85.14	72.90	33.51	13.97	85.14	99.11	53.36	85.14	138.50
28		86.87	17.25	104.12	86.87		73.24	84.46	78.00	33.51	8.87	84.46	93.33	53.36	84.46	137.82
29		86.87	17.25	104.12	86.87		73.24	83.68	78.10	33.51	8.77	83.68	92.45	53.36	83.68	137.04
30		86.87	17.25	104.12	86.87		73.24	82.95	83.20	33.51	3.67	82.95	86.62	53.36	82.95	136.31
31-43							73.26	77.83				77.83	77.83		77.83	77.83
Total	261.41	2272.17	333.34	2605.51	2533.58	2197.36	2197.36	2521.49	1345.50	603.31	1188.08	2521.49	2910.92	1930.27	2521.49	3541.81

Based on the above estimates, the resulting net cash flow of GOB expenditures over the life of the project and repayment period, broken down into local and foreign components, is presented in Table E.46. The Table also presents the cash flow of platform protection and maintenance which should be covered by the beneficiaries. However, should the beneficiaries be unable to take care of protection and maintenance in whole or in part, the shortfall will have to be covered by GOB to prevent degradation of the infrastructure and the expenditures included in the cost recovery program.

Cost Recovery Potential

Potential cost recovery must carefully be considered to determine the long-term financial sustainability of the project. This can be measured by:

CRI = T/E

where:

CRI = Cost Recovery Index
T = Taxes and other charges on project beneficiaries
E = Project Expenditures by government

The 2 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.

Presuming that it is the annual O&M cost of the project which must be recovered on an on-going basis, the 2 key issues are:

- Organizational structure and adequate on-financial arrangements to continue with the maintenance dredging, and
- Organizational structure and adequate on-financial arrangements to ensure maintenance of the village platforms.

This can be facilitated by carefully equating annual component benefits to annual component costs; determining respective user capacities-to-pay; and then developing appropriate collection and re-investment mechanisms. In this context, one inherent difficulty with multiple use resource management projects, is the impracticality of withholding benefits if a "free rider" refuses to pay. Another difficulty is developing a practical cost-sharing arrangement.

In addition, a cursory financial analysis regarding the projected benefits to agriculture, navigation, fisheries, and socioeconomic infrastructure suggests that policy-makers may have difficulty establishing a full O&M cost recovery policy simply because reoccurring O&M costs are relatively high. They could amount to as much as 20% of annual long-term benefits and (aside from the two other difficulties referred to above) this is a relatively high percentage of user benefits to try to recover.

Cost recovery scenarios are presented in Chapter 11 of the Main Report.

10. MULTI-CRITERIA ANALYSIS

Finally, the FPCO *Guidelines* describe a methodology for assessing impacts accruing from the proposed Kalni-Kushiyara River Management Project 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 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:

Economic Impacts
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 8.7).

Financial Impacts
Considers financial impacts on beneficiaries and government. Focuses on income changes to beneficiaries (Section 9.1).

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.

The results of the multi-criteria analysis are presented in Table E.47. The multi-criteria analysis is also discussed in Chapter 11 of the KKRMP feasibility study Main Report.

Table E.47: Multi-Criteria Analysis

1. Economic		
Variable	**EIRR (%)**	**NPV (million Tk)**
Alternative 1 development	17.2	531.0
Pessimistic (average of 11 sensitivities)	12.6	69.2
Optimistic (average of 7 sensitivities)	18.7	677.8
Most Likely Range (symmetric)	14.6 to 19.8	

2. Financial				
Agriculture	**LL**	**S**	**M**	**L**
Impact on Farm Income (%)	+21.2	+17.9	+18.8	+20.3
Impact on Total Farm Family Income (%)	+1.6	+5.9	+12.2	+14.4
Impact on Navigation Sector Incomes (%)	+5 to 10			
Impact on Fishery Sector Incomes (%)	+2.4			
Impact on Flood/Wave-Protected Households/Infrastructure (per household)	+10% (approx. Tk 3,000/HH year)			
Sustainable Financial Long-Term Plan (monetary +institutional)	Separable/recoverable			
Relatively Low Foreign Exchange Requirements	Yes			

3. Quantitative Impacts			
Indicator	Unit	Value	%
Incremental Cereal Production (Year 15)	tonnes	221,000	13.4
Incremental Non-Cereal Production (Year 15)	tonnes	24,000	-16.9
Incremental Fish Production	tonnes	1,329	2.4
Homesteads Protected from Floods/Waves	numbers	25,000	7
Increased Long-Term Employment (% of total project area)	person-years	16,000	+1 to 2
Construction Employment	person-years	20,000	

4. Qualitative Impacts (ranked from -10 to +10)	
Criteria	**Rank**
Number of Direct Beneficiaries (%of project area population)	+8
Diversity of Direct Beneficiaries (sectors, sub-regions)	+8
Stimulus to Equality of Opportunity (employment)	+7
Targeting of the "Poorest of the Poor"	+3
Assistance to Regional Food Self-Sufficiency	+6
Stimulus to Social Amenities (potable water, sanitation, health/education)	+7
Addresses Potentially Irreversible Resource Degradation	+10
Addresses Gender Inequities/Empowerment of the Relatively Powerless	+5
Augments Social Capital (public land and water, facilities, and other resources)	+8
Conducive to Local Organization & Management	+3
High Priority Locally-Perceived "Felt Need"	+8
Increased Conflict versus Social Harmony	+4
Will Generate Perceptible & Widespread Improvement to "Quality of Life"	+7

Note: LL = Landless Farmers S = Small Farmers M = Medium Farmers L = Large Farmers

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FIGURES

Figure E.1

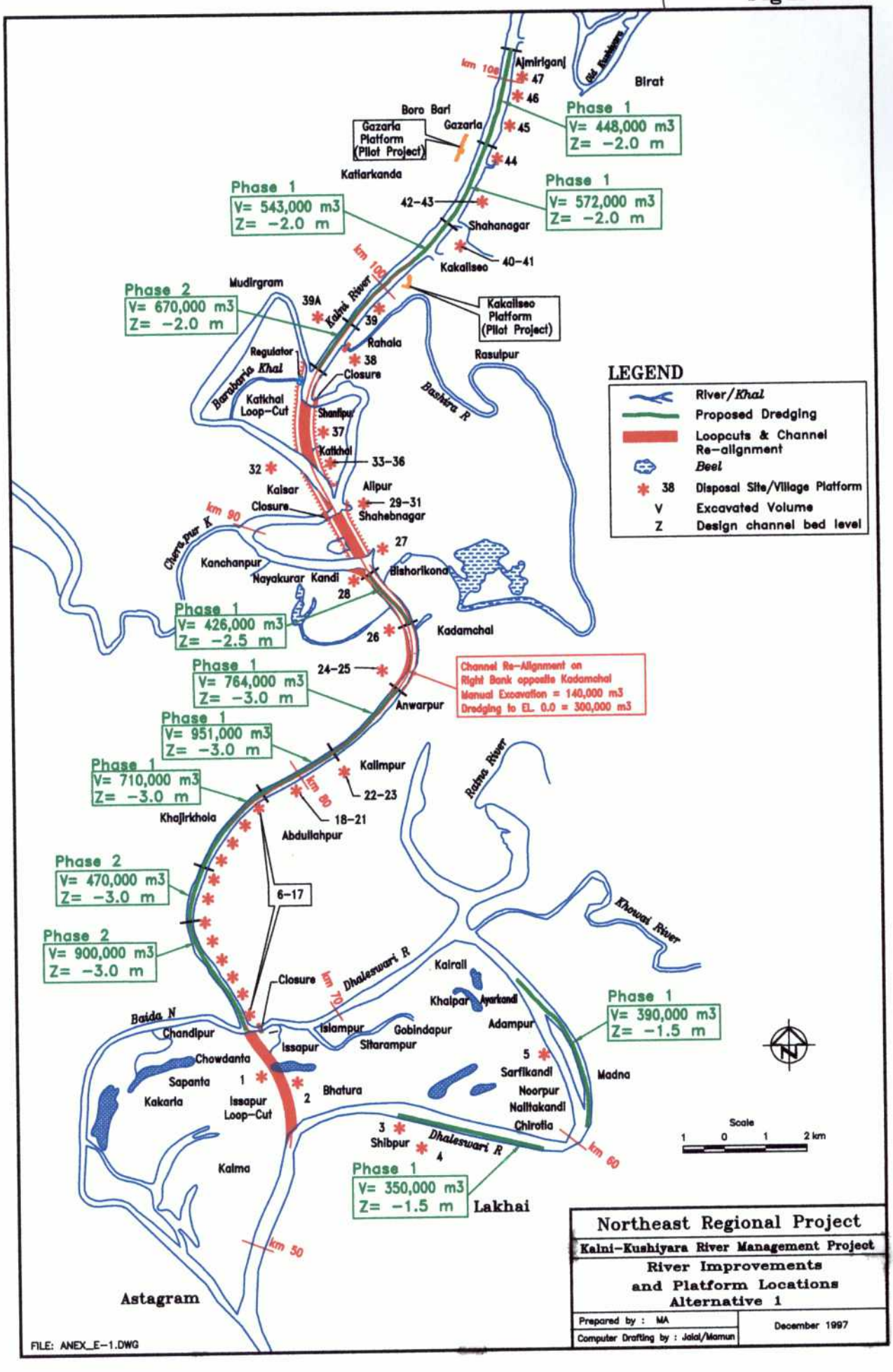
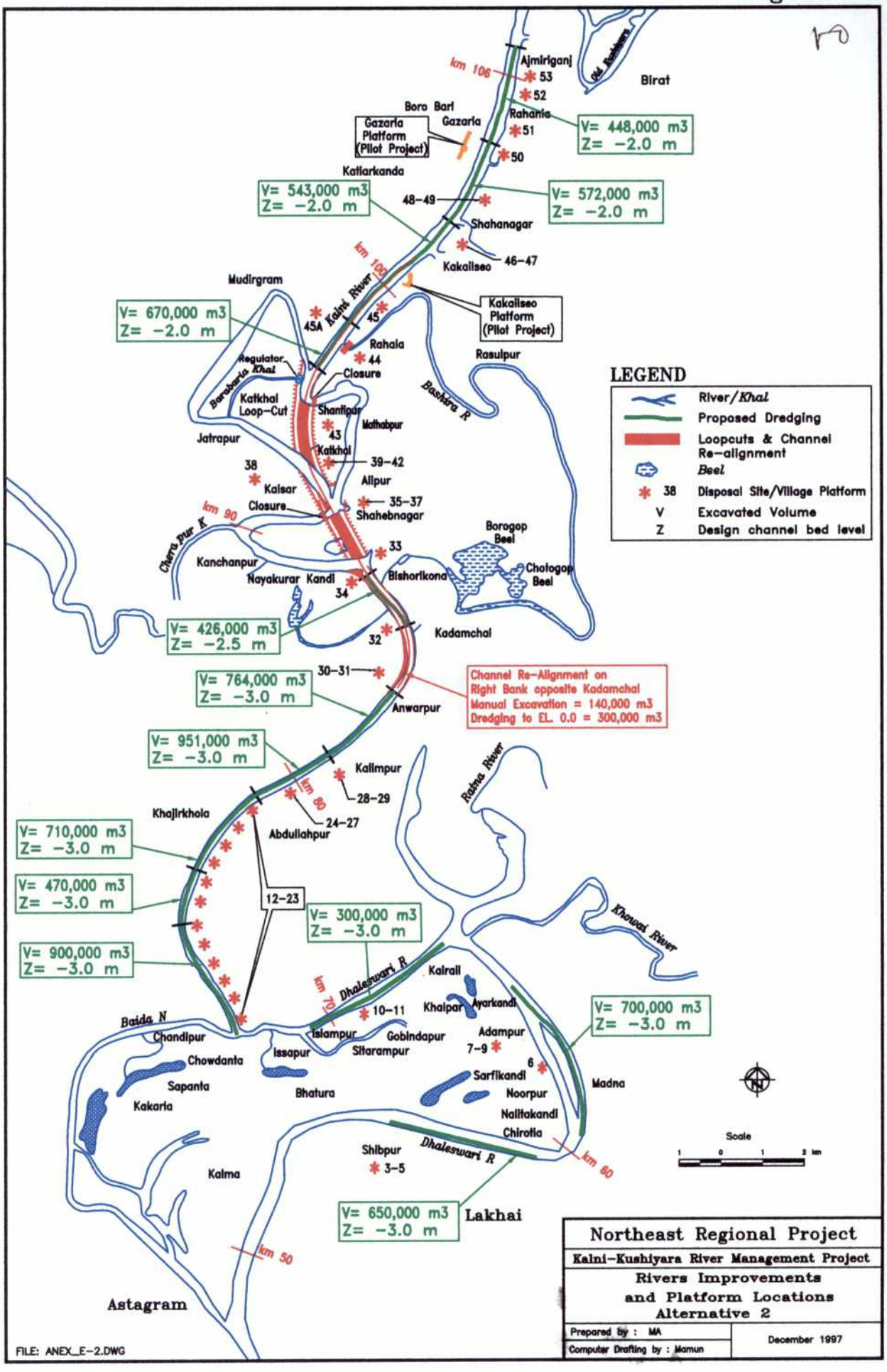

Ajmiriganj
47
46
Birat
Old Brahmaputra
Boro Bari
Gazaria Platform (Pilot Project)
Gazaria
45
44
Katlarkanda
Phase 1
V= 448,000 m3
Z= -2.0 m
Phase 1
V= 543,000 m3
Z= -2.0 m
42-43
Shahanagar
Phase 1
V= 572,000 m3
Z= -2.0 m
Kakaliseo
40-41
km 100
Mudirgram
Phase 2
V= 670,000 m3
Z= -2.0 m
39A
Kalni River
39
Kakaliseo Platform (Pilot Project)
Rahala
38
Regulator
Closure
Barobaria Khal
Katkhal Loop-Cut
Rasulpur
Bashira R
Shanipur
37
Katkhal
33-36
32
Kaisar
Alipur
29-31
Shahebnagar
Closure
km 90
Chora Pur R
27
Kanchanpur
Nayakurar Kandi
Bishorikona
28
Phase 1
V= 426,000 m3
Z= -2.5 m
26
Kadamchal
Phase 1
V= 764,000 m3
Z= -3.0 m
24-25
Channel Re-Alignment on Right Bank opposite Kadamchal
Manual Excavation = 140,000 m3
Dredging to EL. 0.0 = 300,000 m3
Anwarpur
Phase 1
V= 951,000 m3
Z= -3.0 m
Kalimpur
Phase 1
V= 710,000 m3
Z= -3.0 m
22-23
km 80
Khajirkhola
18-21
Abdullahpur
Raina River
Phase 2
V= 470,000 m3
Z= -3.0 m
6-17
Phase 2
V= 900,000 m3
Z= -3.0 m
Khowai River
Kairali
Closure
km 70
Dhaleswari R
Khaipar
Ayarkandi
Phase 1
V= 390,000 m3
Z= -1.5 m
Baida N
Chandipur
Islampur
Gobindapur
Adampur
Issapur
Sitarampur
Chowdanta
5
Sarfikandi
Madna
Sapanta
1
Bhatura
Noorpur
Kakaria
Issapur Loop-Cut
2
Nalltakandi
Chirotia
3
Shibpur
4
Dhaleswari R
km 60
Kalma
Phase 1
V= 350,000 m3
Z= -1.5 m
Lakhai
km 50
Astagram
N
Scale
1 0 1 2 km
LEGEND
River/Khal
Proposed Dredging
Loopcuts & Channel Re-alignment
Beel
38 Disposal Site/Village Platform
V Excavated Volume
Z Design channel bed level
Northeast Regional Project
Kalni-Kushiyara River Management Project
River Improvements and Platform Locations Alternative 1
Prepared by : MA
Computer Drafting by : Jalal/Mamun
December 1997
FILE: ANEX_E-1.DWG

Figure E.2


Ajmiriganj
53
52
Rahania
51
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Birat
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Gazaria Platform (Pilot Project)
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48-49
V= 572,000 m3
Z= -2.0 m
Shahanagar
46-47
Kakaliseo
km 100
Mudirgram
Kalni River
V= 670,000 m3
Z= -2.0 m
454
45
Kakaliseo Platform (Pilot Project)
Rahala
44
Rasulpur
Regulator
Barubaria Khal
Closure
Katkhal Loop-Cut
Shantipur
Mahabpur
Baskira R
Jatrapur
43
Katkhal
39-42
38
Kaisar
Closure
Ailpur
35-37
Shahebnagar
km 90
Charra Pur R
Borogop Beel
33
Kanchanpur
Nayakurar Kandi
34
Bishorikona
Chotogop Beel
V= 426,000 m3
Z= -2.5 m
32
Kadamchal
30-31
V= 764,000 m3
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Kalimpur
28-29
Rahna River
km 80
Khajirkhola
24-27
Abdullahpur
V= 710,000 m3
Z= -3.0 m
V= 470,000 m3
Z= -3.0 m
12-23
V= 300,000 m3
Z= -3.0 m
Khowai River
V= 900,000 m3
Z= -3.0 m
Dhaleswari R
km 70
Kairail
Khaipar
Ayarkandi
10-11
Baida N
Chandipur
Islampur
Gobindapur
Adampur
V= 700,000 m3
Z= -3.0 m
7-9
Issapur
Sitarampur
6
Chowdanta
Sarfikandi
Madna
Sapanta
Bhatura
Noorpur
Kakaria
Nalitakandi
Chirotia
Shibpur
3-5
Dhaleswari R
km 60
Kalma
V= 650,000 m3
Z= -3.0 m
Lakhai
km 50
Astagram
LEGEND
River/Khal
Proposed Dredging
Loopcuts & Channel Re-alignment
Beel
38 Disposal Site/Village Platform
V Excavated Volume
Z Design channel bed level
N
Scale
1 0 1 2 km
Northeast Regional Project
Kalni-Kushiyara River Management Project
Rivers Improvements and Platform Locations Alternative 2
Prepared by : MA
Computer Drafting by : Mamun
December 1997
FILE: ANEX_E-2.DWG

KALNI-KUSHIYARA RIVER MANAGEMENT PROJECT FEASIBILITY STUDY

ANNEX E
ECONOMICS
APPENDIX E.1

SUPPORTING INFORMATION

March 1998

Table 1 (a): Capital Cost Schedule : Alternative I

Item		Financial Cost (M Tk)	Conversion Factor	Economic Cost (M Tk)	1	2	3	4	5	6	7	8	9
Channel Dredging		603.36	0.9	543.02	0.00	0.00	0.00	54.30	195.49	293.23	0.00	0.00	0.00
Channel Realignment	Manual	10.78	0.9	9.70	0.00	0.00	0.00	0.00	9.70	0.00	0.00	0.00	0.00
	Dredging	24.60	0.9	22.14	0.00	0.00	0.00	0.00	22.14	0.00	0.00	0.00	0.00
Issapur Loop Cut	Dredging	254.00	0.9	228.60	0.00	0.00	160.02	68.58	0.00	0.00	0.00	0.00	0.00
	Manual Earthwork	105.61	0.9	95.05	0.00	0.00	95.05	0.00	0.00	0.00	0.00	0.00	0.00
	Slope Protection-Soft	5.25	0.9	4.73	0.00	0.00	4.73	0.00	0.00	0.00	0.00	0.00	0.00
	Slope Protection-Hard	84.03	0.75	63.02	0.00	0.00	0.00	63.02	0.00	0.00	0.00	0.00	0.00
	Drains-Stairs	0.95	0.75	0.71	0.00	0.00	0.00	0.50	0.21	0.00	0.00	0.00	0.00
	Levelling	1.53	0.9	1.38	0.00	0.00	0.00	1.38	0.00	0.00	0.00	0.00	0.00
	Closure	3.96	0.9	3.56	0.00	0.00	0.00	3.56	0.00	0.00	0.00	0.00	0.00
Katkhal Loop Cut	Dredging	264.05	0.9	237.65	0.00	0.00	95.06	118.82	23.76	0.00	0.00	0.00	0.00
	Manual Earthwork	79.41	0.9	71.47	0.00	0.00	28.59	35.73	7.15	0.00	0.00	0.00	0.00
	Slope Protection-Soft	10.53	0.9	9.48	0.00	0.00	3.79	4.74	0.95	0.00	0.00	0.00	0.00
	Slope Protection-Hard	92.92	0.75	69.69	0.00	0.00	0.00	27.88	34.85	6.97	0.00	0.00	0.00
	Closure	17.47	0.9	15.72	0.00	0.00	0.00	0.00	15.72	0.00	0.00	0.00	0.00
	Temporary Bank Protection	6.62	0.9	5.96	5.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Permanent Bank Protection	42.39	0.75	31.79	0.00	0.00	0.00	0.00	31.79	0.00	0.00	0.00	0.00
Madna Closures		1.45	0.9	1.31	0.00	0.00	0.00	1.31	0.00	0.00	0.00	0.00	0.00
River Training		110.67	0.77	85.22	0.00	0.00	0.00	0.00	25.56	59.65	0.00	0.00	0.00
Levees		10.86	0.9	9.77	0.00	0.00	0.00	0.00	0.00	9.77	0.00	0.00	0.00
Homestead Platforms	Confinement Dyke Construction	96.50	0.9	86.85	0.00	0.00	0.00	9.55	39.08	38.21	0.00	0.00	0.00
	Slope Protection-Soft : First Year	16.41	0.9	14.77	0.00	0.00	0.00	1.62	6.65	6.50	0.00	0.00	0.00
	Slope Protection-Soft : Three Years	28.41	0.9	25.57	0.00	0.00	0.00	0.00	1.02	4.86	8.44	5.63	5.63
	Slope Protection-Hard	111.18	0.75	83.39	0.00	0.00	0.00	0.00	8.34	37.52	37.52	0.00	0.00
	Dyke Repairs	1.93	0.9	1.74	0.00	0.00	0.00	0.00	0.19	0.78	0.76	0.00	0.00
	Drains-Stairs	13.20	0.75	9.90	0.00	0.00	0.00	0.00	1.49	4.46	3.96	0.00	0.00
	Levelling	5.23	0.9	4.71	0.00	0.00	0.00	0.00	0.99	1.98	1.74	0.00	0.00
	Topsoil	22.99	0.9	20.69	0.00	0.00	0.00	0.00	4.35	8.69	7.66	0.00	0.00
	Effluent Outlet-Construction	1.30	0.9	1.17	0.00	0.00	0.00	0.18	0.53	0.47	0.00	0.00	0.00
	Effluent Outlet-Filling	1.30	0.9	1.17	0.00	0.00	0.00	0.00	0.18	0.53	0.47	0.00	0.00
Drainage Regulators		23.17	0.82	19.00	0.00	0.00	0.00	0.00	11.40	7.60	0.00	0.00	0.00
EMP	Mitigation	20.63	0.9	18.57	3.71	7.43	1.86	1.86	1.86	1.86	0.00	0.00	0.00
	Compensation	0.66	0.9	0.59	0.00	0.00	0.06	0.12	0.18	0.24	0.00	0.00	0.00
	Enhancement	28.91	0.9	26.02	0.00	0.00	1.82	2.60	5.20	5.20	7.29	3.90	0.00
	Training	0.5	0.9	0.45	0.09	0.09	0.05	0.05	0.09	0.05	0.05	0.00	0.00
	Monitoring	6.9	0.9	6.21	1.24	1.24	0.62	0.62	1.24	0.62	0.62	0.00	0.00
BASE COST		**2109.66**		**1830.75**	**11.00**	**8.76**	**391.63**	**396.42**	**450.10**	**489.18**	**68.50**	**9.53**	**5.63**
Physical Contingencies(15%)		316.45		274.61	1.65	1.31	58.75	59.46	67.52	73.38	10.28	1.43	0.84
SUB-TOTAL		**2426.11**		**2105.37**	**12.65**	**10.07**	**450.38**	**455.88**	**517.62**	**562.56**	**78.78**	**10.96**	**6.47**
Study Cost		291.80	0.9	262.62	26.26	52.52	39.39	39.39	39.39	26.26	26.26	13.13	0.00
SUB-TOTAL		**2717.91**		**2367.99**	**38.92**	**62.60**	**489.77**	**495.27**	**557.01**	**588.82**	**105.04**	**24.09**	**6.47**
Land Acquisition	Issapur Loop Cut	37.80											
	Katkhal Loop Cut	24.38											
	Levees and Structures	2.40											
	Navigation	0.36											
	Anandapur	1.56											
	Abdullahpur	3.52											
TOTAL		2787.93		2367.99	38.92	62.60	489.77	495.27	557.01	588.82	105.04	24.09	6.47

Table 1 (b): O & M Cost Schedule : Alternative I (Financial)

Item		1 - 6 (M Tk)	7 (M Tk)	8 (M Tk)	9 (M Tk)	10 (M Tk)	11 (M Tk)	12 (M Tk)	13 (M Tk)	14 (M Tk)	15 (M Tk)	16 (M Tk)	17 (M Tk)	18 - 30 (M Tk)
Construction	Dyke			4.17	4.17	4.17	3.75	3.75	3.75	3.33	3.33	3.33	3.33	0.73
	Dredging			82.00	82.00	82.00	73.80	73.80	73.80	65.60	65.60	65.60	65.60	65.60
	Protection			2.14	2.14	2.14	1.92	1.92	1.92	1.71	1.71	1.71	1.71	0.00
	Dyke O&M			0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.01
	Topsoil			2.44	2.44	2.44	2.20	2.20	2.20	1.96	1.96	1.96	1.96	0.00
	Drains			0.89	0.89	0.89	0.80	0.80	0.80	0.71	0.71	0.71	0.71	0.00
	First Year			0.15	0.15	0.15	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.00
	Third Year			0.35	0.35	0.35	0.31	0.31	0.31	0.28	0.28	0.28	0.28	0.00
	Outlet Both			0.22	0.22	0.22	0.20	0.20	0.20	0.18	0.18	0.18	0.18	0.04
	Earthwork		1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
	Bank Protection		15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
	Regulators		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
	Slope Protection(hard)		5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30
	Total	**0.00**	**22.76**	**115.20**	**115.20**	**115.20**	**105.95**	**105.95**	**105.95**	**96.72**	**96.72**	**96.72**	**96.72**	**89.14**
	Physical Contingencies(15%)	0.00	3.41	17.28	17.28	17.28	15.89	15.89	15.89	14.51	14.51	14.51	14.51	13.37
EMP	Mitigation			0.57	0.57	0.57	0.51	0.51	0.51	0.45	0.45	0.45	0.45	0.45
	Compensation			0.06	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04
	Enhancement			1.13	1.13	1.13	1.02	1.02	1.02	0.90	0.90	0.90	0.90	0.90
	Total	**0.00**	**0.00**	**1.75**	**1.75**	**1.75**	**1.58**	**1.58**	**1.58**	**1.40**	**1.40**	**1.40**	**1.40**	**1.40**
	Physical Contingencies(15%)	0.00	0.00	0.26	0.26	0.26	0.24	0.24	0.24	0.21	0.21	0.21	0.21	0.21
TOTAL		**0.00**	**26.17**	**134.49**	**134.49**	**134.49**	**123.65**	**123.65**	**123.65**	**112.84**	**112.84**	**112.84**	**112.84**	**104.12**

Table 1 (c): O & M Cost Schedule : Alternative I (Economic)

Item		1 - 6 (M Tk)	7 (M Tk)	8 (M Tk)	9 (M Tk)	10 (M Tk)	11 (M Tk)	12 (M Tk)	13 (M Tk)	14 (M Tk)	15 (M Tk)	16 (M Tk)	17 (M Tk)	18 - 30 (M Tk)
Construction	Dyke	0.00	0.00	3.75	3.75	3.75	3.38	3.38	3.38	3.00	3.00	3.00	3.00	0.66
	Dredging	0.00	0.00	73.80	73.80	73.80	66.42	66.42	66.42	59.04	59.04	59.04	59.04	59.04
	Protection	0.00	0.00	1.93	1.93	1.93	1.73	1.73	1.73	1.54	1.54	1.54	1.54	0.00
	Dyke O&M	0.00	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.01
	Topsoil	0.00	0.00	2.20	2.20	2.20	1.98	1.98	1.98	1.76	1.76	1.76	1.76	0.00
	Drains	0.00	0.00	0.80	0.80	0.80	0.72	0.72	0.72	0.64	0.64	0.64	0.64	0.00
	First Year	0.00	0.00	0.14	0.14	0.14	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.00
	Third Year	0.00	0.00	0.32	0.32	0.32	0.28	0.28	0.28	0.25	0.25	0.25	0.25	0.00
	Outlet Both	0.00	0.00	0.20	0.20	0.20	0.18	0.18	0.18	0.16	0.16	0.16	0.16	0.04
	Earthwork	0.00	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
	Bank Protection	0.00	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77
	Regulators	0.00	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
	Slope Protection(hard)	0.00	4.77	4.77	4.77	4.77	4.77	4.77	4.77	4.77	4.77	4.77	4.77	4.77
	Sub-Total	**0.00**	**20.48**	**103.68**	**103.68**	**103.68**	**95.36**	**95.36**	**95.36**	**87.05**	**87.05**	**87.05**	**87.05**	**80.23**
	Physical Contingencies(15%)	0.00	3.07	15.55	15.55	15.55	14.30	14.30	14.30	13.06	13.06	13.06	13.06	12.03
EMP	Mitigation	0.00	0.00	0.51	0.51	0.51	0.46	0.46	0.46	0.41	0.41	0.41	0.41	0.41
	Compensation	0.00	0.00	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Enhancement	0.00	0.00	1.02	1.02	1.02	0.92	0.92	0.92	0.81	0.81	0.81	0.81	0.81
	Sub-Total	**0.00**	**0.00**	**1.58**	**1.58**	**1.58**	**1.42**	**1.42**	**1.42**	**1.26**	**1.26**	**1.26**	**1.26**	**1.26**
	Physical Contingencies(15%)	0.00	0.00	0.24	0.24	0.24	0.21	0.21	0.21	0.19	0.19	0.19	0.19	0.19
TOTAL		**0.00**	**23.56**	**121.04**	**121.04**	**121.04**	**111.29**	**111.29**	**111.29**	**101.56**	**101.56**	**101.56**	**101.56**	**93.71**

Table 2 (a): Capital Cost Schedule : Alternative II

Item		Financial Cost (M Tk)	Conversion Factor	Economic Cost (M Tk)	1	2	3	4	5	6	7	8	9
Channel Dredging		677.98	0.9	610.18	0.00	0.00	0.00	61.02	219.67	329.50	0.00	0.00	0.00
Channel Realignmen	Manual	10.78	0.9	9.70	0.00	0.00	0.00	0.00	9.70	0.00	0.00	0.00	0.00
	Dredging	24.60	0.9	22.14	0.00	0.00	0.00	0.00	22.14	0.00	0.00	0.00	0.00
Katkhal Loop Cut	Dredging	264.05	0.9	237.65	0.00	0.00	95.06	118.82	23.76	0.00	0.00	0.00	0.00
	Manual Earthwork	79.41	0.9	71.47	0.00	0.00	28.59	35.73	7.15	0.00	0.00	0.00	0.00
	Slope Protection-Soft	10.53	0.9	9.48	0.00	0.00	3.79	4.74	0.95	0.00	0.00	0.00	0.00
	Slope Protection-Hard	92.92	0.75	69.69	0.00	0.00	0.00	27.88	34.85	6.97	0.00	0.00	0.00
	Closure	17.47	0.9	15.72	0.00	0.00	0.00	0.00	15.72	0.00	0.00	0.00	0.00
	Temporary Bank Protection	6.62	0.9	5.96	5.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Permanent Bank Protection	42.39	0.75	31.79	0.00	0.00	0.00	0.00	31.79	0.00	0.00	0.00	0.00
Madna Closures		1.45	0.9	1.31	0.00	0.00	0.00	1.31	0.00	0.00	0.00	0.00	0.00
River Training		110.67	0.77	85.22	0.00	0.00	0.00	0.00	25.56	59.65	0.00	0.00	0.00
Levees		10.86	0.9	9.77	0.00	0.00	0.00	0.00	0.00	9.77	0.00	0.00	0.00
Homestead Platform	Confinement Dyke Construction	109.20	0.9	98.28	0.00	0.00	0.00	10.81	44.23	43.24	0.00	0.00	0.00
	Slope Protection-Soft : First Year	18.94	0.9	17.05	0.00	0.00	0.00	1.88	7.67	7.50	0.00	0.00	0.00
	Slope Protection-Soft : Three Years	30.70	0.9	27.63	0.00	0.00	0.00	0.00	1.11	5.25	9.12	6.08	6.08
	Slope Protection-Hard	138.23	0.75	103.67	0.00	0.00	0.00	0.00	10.37	46.65	46.65	0.00	0.00
	Dyke Repairs	2.07	0.9	1.86	0.00	0.00	0.00	0.00	0.20	0.84	0.82	0.00	0.00
	Drains-Stairs	18.30	0.75	13.73	0.00	0.00	0.00	0.00	2.06	6.18	5.49	0.00	0.00
	Levelling	5.80	0.9	5.22	0.00	0.00	0.00	0.00	1.10	2.19	1.93	0.00	0.00
	Topsoil	25.52	0.9	22.97	0.00	0.00	0.00	0.00	4.82	9.65	8.50	0.00	0.00
	Effluent Outlet-Construction	1.45	0.9	1.31	0.00	0.00	0.00	0.20	0.59	0.52	0.00	0.00	0.00
	Effluent Outlet-Filling	1.45	0.9	1.31	0.00	0.00	0.00	0.00	0.20	0.59	0.52	0.00	0.00
Drainage Regulators		23.17	0.82	19.00	0.00	0.00	0.00	0.00	11.40	7.60	0.00	0.00	0.00
EMP	Mitigation	11.56	0.9	10.40	2.08	4.16	1.04	1.04	1.04	1.04	0.00	0.00	0.00
	Compensation	0.71	0.9	0.64	0.00	0.00	0.06	0.13	0.19	0.26	0.00	0.00	0.00
	Enhancement	29.93	0.9	26.94	0.00	0.00	1.89	2.69	5.39	5.39	7.54	4.04	0.00
	Training	0.5	0.9	0.45	0.09	0.09	0.05	0.05	0.09	0.05	0.05	0.00	0.00
	Monitoring	6.9	0.9	6.21	1.24	1.24	0.62	0.62	1.24	0.62	0.62	0.00	0.00
BASE COST		**1774.16**		**1536.73**	**9.37**	**5.49**	**131.09**	**266.90**	**482.98**	**543.45**	**81.24**	**10.12**	**6.08**
Physical Contingencies(15%)		266.12		230.51	1.41	0.82	19.66	40.04	72.45	81.52	12.19	1.52	0.91
SUB-TOTAL		**2040.28**		**1767.24**	**10.78**	**6.32**	**150.76**	**306.94**	**555.43**	**624.97**	**93.43**	**11.64**	**6.99**
Study Cost		291.80	0.9	262.62	26.26	52.52	39.39	39.39	39.39	26.26	26.26	13.13	0.00
SUB-TOTAL		**2332.08**		**2029.86**	**37.04**	**58.84**	**190.15**	**346.33**	**594.82**	**651.23**	**119.69**	**24.77**	**6.99**
Land Acquisition	Issapur Loop Cut	0.00											
	Katkhal Loop Cut	24.38											
	Levees and Structures	4.20											
	Navigation	0.72											
	Anandapur	1.56											
	Abdullahpur	3.52											
TOTAL		**2366.46**		**2029.86**	**37.04**	**58.84**	**190.15**	**346.33**	**594.82**	**651.23**	**119.69**	**24.77**	**6.99**

Table 2 (b): O & M Cost Schedule : Alternative II (Financial)

Item		1 - 6 (M Tk)	7 (M Tk)	8 (M Tk)	9 (M Tk)	10 (M Tk)	11 (M Tk)	12 (M Tk)	13 (M Tk)	14 (M Tk)	15 (M Tk)	16 (M Tk)	17 (M Tk)	18-30 (M Tk)
Construction	Dyke			7.50	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	1.37
	Dredging			147.60	123.00	123.00	123.00	123.00	123.00	123.00	123.00	123.00	123.00	123.00
	Protection			3.85	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	0.00
	Dyke O&M			0.38	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.07
	Topsoil			4.40	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	0.00
	Stairs Drains			2.40	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00
	Soft First Year			0.27	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.00
	Soft Third Year			0.63	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.00
	Outlet Both			0.40	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.07
	Earthwork		1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
	Bank Protection		15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
	Regulators		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
	Slope Protection(hard)		2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79
	Sub-Total	**0.00**	**20.25**	**187.68**	**159.76**	**159.76**	**159.76**	**159.76**	**159.76**	**159.76**	**159.76**	**159.76**	**159.76**	**144.76**
	Physical Contingencies(15%)	0.00	3.04	28.15	23.96	23.96	23.96	23.96	23.96	23.96	23.96	23.96	23.96	21.71
EMP	Mitigation			0.92	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
	Compensation			0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Enhancement			2.01	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
	Sub-Total	**0.00**	**0.00**	**3.03**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**	**2.53**
	Physical Contingencies(15%)	0.00	0.00	0.45	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
TOTAL		**0.00**	**23.29**	**219.32**	**186.63**	**186.63**	**186.63**	**186.63**	**186.63**	**186.63**	**186.63**	**186.63**	**186.63**	**169.38**

Table 2 (c): O & M Cost Schedule : Alternative II (Economic)

Item		1 - 6 (M Tk)	7 (M Tk)	8 (M Tk)	9 (M Tk)	10 (M Tk)	11 (M Tk)	12 (M Tk)	13 (M Tk)	14 (M Tk)	15 (M Tk)	16 (M Tk)	17 (M Tk)	18 - 30 (M Tk)
Construction	Dyke	0.00	0.00	6.75	5.63	5.63	5.63	5.63	5.63	5.63	5.63	5.63	5.63	1.23
	Dredging	0.00	0.00	132.84	110.70	110.70	110.70	110.70	110.70	110.70	110.70	110.70	110.70	110.70
	Protection	0.00	0.00	3.47	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	0.00
	Dyke O&M	0.00	0.00	0.34	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.06
	Topsoil	0.00	0.00	3.96	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	0.00
	Drains	0.00	0.00	2.16	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	0.00
	First Year	0.00	0.00	0.24	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.00
	Third Year	0.00	0.00	0.57	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.00
	Outlet Both	0.00	0.00	0.36	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.06
	Earthwork	0.00	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
	Bank Protection	0.00	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77	13.77
	Regulators	0.00	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
	Slope Protection(hard)	0.00	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51
	Sub-Total	**0.00**	**18.23**	**168.91**	**143.78**	**143.78**	**143.78**	**143.78**	**143.78**	**143.78**	**143.78**	**143.78**	**143.78**	**130.28**
	Physical Contingencies(15%)	0.00	2.73	25.34	21.57	21.57	21.57	21.57	21.57	21.57	21.57	21.57	21.57	19.54
EMP	Mitigation	0.00	0.00	0.83	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
	Compensation	0.00	0.00	0.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	Enhancement	0.00	0.00	1.81	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	Sub-Total	**0.00**	**0.00**	**2.73**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**	**2.28**
	Physical Contingencies(15%)	0.00	0.00	0.41	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
TOTAL		**0.00**	**20.96**	**197.38**	**167.97**	**167.97**	**167.97**	**167.97**	**167.97**	**167.97**	**167.97**	**167.97**	**167.97**	**152.45**

Table 3 : Conversion Factors for Project Inputs

Standard Conversion Factor(SCF)	0.90
Project Inputs	
Skilled Labour (SCF)	0.90
Unskilled Labour	0.84
Cement	0.71
Steel (Basic Metal)	0.73
Liner, Screen (Metal Products)	0.67
Vehicle and Component (Transport Equipment)	0.61
Machinery : Normal Duty	0.67
Machinery : Concessionary Duty	0.86
Engine, Pump and Accessories (Pump Motor)	0.77
Pumping Cost, Minor Irrigation	0.79
Diesel, Petroleum	0.72
Bricks (SCF)	0.90
Dredging (SCF)	0.90
Drainage Regulators	0.82
River Training	0.77
Earthwork (SCF)	0.90
Permanent Bank Protection (Concrete Structure)	0.75
Slope Protection, Hard (Concrete Structure)	0.75
Physical Contingencies (SCF)	0.90
Engineering and Administration (SCF)	0.90

Note : Updated to 1995 prices following "Special Study on Economics : Estimation of Economic Prices of Selected Commodities for use in FAP Planning Studies", Flood Plan Coordination Organization, Government of Bangladesh, 1992.

Table 4(a) : Economic Prices of Agricultural Outputs

Crops	Main Product			By-Product			By Product Factor (t/ t)
	Market (Tk/ t)	Conversion Factor	Economic (Tk/ t)	Market (Tk/ t)	Conversion Factor	Economic (Tk/ t)	
HYV *Boro*	5936	1.05	6233	1006	0.90	905	1.0
Local *Boro*	6155	1.05	6463	1341	0.90	1207	2.0
B *Aus*	6029	1.05	6330	1341	0.90	1207	2.0
DWR	6805	1.05	7145	1341	0.90	1207	1.0
LT *Aman*	6778	1.05	7117	1341	0.90	1207	2.0
HYV T *Aman*	6809	1.05	7149	1006	0.90	905	1.0
Wheat	6978	1.39	9699	750	0.90	675	1.0
Pulses	18143	0.90	16329				
Groundnut	18000	0.90	16200				
Oilseeds	17328	0.77	13343				
Potato	4619	0.90	4157				
Sweet Potato	2379	0.90	2141				
Spices	7788	0.90	7009				
Vegetables	5670	0.90	5103				

Note : Updated to 1995 prices following "Special Study on Economics : Estimation of Economic Prices of Selected Commodities for use in FAP Planning Studies", Flood Plan Coordination Organization, Government of Bangladesh, 1992.

Table 4(b): Economic Prices of Crop Inputs

Inputs	Market	Conversion Factor	Economic
Fertilizer(Tk/kg)			
Urea	5.56	1.05	5.84
TSP	8.31	1.17	9.72
MP	7.43	1.17	8.69
Seeds(Tk/kg)			
HYV *Boro*	11	1.05	11.55
Local *Boro*	11.17	1.05	11.73
B *Aus*	10.67	1.05	11.20
DWR	10.83	1.05	11.37
LT *Aman*	10.83	1.05	11.37
HYV *Aman*	10.33	1.05	10.85
Wheat	12	1.39	16.68
Pulses	28.33	0.90	25.50
Groundnut	22	0.90	19.80
Oilseeds	23	0.77	17.71
Potato	13	0.90	11.70
Sweet Potato	2.25	0.90	2.03
Spices	600	0.90	540.00
Vegetables	300	0.90	270.00
Irrigation(Tk/ha)			
Traditional	1200	0.79	948.00
Modern	3500	0.79	2765.00
Others			
Labour(Tk/pd)	50	0.85	42.50
Bullock (Tk/bd)	45	0.90	40.50
Pesticide (Tk/kg)	559.7	0.90	503.73

Table 5 : Crop Areas in Present, FWO & FW Scenarios

Crop	Present (ha)						FWO (ha)						FW - Alternative 1 (ha)					
	1:2 year		1:5 year		1:10 year		1:2 year		1:5 year		1:10 year		1:2 year		1:5 year		1:10 year	
	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged	Damage Free	Damaged
HYV *Boro*	169,239	24,513	61,411	132,341	9,217	184,535	146,549	47,587	44,749	149,387	4,292	189,844	201,429	3,668	86,395	118,702	37,599	167,498
Local *Boro*	25,710	17,300	9,329	33,681	1,400	41,610	19,531	17,862	5,935	31,458	558	36,835	25,625	7,008	13,746	18,887	5,982	26,651
B *Aus*	7,384	62	2,679	4,767	402	7,044	5,639	900	1,721	4,818	169	6,370	7,361	1	3,101	4,261	1,350	6,012
DWR	21,245	4,052	7,709	17,588	1,157	24,140	20,130	7,705	6,142	21,693	704	27,131	24,028	1,320	10,678	14,670	4,646	20,702
LT *Aman*	36	0	13	23	2	34	24	5	7	22	1	28	35	0	15	20	7	28
HYV T *Aman*	7,430	88	2,696	4,822	405	7,113	6,400	1,048	1,954	5,494	192	7,256	7,428	6	3,131	4,303	1,363	6,071
Wheat	151	2	55	98	8	145	198	34	61	171	6	226	152	0	64	88	28	124
Pulses	108	4	39	73	6	106	119	23	36	106	4	138	111	0	47	64	20	91
Groundnut	700	19	254	465	38	681	515	94	158	451	16	593	631	0	266	365	116	515
Oilseeds	262	50	95	217	14	298	246	86	75	257	7	325	287	21	130	178	56	252
Potato	926	26	336	616	50	902	704	129	215	618	21	812	941	0	396	545	173	768
Sweet Potato	495	10	180	325	27	478	401	70	123	348	12	459	470	0	198	272	86	384
Spices	1,290	29	468	851	70	1,249	1,488	316	455	1,349	48	1,756	1,285	8	545	748	237	1,056
Vegetables	502	22	182	342	28	496	864	217	264	817	29	1,052	562	11	241	332	105	468
Total Paddy	231,044	46,015	83,837	193,222	12,583	264,476	198,273	75,107	60,508	212,872	5,916	267,464	265,906	12,003	117,066	160,843	50,947	226,962
Total Non-Rice	4,434	162	1,609	2,987	241	4,355	4,535	969	1,387	4,117	143	5,361	4,439	40	1,887	2,592	821	3,658
TOTAL CROP AREA	235,478	46,177	85,446	196,209	12,824	268,831	202,808	76,076	61,895	216,989	6,059	272,825	270,345	12,043	118,953	163,435	51,768	230,620
Total Cultivated Area					279,850						276,945						27,424	
Cropping Intensity					1.006						1.007						1.018	

Table 6 : Crop Yields in Present, FWO & FW Scenarios

Crop	Present, FWO & FW (tonne/ ha)		Weighted Average (tonne/ ha)								
	Damage Free	Damaged	Present			FWO			FW - Alternative 1		
			1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	4.69	2.90	4.46	3.47	2.99	4.25	3.31	2.94	4.66	3.65	3.23
Local *Boro*	3.11	1.60	2.50	1.93	1.65	2.39	1.84	1.62	2.79	2.24	1.88
B *Aus*	1.10	1.04	1.10	1.06	1.04	1.09	1.06	1.04	1.10	1.07	1.05
DWR	1.93	1.50	1.86	1.63	1.52	1.81	1.59	1.51	1.91	1.68	1.58
LT *Aman*	2.15	1.75	2.15	1.89	1.77	2.08	1.85	1.76	2.15	1.92	1.83
HYV T *Aman*	3.20	2.24	3.19	2.58	2.29	3.06	2.49	2.26	3.20	2.64	2.42
Wheat	2.11	2.00	2.11	2.04	2.01	2.09	2.03	2.00	2.11	2.05	2.02
Pulses	0.81	0.80	0.81	0.80	0.80	0.81	0.80	0.80	0.81	0.80	0.80
Groundnut	2.04	2.00	2.04	2.01	2.00	2.03	2.01	2.00	2.04	2.02	2.01
Oilseeds	0.91	0.80	0.89	0.83	0.80	0.88	0.82	0.80	0.90	0.85	0.82
Potato	11.15	10.00	11.12	10.41	10.06	10.97	10.30	10.03	11.15	10.48	10.21
Sweet Potato	9.53	9.00	9.52	9.19	9.03	9.45	9.14	9.01	9.53	9.22	9.10
Spices	6.00	5.00	5.98	5.35	5.05	5.82	5.25	5.03	5.99	5.42	5.18
Vegetables	9.25	9.00	9.24	9.09	9.01	9.20	9.06	9.01	9.25	9.11	9.05

Table 7(a) : Total Production of Main Products in Present, FWO & FW Scenarios

Crops	Present ('000 tonnes)			FWO ('000 tonnes)			FW - Alternative 1 ('000 tonnes)		
	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	864.82	671.81	578.38	825.32	643.10	570.68	955.34	749.43	662.08
Local *Boro*	107.64	82.90	70.93	89.32	68.79	60.67	90.91	72.97	61.25
B *Aus*	8.19	7.90	7.77	7.14	6.90	6.81	8.10	7.84	7.74
DWR	47.08	41.26	38.44	50.41	44.39	42.06	48.35	42.61	40.02
LT *Aman*	0.08	0.07	0.06	0.06	0.05	0.05	0.08	0.07	0.06
HYV T *Aman*	23.97	19.43	17.23	22.83	18.56	16.87	23.78	19.66	17.96
Wheat	0.32	0.31	0.31	0.49	0.47	0.46	0.32	0.31	0.31
Pulses	0.09	0.09	0.09	0.11	0.11	0.11	0.09	0.09	0.09
Groundnut	1.47	1.45	1.44	1.24	1.22	1.22	1.29	1.27	1.27
Oilseeds	0.28	0.26	0.25	0.29	0.27	0.27	0.28	0.26	0.25
Potato	10.58	9.91	9.58	9.14	8.58	8.35	10.49	9.87	9.61
Sweet Potato	4.81	4.64	4.56	4.45	4.30	4.25	4.48	4.33	4.28
Spices	7.89	7.06	6.67	10.51	9.48	9.07	7.75	7.01	6.70
Vegetables	4.84	4.76	4.72	9.95	9.80	9.74	5.30	5.22	5.18
Total Rice ('000 tonnes)	1051.77	823.37	712.81	995.07	781.80	697.13	1126.56	892.58	789.11
Average Rice (tonnes/ha)	3.80	2.97	2.57	3.64	2.86	2.55	4.05	3.21	2.84
Total Non-Rice ('000 tonnes)	30.28	28.48	27.61	36.18	34.23	33.47	29.99	28.36	27.69
Ave Non-Rice (tonnes/ha)	6.59	6.20	6.01	6.57	6.22	6.08	6.70	6.33	6.18

Table 7(b) : Total Production of By-Products in Present, FWO & FW Scenarios

Crops	Present ('000 tonnes)			FWO ('000 tonnes)			FW ('000 tonnes)		
	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	864.82	671.81	578.38	825.32	643.10	570.68	955.34	749.43	662.08
Local *Boro*	215.28	165.81	141.86	178.64	137.58	121.34	181.81	145.94	122.49
B *Aus*	16.37	15.81	15.54	14.28	13.81	13.62	16.20	15.69	15.47
DWR	47.08	41.26	38.44	50.41	44.39	42.06	48.35	42.61	40.02
LT *Aman*	0.15	0.14	0.13	0.12	0.11	0.10	0.15	0.13	0.13
HYV T *Aman*	23.97	19.43	17.23	22.83	18.56	16.87	23.78	19.66	17.96
Wheat	0.32	0.31	0.31	0.49	0.47	0.46	0.32	0.31	0.31
Pulses									
Groundnut									
Oilseeds									
Potato									
Sweet Potato									
Spices									
Vegetables									

Table 8 : Total Revenue Earned in Present, FWO & FW Scenarios (Economic)

Crop	Present (million Tk)			FWO (million Tk)			FW (million Tk)		
	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	6,173.25	4,795.49	4,128.59	5,891.28	4,590.54	4,073.61	6,819.40	5,349.57	4,726.08
Local *Boro*	955.45	735.89	629.61	792.86	610.62	538.55	806.94	647.72	543.65
B *Aus*	71.59	69.12	67.92	62.42	60.37	59.55	70.81	68.58	67.66
DWR	393.23	344.61	321.08	421.02	370.78	351.25	403.86	355.91	334.25
LT *Aman*	0.74	0.65	0.61	0.58	0.51	0.49	0.72	0.64	0.61
HYV T *Aman*	193.10	156.49	138.78	183.87	149.49	135.87	191.57	158.34	144.67
Wheat	3.35	3.24	3.18	5.04	4.88	4.82	3.33	3.23	3.19
Pulses	1.48	1.47	1.46	1.87	1.86	1.86	1.47	1.46	1.45
Groundnut	23.75	23.46	23.32	20.07	19.83	19.74	20.85	20.62	20.52
Oilseeds	3.71	3.47	3.35	3.90	3.65	3.55	3.71	3.48	3.37
Potato	44.00	41.18	39.81	37.99	35.66	34.73	43.62	41.01	39.95
Sweet Potato	10.29	9.94	9.76	9.53	9.22	9.09	9.59	9.28	9.15
Spices	55.27	49.51	46.72	73.65	66.41	63.56	54.32	49.13	46.98
Vegetables	24.71	24.30	24.10	50.75	49.98	49.68	27.03	26.62	26.45
Total Rice (million Tk)	7,787.36	6,102.26	5,286.59	7,352.03	5,782.32	5,159.32	8,293.30	6,580.76	5,816.92
Average Rice (Tk/ ha)	28,107	22,025	19,081	26,893	21,151	18,872	29,842	23,680	20,931
Total Non-Rice (million Tk)	166.56	156.56	151.71	202.81	191.50	187.03	163.92	154.83	151.05
Average (Tk/ ha)	36,240	34,064	33,010	36,848	34,793	33,982	36,597	34,568	33,725
TOTAL (million Tk)	7,953.92	6,258.81	5,438.31	7,554.84	5,973.82	5,346.36	8,457.22	6,735.59	5,967.98
AVERAGE (Tk/ ha)	28,240	22,222	19,308	27,090	21,420	19,171	29,949	23,852	21,134

Table 9 : Agricultural Production Input Levels in Present, FWO & FW Scenarios

Crops	Seed		Labour		Bullock		Fertilizer						Pesticide		Irrigation Cost		Cost of Production (Tk/ ha)
							Urea		TSP		MP				Modern	Traditional	
	Unit (kg)	Cost (Tk)	Unit (PD)	Cost (Tk)	Unit (bd)	Cost (Tk)	Unit (kg)	Cost (Tk)	Unit (kg)	Cost (Tk)	Unit (kg)	Cost (Tk)	Unit (kg)	Cost (Tk)	(Tk) (Tk)	(Tk) (Tk)	
HYV *Boro*	100	1155	205	8712.5	45	1823	134.7	786	73.3	713	26.3	229	1.4	710	2216	154	16498
Local *Boro*	72	845	154	6545	40	1620	42.4	248	19.1	186	2.1	18	0.5	252	1470	269	11453
B *Aus*	75	840	117	4972.5	41	1661	6.7	39									7512
DWR	94	1069	101	4282.5	39	1580	32.3	189									7120
LT *Aman*	90	1023	107	4547.5	42	1701	59.3	346	59.3	577	11.1	96					8291
HYV T *Ama*	96	1041	150	6375	41	1661	61.0	356	20.0	194	5.2	45					9673
Wheat	132	2202	99	4207.5	44	1782	130.0	759	61.0	593			0.8	393			9936
Pulses	23	586	45	1912.5	40	1620	13.0	76									4195
Groundnut	90	1772	167	7097.5	5	203	54.0	315	64.3	625							10013
Oilseeds	12	213	115	4887.5	42	1701	49.5	289	22.2	216	12.1	105			1438		8849
Potato	521	6096	188	7990	46	1863	96.2	562	43.1	419	3.9	34	1.5	756			17719
Sweet Potato	800	1620	116	4930	46	1863	14.9	87	14.6	142	19.8	172			462	158	9434
Spices	10	5400	181	7692.5	44	1782	116.1	678	88.2	858	8.7	76	1.4	705	1843	316	19350
Vegetables	30	5400	181	7692.5	50	2025	41.0	239	27.7	269			1.0	504	1843	316	18289

Note : bd = Bullock(draught power) days

Table 10 : Total Cost of Production in Present, FWO & FW Scenarios (Economic)

Crop	Present (million Tk)			FWO (million Tk)			FW (million Tk)		
	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	3,196.53	3,196.53	3,196.53	3,202.86	3,202.86	3,202.86	3,383.70	3,383.70	3,383.70
Local *Boro*	492.58	492.58	492.58	428.25	428.25	428.25	373.73	373.73	373.73
B *Aus*	55.94	55.94	55.94	49.12	49.12	49.12	55.31	55.31	55.31
DWR	180.10	180.10	180.10	198.17	198.17	198.17	180.47	180.47	180.47
LT *Aman*	0.30	0.30	0.30	0.24	0.24	0.24	0.29	0.29	0.29
HYV T *Aman*	72.72	72.72	72.72	72.04	72.04	72.04	71.91	71.91	71.91
Wheat	1.52	1.52	1.52	2.31	2.31	2.31	1.51	1.51	1.51
Pulses	0.47	0.47	0.47	0.60	0.60	0.60	0.47	0.47	0.47
Groundnut	7.20	7.20	7.20	6.10	6.10	6.10	6.32	6.32	6.32
Oilseeds	2.76	2.76	2.76	2.94	2.94	2.94	2.73	2.73	2.73
Potato	16.87	16.87	16.87	14.76	14.76	14.76	16.67	16.67	16.67
Sweet Potato	4.76	4.76	4.76	4.44	4.44	4.44	4.43	4.43	4.43
Spices	25.52	25.52	25.52	34.91	34.91	34.91	25.02	25.02	25.02
Vegetables	9.58	9.58	9.58	19.77	19.77	19.77	10.48	10.48	10.48
Total Rice (million Tk)	3,998.16	3,998.16	3,998.16	3,950.69	3,950.69	3,950.69	4,065.40	4,065.40	4,065.40
Average Rice (Tk/ ha)	14,431	14,431	14,431	14,451	14,451	14,451	14,629	14,629	14,629
Total Non-Rice (million Tk)	68.69	68.69	68.69	85.82	85.82	85.82	67.63	67.63	67.63
Average (Tk/ ha)	14,945	14,945	14,945	15,592	15,592	15,592	15,098	15,098	15,098
TOTAL (million Tk)	4,066.85	4,066.85	4,066.85	4,036.50	4,036.50	4,036.50	4,133.02	4,133.02	4,133.02
AVERAGE (Tk/ ha)	14,439	14,439	14,439	14,474	14,474	14,474	14,636	14,636	14,636

Table 11 : Net Return in Present, FWO & FW Scenarios (Economic)

Crop	Present (million Tk)			FWO (million Tk)			FW (million Tk)		
	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year	1:2 year	1:5 year	1:10 year
HYV *Boro*	2,976.72	1,598.96	932.06	2,688.42	1,387.68	870.74	3,435.71	1,965.87	1,342.39
Local *Boro*	462.88	243.31	137.04	364.61	182.38	110.31	433.20	273.98	169.92
B *Aus*	15.65	13.18	11.99	13.30	11.25	10.43	15.51	13.27	12.35
DWR	213.12	164.51	140.98	222.85	172.61	153.08	223.40	175.45	153.79
LT *Aman*	0.44	0.35	0.31	0.33	0.27	0.25	0.43	0.35	0.32
HYV T *Aman*	120.38	83.78	66.06	111.83	77.45	63.83	119.66	86.44	72.76
Wheat	1.83	1.72	1.66	2.73	2.58	2.52	1.82	1.72	1.68
Pulses	1.01	1.00	0.99	1.28	1.27	1.26	1.00	0.99	0.99
Groundnut	16.55	16.26	16.12	13.97	13.74	13.64	14.54	14.30	14.20
Oilseeds	0.95	0.71	0.59	0.97	0.72	0.62	0.98	0.75	0.64
Potato	27.13	24.31	22.95	23.23	20.90	19.97	26.94	24.34	23.27
Sweet Potato	5.53	5.17	5.00	5.09	4.77	4.65	5.16	4.85	4.72
Spices	29.74	23.98	21.19	38.75	31.50	28.65	29.30	24.11	21.96
Vegetables	15.12	14.71	14.52	30.98	30.21	29.91	16.55	16.14	15.97
Total Rice (million Tk)	3,789.20	2,104.10	1,288.43	3,401.34	1,831.63	1,208.64	4,227.90	2,515.36	1,751.53
Average Rice(Tk/ ha)	13,676	7,594	4,650	12,442	6,700	4,421	15,213	9,051	6,303
Total Non-Rice (million Tk)	97.87	87.87	83.02	116.99	105.68	101.22	96.29	87.20	83.43
Average(Tk/ ha)	21,295	19,119	18,064	21,256	19,201	18,390	21,499	19,470	18,626
TOTAL (million Tk)	3,887.07	2,191.97	1,371.46	3,518.34	1,937.32	1,309.85	4,324.19	2,602.57	1,834.96
AVERAGE(Tk/ ha)	13,801	7,782	4,869	12,616	6,947	4,697	15,313	9,216	6,498

Table 12 : Annual Incremental Net Return in Agriculture(FW-FWO) - Economic

Crop	1:2 year Increment		1:5 year Increment		1:10 year Increment	
	(million Tk)	(%)	(million Tk)	(%)	(million Tk)	(%)
HYV *Boro*	747.29	93	578.19	87	471.64	90
Local *Boro*	68.59	9	91.61	14	59.61	11
B *Aus*	2.21	0	2.03	0	1.92	0
DWR	0.55	0	2.84	0	0.71	0
LT *Aman*	0.09	0	0.08	0	0.07	0
HYV T *Aman*	7.83	1	8.98	1	8.94	2
Wheat	-0.92	0	-0.86	0	-0.84	0
Pulses	-0.28	0	-0.27	0	-0.27	0
Groundnut	0.57	0	0.56	0	0.56	0
Oilseeds	0.02	0	0.04	0	0.03	0
Potato	3.71	0	3.44	1	3.30	1
Sweet Potato	0.07	0	0.08	0	0.07	0
Spices	-9.44	-1	-7.39	-1	-6.70	-1
Vegetables	-14.43	-2	-14.07	-2	-13.94	-3
Total	**805.86**	**100.0%**	**665.25**	**100.0%**	**525.10**	**100.0%**
Average (Tk/ha)	**2,905**		**2,398**		**1,893**	

Table 13 : Population and Rice Demand Calculations

Year	Population (persons)			Rice Demand (tonnes)			Demand in Dry Season (tonnes)	Rice Imported (tonnes)	Local Sources (tonnes)
	Urban	Rural	Total	Urban	Rural	Total			
Base:1995	76,021	669,283	745,304	11,403	100,392	111,796	46,582	30,000	16,582
1	79,910	678,489	758,399	11,987	101,773	113,760	47,400	30,527	16,873
2	83,998	687,821	771,819	12,600	103,173	115,773	48,239	31,067	17,171
3	88,295	697,281	785,576	13,244	104,592	117,836	49,099	31,621	17,477
4	92,812	706,872	799,684	13,922	106,031	119,953	49,980	32,189	17,791
5	97,560	716,594	814,154	14,634	107,489	122,123	50,885	32,771	18,113
6	101,979	725,948	827,927	15,297	108,892	124,189	51,745	33,326	18,420
7	106,599	735,423	842,022	15,990	110,313	126,303	52,626	33,893	18,733
8	111,428	745,022	856,450	16,714	111,753	128,468	53,528	34,474	19,054
9	116,475	754,747	871,222	17,471	113,212	130,683	54,451	35,068	19,383
10	121,752	764,598	886,350	18,263	114,690	132,953	55,397	35,677	19,719
11	126,567	773,571	900,138	18,985	116,036	135,021	56,259	36,232	20,026
12	131,573	782,649	914,222	19,736	117,397	137,133	57,139	36,799	20,340
13	136,777	791,833	928,610	20,517	118,775	139,292	58,038	37,378	20,660
14	142,187	801,125	943,312	21,328	120,169	141,497	58,957	37,970	20,987
15	147,811	810,527	958,338	22,172	121,579	143,751	59,896	38,575	21,321
16	152,824	818,526	971,350	22,924	122,779	145,703	60,709	39,099	21,611
17	158,007	826,605	984,612	23,701	123,991	147,692	61,538	39,633	21,906
18	163,366	834,764	998,130	24,505	125,215	149,720	62,383	40,177	22,206
19	168,907	843,003	1,011,910	25,336	126,450	151,787	63,244	40,731	22,513
20	174,635	851,324	1,025,959	26,195	127,699	153,894	64,122	41,297	22,826
21	179,592	859,159	1,038,751	26,939	128,874	155,813	64,922	41,812	23,110
22	184,689	867,066	1,051,755	27,703	130,060	157,763	65,735	42,335	23,399
23	189,931	875,046	1,064,977	28,490	131,257	159,747	66,561	42,867	23,694
24	195,322	883,099	1,078,421	29,298	132,465	161,763	67,401	43,409	23,993
25	200,866	891,226	1,092,092	30,130	133,684	163,814	68,256	43,959	24,297
26	205,477	899,269	1,104,746	30,822	134,890	165,712	69,047	44,468	24,578
27	210,194	907,384	1,117,578	31,529	136,108	167,637	69,849	44,985	24,864
28	215,020	915,572	1,130,592	32,253	137,336	169,589	70,662	45,509	25,153
29	219,956	923,834	1,143,790	32,993	138,575	171,569	71,487	46,040	25,447
30	225,005	932,171	1,157,176	33,751	139,826	173,576	72,324	46,579	25,745

Table 14 : Cargo Movements - FW

Year	Rice (tonnes)	Fertilizer for Internal Use (tonnes)	Building Materials (tonnes)	Other Food Items (tonnes)	POL Urban (tonnes)	POL Rural (tonnes)	Consumer Goods (tonnes)	Internal Rehandle (tonnes)	Fertilizer Transhipment (tonnes)	Fertilizer Through-ship (tonnes)
1	30,000	21,756	72,694	19,596	3,123	7,287	30,822	18,528	36,000	160,000
2	30,527	22,409	74,875	19,940	3,217	7,506	31,364	18,984	36,000	160,000
3	31,067	23,081	77,121	20,293	3,313	7,731	31,919	19,452	36,000	160,000
4	31,621	23,773	79,435	20,655	3,413	7,963	32,487	19,935	36,000	160,000
5	32,189	24,486	81,818	21,026	3,515	8,202	33,071	20,431	36,000	160,000
6	32,771	25,221	84,272	21,406	3,620	8,448	33,669	20,941	36,000	160,000
7	33,326	25,978	86,800	21,768	3,729	8,701	34,239	21,454	36,000	160,000
8	33,893	26,757	89,404	22,139	3,841	8,962	34,822	21,982	36,000	160,000
9	34,474	27,560	92,087	22,518	3,956	9,231	35,418	22,524	36,000	160,000
10	35,068	28,387	94,849	22,907	4,075	9,508	36,029	23,082	36,000	160,000
11	35,677	29,238	98,643	23,304	4,238	9,841	36,655	23,760	36,000	160,000
12	36,232	30,115	102,589	23,667	4,407	10,185	37,225	24,442	36,000	160,000
13	36,799	31,019	106,692	24,037	4,584	10,542	37,808	25,148	36,000	160,000
14	37,378	31,949	110,960	24,416	4,767	10,911	38,403	25,878	36,000	160,000
15	37,970	32,908	115,399	24,802	4,958	11,292	39,011	26,634	36,000	160,000
16	38,575	33,895	120,014	25,197	5,156	11,688	39,632	27,416	36,000	160,000
17	39,099	34,912	124,815	25,539	5,362	12,097	40,170	28,199	36,000	160,000
18	39,633	35,959	129,808	25,888	5,577	12,520	40,719	29,010	36,000	160,000
19	40,177	37,038	135,000	26,243	5,800	12,958	41,278	29,849	36,000	160,000
20	40,731	38,149	140,400	26,606	6,032	13,412	41,847	30,718	36,000	160,000
21	41,297	39,294	147,420	26,975	6,333	13,881	42,428	31,763	36,000	160,000
22	41,812	40,472	154,791	27,311	6,650	14,367	42,957	32,836	36,000	160,000
23	42,335	41,687	162,531	27,653	6,982	14,870	43,495	33,955	36,000	160,000
24	42,867	42,937	170,657	28,001	7,332	15,390	44,042	35,123	36,000	160,000
25	43,409	44,225	179,190	28,355	7,698	15,929	44,598	36,340	36,000	160,000
26	43,959	45,552	188,149	28,714	8,083	16,487	45,163	37,611	36,000	160,000
27	44,468	46,919	197,557	29,047	8,487	17,064	45,687	38,923	36,000	160,000
28	44,985	48,326	207,435	29,384	8,912	17,661	46,217	40,292	36,000	160,000
29	45,509	49,776	217,806	29,726	9,357	18,279	46,756	41,721	36,000	160,000
30	46,040	51,269	228,697	30,073	9,825	18,919	47,301	43,212	36,000	160,000

Table 15 : Projected Cargo Cost Savings (Financial)

Year	Rice (M Tk)	Fertilizer (M Tk)	Building Materials (M Tk)	Other Food Items (M Tk)	POL Urban (M Tk)	POL Rural (M Tk)	Consumer Goods (M Tk)	Internal Rehandle of Fertilizer (M Tk)	Fertilizer Tranship (M Tk)	Fertilizer Through-ship (M Tk)	TOTAL (M Tk)
Unit Cost Saving (Tk/ tonne)											
	64.5	67.5	64.5	64.5	64.5	64.5	64.5	12.5	122.5	36	
Total Cost Savings											
1	1.94	1.47	4.69	1.26	0.20	0.47	1.99	0.23	4.41	5.76	**22.42**
2	1.97	1.51	4.83	1.29	0.21	0.48	2.02	0.24	4.41	5.76	**22.72**
3	2.00	1.56	4.97	1.31	0.21	0.50	2.06	0.24	4.41	5.76	**23.03**
4	2.04	1.60	5.12	1.33	0.22	0.51	2.10	0.25	4.41	5.76	**23.35**
5	2.08	1.65	5.28	1.36	0.23	0.53	2.13	0.26	4.41	5.76	**23.68**
6	2.11	1.70	5.44	1.38	0.23	0.54	2.17	0.26	4.41	5.76	**24.01**
7	2.15	1.75	5.60	1.40	0.24	0.56	2.21	0.27	4.41	5.76	**24.35**
8	2.19	1.81	5.77	1.43	0.25	0.58	2.25	0.27	4.41	5.76	**24.70**
9	2.22	1.86	5.94	1.45	0.26	0.60	2.28	0.28	4.41	5.76	**25.06**
10	2.26	1.92	6.12	1.48	0.26	0.61	2.32	0.29	4.41	5.76	**25.43**
11	2.30	1.97	6.36	1.50	0.27	0.63	2.36	0.30	4.41	5.76	**25.88**
12	2.34	2.03	6.62	1.53	0.28	0.66	2.40	0.31	4.41	5.76	**26.33**
13	2.37	2.09	6.88	1.55	0.30	0.68	2.44	0.31	4.41	5.76	**26.80**
14	2.41	2.16	7.16	1.57	0.31	0.70	2.48	0.32	4.41	5.76	**27.28**
15	2.45	2.22	7.44	1.60	0.32	0.73	2.52	0.33	4.41	5.76	**27.78**
16	2.49	2.29	7.74	1.63	0.33	0.75	2.56	0.34	4.41	5.76	**28.30**
17	2.52	2.36	8.05	1.65	0.35	0.78	2.59	0.35	4.41	5.76	**28.82**
18	2.56	2.43	8.37	1.67	0.36	0.81	2.63	0.36	4.41	5.76	**29.35**
19	2.59	2.50	8.71	1.69	0.37	0.84	2.66	0.37	4.41	5.76	**29.91**
20	2.63	2.58	9.06	1.72	0.39	0.87	2.70	0.38	4.41	5.76	**30.48**
21	2.66	2.65	9.51	1.74	0.41	0.90	2.74	0.40	4.41	5.76	**31.17**
22	2.70	2.73	9.98	1.76	0.43	0.93	2.77	0.41	4.41	5.76	**31.88**
23	2.73	2.81	10.48	1.78	0.45	0.96	2.81	0.42	4.41	5.76	**32.62**
24	2.76	2.90	11.01	1.81	0.47	0.99	2.84	0.44	4.41	5.76	**33.39**
25	2.80	2.99	11.56	1.83	0.50	1.03	2.88	0.45	4.41	5.76	**34.20**
26	2.84	3.07	12.14	1.85	0.52	1.06	2.91	0.47	4.41	5.76	**35.04**
27	2.87	3.17	12.74	1.87	0.55	1.10	2.95	0.49	4.41	5.76	**35.90**
28	2.90	3.26	13.38	1.90	0.57	1.14	2.98	0.50	4.41	5.76	**36.81**
29	2.94	3.36	14.05	1.92	0.60	1.18	3.02	0.52	4.41	5.76	**37.75**
30	2.97	3.46	14.75	1.94	0.63	1.22	3.05	0.54	4.41	5.76	**38.74**

Table 16 : Projected Cargo Cost Savings (Economic)

Year	Rice (M Tk)	Fertilizer (M Tk)	Building Materials (M Tk)	Other Food Items (M Tk)	POL Urban (M Tk)	POL Rural (M Tk)	Consumer Goods (M Tk)	Internal Rehandle of Fertilizer (M Tk)	Fertilizer Transhipment (M Tk)	Fertilizer Through-ship (M Tk)	TOTAL * (M Tk)
Unit Cost Saving (Tk.tonne)											
	58.05	60.75	58.05	58.05	58.05	58.05	58.05	11.25	110.25	32.4	
Total Cost Savings											
1	1.74	1.32	4.22	1.14	0.18	0.42	1.79	0.21	3.97	5.18	**0.00**
2	1.77	1.36	4.35	1.16	0.19	0.44	1.82	0.21	3.97	5.18	**0.00**
3	1.80	1.40	4.48	1.18	0.19	0.45	1.85	0.22	3.97	5.18	**0.00**
4	1.84	1.44	4.61	1.20	0.20	0.46	1.89	0.22	3.97	5.18	**0.00**
5	1.87	1.49	4.75	1.22	0.20	0.48	1.92	0.23	3.97	5.18	**4.26**
6	1.90	1.53	4.89	1.24	0.21	0.49	1.95	0.24	3.97	5.18	**8.65**
7	1.93	1.58	5.04	1.26	0.22	0.51	1.99	0.24	3.97	5.18	**21.92**
8	1.97	1.63	5.19	1.29	0.22	0.52	2.02	0.25	3.97	5.18	**22.23**
9	2.00	1.67	5.35	1.31	0.23	0.54	2.06	0.25	3.97	5.18	**22.56**
10	2.04	1.72	5.51	1.33	0.24	0.55	2.09	0.26	3.97	5.18	**22.89**
11	2.07	1.78	5.73	1.35	0.25	0.57	2.13	0.27	3.97	5.18	**23.29**
12	2.10	1.83	5.96	1.37	0.26	0.59	2.16	0.27	3.97	5.18	**23.70**
13	2.14	1.88	6.19	1.40	0.27	0.61	2.19	0.28	3.97	5.18	**24.12**
14	2.17	1.94	6.44	1.42	0.28	0.63	2.23	0.29	3.97	5.18	**24.55**
15	2.20	2.00	6.70	1.44	0.29	0.66	2.26	0.30	3.97	5.18	**25.00**
16	2.24	2.06	6.97	1.46	0.30	0.68	2.30	0.31	3.97	5.18	**25.47**
17	2.27	2.12	7.25	1.48	0.31	0.70	2.33	0.32	3.97	5.18	**25.93**
18	2.30	2.18	7.54	1.50	0.32	0.73	2.36	0.33	3.97	5.18	**26.42**
19	2.33	2.25	7.84	1.52	0.34	0.75	2.40	0.34	3.97	5.18	**26.92**
20	2.36	2.32	8.15	1.54	0.35	0.78	2.43	0.35	3.97	5.18	**27.43**
21	2.40	2.39	8.56	1.57	0.37	0.81	2.46	0.36	3.97	5.18	**28.05**
22	2.43	2.46	8.99	1.59	0.39	0.83	2.49	0.37	3.97	5.18	**28.69**
23	2.46	2.53	9.43	1.61	0.41	0.86	2.52	0.38	3.97	5.18	**29.36**
24	2.49	2.61	9.91	1.63	0.43	0.89	2.56	0.40	3.97	5.18	**30.05**
25	2.52	2.69	10.40	1.65	0.45	0.92	2.59	0.41	3.97	5.18	**30.78**
26	2.55	2.77	10.92	1.67	0.47	0.96	2.62	0.42	3.97	5.18	**31.53**
27	2.58	2.85	11.47	1.69	0.49	0.99	2.65	0.44	3.97	5.18	**32.31**
28	2.61	2.94	12.04	1.71	0.52	1.03	2.68	0.45	3.97	5.18	**33.13**
29	2.64	3.02	12.64	1.73	0.54	1.06	2.71	0.47	3.97	5.18	**33.98**
30	2.67	3.11	13.28	1.75	0.57	1.10	2.75	0.49	3.97	5.18	**34.86**

* It is expected that navigational benefits would gradually be realized during year 5 to 7; Year 5 - 20%, Year 6 - 40% & Year 7 to 30 - 100 %.

Table 17 : Summary of Expected Socio-Economic Infrastructures Benefits (million Taka)

Year	Subtotal #1	Subtotal #2	Subtotal #3	Subtotal #4	Subtotal #5	Subtotal #6	Subtotal #7	Total
1	0.0	0.0	0.0	0.00	0.00	0.0	0.00	0.00
2	0.0	0.0	0.0	0.00	0.00	0.0	0.00	0.00
3	0.0	0.0	0.0	0.00	0.00	0.0	0.00	0.00
4	0.0	0.0	0.0	0.00	0.00	0.0	0.00	0.00
5	3.2	0.1	3.8	0.00	0.56	1.0	0.40	9.06
6	4.8	1.5	5.6	0.50	0.84	2.0	0.80	16.04
7	6.4	4.7	7.5	0.70	1.12	3.0	1.00	24.42
8	8.0	6.1	9.4	9.50	1.40	4.0	1.25	39.65
9	8.0	7.1	10.0	12.24	1.54	5.0	1.25	45.13
10	8.0	8.2	10.6	13.54	1.68	6.0	1.25	49.27
11	8.0	8.2	11.2	14.10	1.82	7.0	1.25	51.57
12	8.0	8.2	11.8	14.74	1.96	8.0	1.25	53.95
13	8.0	8.2	12.4	15.38	2.10	9.0	1.25	56.33
14	8.0	8.2	13.0	16.02	2.24	10.0	1.25	58.71
15	8.0	8.2	13.6	16.66	2.38	11.0	1.25	61.09
16	8.0	8.2	14.2	17.30	2.52	12.0	1.25	63.47
17	8.0	8.2	14.8	17.96	2.66	13.0	1.25	65.87
18	8.0	8.2	15.4	18.66	3.10	14.0	1.25	68.61
19	8.0	8.2	15.4	20.02	3.10	15.0	1.25	70.97
20	8.0	8.2	15.4	21.05	3.10	16.0	1.25	73.00
21	8.0	8.2	15.4	21.66	3.10	16.0	1.25	73.61
22	8.0	8.2	15.4	22.19	3.10	16.0	1.25	74.14
23	8.0	8.2	15.4	22.72	3.10	16.0	1.25	74.67
24	8.0	8.2	15.4	23.25	3.10	16.0	1.25	75.20
25	8.0	8.2	15.4	23.78	3.10	16.0	1.25	75.73
26	8.0	8.2	15.4	24.34	3.10	16.0	1.25	76.29
27	8.0	8.2	15.4	24.34	3.10	16.0	1.25	76.29
28	8.0	8.2	15.4	24.34	3.10	16.0	1.25	76.29
29	8.0	8.2	15.4	24.34	3.10	16.0	1.25	76.29
30	8.0	8.2	15.4	24.34	3.10	16.0	1.25	76.29
NPV 12%	**35.07**	**30.33**	**52.32**	**56.84**	**9.01**	**36.92**	**5.45**	**225.93**
% of Total	**15.5%**	**13.4%**	**23.2%**	**25.2%**	**4.0%**	**16.3%**	**2.4%**	**100.0%**

Subtotal #1 = Kalni Kushiyara river bank flood protection
Subtotal #2 = Additional river bank protection & related land development
Subtotal #3 = Village platform(VP) flood and wave protection (implemented + O & M)
Subtotal #4 = VP homestead gardens, fruit trees, and slope protection
Subtotal #5 = VP homestead grain drying
Subtotal #6 = Improvements of quality-of-life
Subtotal #7 = Reduction of O & M costs for existing projects

Table 18 : Farm Budget Simulations: Small & Landless Farmers

	Item	Present					FWO					FW				
		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*	
1	REVENUE															
2	Yield:Damage Free(tonnes/ha)	4.80	3.30	2.00	3.30		4.80	3.30	2.00	3.30		4.80	3.30	2.00	3.30	
3	Area:Damage Free (%)	87.3	59.8	84.0	98.8		75.5	52.2	72.3	85.9		98.2	78.5	94.8	100.0	
4	Yield:Damaged(tonnes/ha)	3.00	1.70	1.60	2.30		3.00	1.70	1.60	2.30		3.00	1.70	1.60	2.30	
5	Area:Damaged (%)	12.7	40.2	16.0	1.2		24.5	47.8	27.7	14.1		1.8	21.5	5.2	0.0	
6	Average Yield(tonnes/ha)	4.57	2.66	1.94	3.29		4.36	2.54	1.89	3.16		4.77	2.96	1.98	3.30	
7	By Product Factor(tonne/tonne)	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)	5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809	
9	Prices of By Product (Tk)	1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006	
10	Value of Production (Tk)	36,333	19,915	18,367	25,696		34,645	19,004	17,923	24,688		37,893	22,158	18,777	25,790	
11	COSTS (Tk)															
12	Labour Costs(Hired)	999	1,741	788	1,934		1,000	1,741	790	1,933		998	1,740	786	1,934	
13	(% Hired)	10%	20%	15%	25%		10%	20%	15%	25%		10%	20%	15%	25%	
14	Bullock	2,074	2,006	1,826	1,903		2,076	2,006	1,831	1,902		2,073	2,006	1,821	1,903	
15	Seeds	1,127	853	1,059	1,023		1,128	853	1,062	1,023		1,126	853	1,056	1,023	
16	Fertilizers	1,591	523	187	561		1,592	523	188	561		1,590	523	187	560	
17	Pesticides	808	653	0	0		809	654	0	0		808	654	0	0	
18	Irrigation	3,073	2,337	0	0		3,076	2,338	0	0		3,071	2,337	0	0	
19	Others	992	714	544	618		992	714	546	617		991	714	543	618	
20	Cost of Production	10,664	8,828	4,404	6,038		10,673	8,830	4,417	6,036		10,656	8,828	4,392	6,037	
21	MARGIN/HECTARE:Own Land	25,670	11,087	13,963	19,658		23,972	10,174	13,506	18,652		27,237	13,330	14,384	19,752	
22	Cost of Rent (Tk/ ha)	14,871	7,773	8,560	12,057		14,019	7,320	8,337	11,553		15,650	8,897	8,767	12,103	
23	MARGIN/HECTARE:Rented Land	10,799	3,314	5,403	7,601		9,953	2,854	5,169	7,099		11,587	4,433	5,617	7,649	
24	Cropped Area (%)	69%	15%	9%	3%		69%	13%	10%	3%		73%	12%	9%	3%	
25	Weighted Average Margin (Tk/ha):Own Land					21,145					19,830					23,129
26	Weighted Average Margin (Tk/ha):Rented Land					8,628					7,988					9,631
27	Own Land (ha)					0.40					0.40					0.40
28	Rented Land (ha)					0.30					0.30					0.30
29	Cropping Intensity					1.01					1.01					1.02
30	Actual Margin/year (Tk)					11,157					10,432					12,384

Notes

2. Kalni Kushiyara 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. Kalni Kushiyara Farm Household Survey.

19. Includes loan interest for short term credit and miscellaneous expenses(see main text).

22. 50 % of the value of production less 50 % of cash cost; Kalni Kushiyara Farm Household Survey.

23. Value of production less cost of production & cost of rent

25,26. Assumes excluded crops have the same average gross margin for all farm sizes.

27,28. See Annex D

Table 19 : Farm Budget Simulations: Medium-Sized Farmers

	Item	Present					FWO					FW				
		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*	
1	**REVENUE**															
2	Yield:Damage Free(tonnes/ha)	4.60	2.90	1.90	3.20		4.60	2.90	1.90	3.20		4.60	2.90	1.90	3.20	
3	Area:Damage Free (%)	87.3	59.8	84.0	98.8		75.5	52.2	72.3	85.9		98.2	78.5	94.8	100.0	
4	Yield:Damaged(tonnes/ha)	2.80	1.50	1.50	2.20		2.80	1.50	1.50	2.20		2.80	1.50	1.50	2.20	
5	Area:Damaged (%)	12.7	40.2	16.0	1.2		24.5	47.8	27.7	14.1		1.8	21.5	5.2	0.0	
6	Average Yield(tonnes/ha)	4.37	2.34	1.84	3.19		4.16	2.23	1.79	3.06		4.57	2.60	1.88	3.20	
7	By Product Factor(tonne/tonne)	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)	5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809	
9	Prices of By Product (Tk)	1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006	
10	Value of Production (Tk)	34,744	17,520	17,418	24,914		33,056	16,722	16,974	23,906		36,303	19,482	17,828	25,008	
11	**COSTS (Tk)**															
12	Labour Costs(Hired)	2,388	2,680	1,494	3,000		2,384	2,681	1,497	2,994		2,390	2,678	1,492	3,000	
13	(% Hired)	25%	35%	30%	40%		25%	35%	30%	40%		25%	35%	30%	40%	
14	Bullock	1,984	1,765	1,731	1,845		1,981	1,765	1,734	1,842		1,986	1,764	1,729	1,845	
15	Seeds	1,078	751	1,004	992		1,076	751	1,006	990		1,079	750	1,003	992	
16	Fertilizers	1,521	460	178	544		1,519	461	178	543		1,523	460	177	543	
17	Pesticides	773	574	0	0		772	575	0	0		774	575	0	0	
18	Irrigation	2,939	2,056	0	0		2,935	2,057	0	0		2,942	2,055	0	0	
19	Others	948	628	516	599		947	629	517	598		949	628	515	599	
20	Cost of Production	11,630	8,915	4,924	6,979		11,615	8,919	4,932	6,968		11,643	8,910	4,917	6,979	
21	**MARGIN/HECTARE:Own Land**	23,114	8,605	12,494	17,935		21,441	7,803	12,043	16,939		24,660	10,573	12,911	18,029	
22	Cost of Rent (Tk/ ha)															
23	**MARGIN/HECTARE:Rented Land**															
24	Cropped Area (%)	69%	15%	9%	3%		70%	13%	10%	3%		73%	12%	9%	3%	
25	Weighted Average Margin (Tk/ha):Own Land					19,156					17,961					21,136
26	Weighted Average Margin (Tk/ha):Rented Land															
27	Own Land (ha)					1.90					1.90					1.90
28	Rented Land (ha)															
29	Cropping Intensity					1.01					1.01					1.02
30	**Actual Margin/year (Tk)**					36,760					34,467					40,962

Notes

2. Kalni Kushiyara 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. Kalni Kushiyara Farm Household Survey.

19. Includes loan interest for short term credit and miscellaneous expenses(see main text).

22. Kalni Kushiyara Farm Household Survey.

25,26. Assumes excluded crops have the same average gross margin for all farm sizes.

27,28. See Annex D

Table 20 : Farm Budget Simulations : Large Farmer

	Item	Present					FWO					FW				
		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*		HYV *Boro*	Local *Boro*	DWR	HYV *Aman*	
1	**REVENUE**															
2	Yield:Damage Free(tonnes/ha)	4.20	2.80	1.80	3.00		4.20	2.80	1.80	3.00		4.20	2.80	1.80	3.00	
3	Area:Damage Free (%)	87.3	59.8	84.0	98.8		75.5	52.2	72.3	85.9		98.2	78.5	94.8	100.0	
4	Yield:Damaged(tonnes/ha)	2.60	1.40	1.40	2.10		2.60	1.40	1.40	2.10		2.60	1.40	1.40	2.10	
5	Area:Damaged (%)	12.7	40.2	16.0	1.2		24.5	47.8	27.7	14.1		1.8	21.5	5.2	0.0	
6	Average Yield(tonnes/ha)	4.00	2.24	1.74	2.99		3.81	2.13	1.69	2.87		4.17	2.50	1.78	3.00	
7	By Product Factor(tonne/tonne)	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)	5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809		5,936	6,155	6,805	6,809	
9	Prices of By Product (Tk)	1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006		1,006	1,341	1,341	1,006	
10	Value of Production (Tk)	31,767	16,770	16,469	23,361		30,266	15,972	16,025	22,453		33,153	18,733	16,879	23,445	
11	**COSTS (Tk)**															
12	Labour Costs(Hired)	5,239	5,130	3,062	5,273		5,240	5,121	3,062	5,273		5,239	5,150	3,061	5,273	
13	(% Hired)	60%	70%	65%	75%		60%	70%	65%	75%		60%	70%	65%	75%	
14	Bullock	1,814	1,689	1,637	1,730		1,814	1,686	1,637	1,730		1,813	1,696	1,637	1,730	
15	Seeds	985	719	950	930		985	717	950	930		985	721	949	930	
16	Fertilizers	1,391	441	168	510		1,391	440	168	510		1,391	442	168	509	
17	Pesticides	707	550	0	0		707	550	0	0		707	553	0	0	
18	Irrigation	2,687	1,968	0	0		2,687	1,965	0	0		2,687	1,976	0	0	
19	Others	867	602	488	562		867	600	488	562		867	604	488	562	
20	Cost of Production	13,690	11,099	6,305	9,005		13,691	11,080	6,305	9,005		13,689	11,142	6,304	9,005	
21	**MARGIN/HECTARE:Own Land**	18,077	5,671	10,165	14,355		16,575	4,892	9,720	13,448		19,464	7,590	10,575	14,440	
22	Cost of Rent (Tk/ ha)	3,299	2,183	623	792		3,302	2,184	625	792		3,297	2,184	621	791	
23	**MARGIN/HECTARE:Rented Land**	14,871	7,773	8,560	12,057		11,830	5,804	7,388	10,436		13,280	7,184	7,818	10,931	
24	Cropped Area (%)	69%	15%	9%	3%		70%	13%	10%	3%		73%	12%	9%	3%	
25	Weighted Average Margin (Tk/ha):Own Land					14,935					13,858					16,714
26	Weighted Average Margin (Tk/ha):Rented Land					13,065					10,483					11,965
27	Own Land (ha)					6.30					6.30					6.30
28	Rented Land (ha)					2.50					2.50					2.50
29	Cropping Intensity					1.01					1.01					1.02
30	**Actual Margin/year (Tk)**					128,018					114,646					137,916

Notes

2. Kalni Kushiyara 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. Kalni Kushiyara Farm Household Survey.

19. Includes loan interest for short term credit and miscellaneous expenses(see main text).

22. 50 % of cash cost of production of small farmers ; Kalni Kushiyara Farm Household Survey.

23. 50 % of value of production less cost of rent.

25,26. Assumes excluded crops have the same average gross margin for all farm sizes.

27,28. See Annex D

KALNI-KUSHIYARA RIVER MANAGEMENT PROJECT FEASIBILITY STUDY

ANNEX E
ECONOMICS
APPENDIX E.2

Estimation of Economic Prices of Selected Products for Use in Evaluation of Water Management Projects in Bangladesh

March 1998

FINAL REPORT

Estimation of Economic Prices of Selected Products for Use in Evaluation of Water Management Projects in Bangladesh

Quazi Shahabuddin
Iqbal Ahmed Syed

March 5, 1998

I. Introduction

The objective of this study is to estimate a set of conversion factors for use in economic evaluation of water sector projects in the country. This has been essentially achieved through updating the set of conversion factors estimated by Shahabuddin and Rahman (1992) earlier for use in FAP planning studies. Such a need of updating arises for a number of reasons, the most important of which include the changes in world market condition and recent changes in fiscal and trade policy regimes which is reflected in the base-year price of 1995, which may be markedly different from those prevailed in the early nineties. Since the estimation of conversion factors in this study essentially follows the methodology used in Shahabuddin and Rahman (1992), no attempt has been made to elaborate the estimation procedures used in this study.[1] Instead, the study largely focuses in describing how the updating exercise has been carried out and presenting the estimated conversion factors of selected agricultural products and project inputs for water resources development in Bangladesh. These are presented in Section II.

II. Estimated Conversion Factors of Selected Commodities and Project Inputs

Following the methodology used in Shahabuddin and Rahman (1992), specific conversion factors for selected agricultural products and inputs, industrial products, shadow wage rate conversion factor for rural unskilled labour

[1] Several appraisal methodologies have been developed of which the most widely known and used are UNIDO Guidelines and Little-Mirrlees (LM) approaches. It should be emphasized, however, that though different in revaluation procedure, both approaches are basically the same and if consistently applied, any of these two methods would serve well for evaluation purposes. However, LM approach may be preferred because of the emphasis it places on the use of border prices. Moreover, Bangladesh has considerable familiarity in using this approach. Based on these considerations, Shahabuddin and Rahman (1992) followed this approach in their study, though in a somewhat simplified form. The simplifications introduced consist of non-consideration of income distributional effects of project activities and ignoring any premium that public income may have over private income. Non-consideration of income distributional impact is mainly justified in view of the arbitrariness involved in assigning particular distributional weights to different income classes.

and finally, standard conversion factor have been estimated using more recent data. All the calculations have been done at mid 1995 prices. These are discussed below for each of the selected group of products and factors including shadow wage rate and standard conversion factor.

Tradeable Goods: Agricultural Products and Inputs

Import parity prices were estimated for rice, wheat, oilseeds, sugarcane and fertilizer (TSP & MP). In each case, World Bank 2000 projected FOB prices have been appropriately adjusted for quality differences, freight and insurance costs, as well as for internal trade (including handling, storage, etc.) and transport costs at different stages from the port to the farm gate. As for freight and insurance costs, the figures used in the earlier study have been inflated by using MUV index. In case of costs incurred from internal trade and transport, appropriate sectoral deflators were used to update these to 1995 prices. Similarly, export parity prices were estimated for rice, jute and urea.

The estimated economic prices and the conversion factors are presented in Tables II.1 and II.2 for agricultural outputs and inputs, respectively. The procedures involved are the same as those used in Shahabuddin and Rahman (1992), which are provided in Annex A of this Report.

Tradable Goods : Project Inputs

Most of the project inputs like cement, steel, metal products, transport equipment, machinery, engine, pump and accessories were importables and could be identified in the common category of item for the purpose of estimating conversion factors. Conversion factors were updated using the same methodology adopted earlier (1992) and taking into account of the changes in the government fiscal and commercial policy variables such as taxes, import duties and licence fees. Information on various import duties were collected from National Board of Revenue, Government of Bangladesh.

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Table II.1 : Economic Prices of Agricultural Outputs (1995, Tk./MT)

Crops	Main Product			By-Product		
	Market Price	Coversion Factor	Economic Price	Market price	Conversion Factor	Economic price
HYV Boro	5936	1.05	6233	1006	0.90	905
Local Boro	6155	1.05	6463	1341	0.90	1207
Local Aus	6029	1.05	6330	1341	0.90	1207
HYV Aus	6445	1.05	6767			
B Aman	6805	1.05	71.45	1341	0.90	1207
LT Aman	6778	1.05	7117	1341	0.90	1207
HYV Aman	6809	1.05	7149	1006	0.90	905
Wheat	6978	1.39	9699	750	0.90	675
Pulses (Masur)	18143	0.90	16329			
Groundnut	18000	0.90	16200			
Oilseeds (Rape & Mustard)	17328	0.77	13343			
Potato	4619	0.90	4175			
Jute	6470	1.35	8730			
Sweet Potato	2379	0.90	2141			
Spices (Onion)	7788	0.90	7009			
Vegetables (Radish)	5670	0.90	5103			
Sugarcane	1180	0.85	1000			
Tobacco	29860	0.90	26874			

Notes:(1) Details of derivation of these estimates are provided in Annex A.
(2) Economic price of paddy is based on an average of import and export parity prices.

In case of all the above mentioned project inputs, the CIF prices were assumed to be 100 to which taxes, license fees, development surcharge were added to yield tax paid landed cost. To the handling charges at the port, the appropriate trade and transport margins were added to yield domestic prices. The border prices were estimated by adding the trade, transport and port handling charges at border prices to the CIF price. Conversion factor of diesel (petroleum products) were updated by estimating its import parity price. In this case, the World Bank projected 2005 FOB price expressed at 1995 prices was

used. The methodology for estimating the import parity price for diesel was the same as that followed in case of agricultural outputs and inputs earlier.

Table II.2 : Economic Prices of Inputs in Crop Production

Inputs	Market Price	Conversion Factor	Economic Price
Fertilizer (Tk/kg)			
Urea	5.56	1.05	5.84
TSP	8.31	1.17	9.72
MP	7.43	1.17	8.69
Seeds (Tk/kg)			
HYV Boro	11.00	1.05	11.55
Local Boro	11.17	1.05	11.73
Local Aus	10.67	1.05	11.20
HYV Aus	10.83	1.05	11.37
B Aman	10.83	1.05	11.37
LT Aman	10.83	1.05	11.37
HYV Aman	10.33	1.05	10.85
Wheat	12.00	1.39	16.68
Pulses	28.33	0.90	25.50
Groundnut	22.00	0.90	19.80
Oilseeds	23.00	0.77	17.71
Potato	13.00	0.90	11.70
Jute	37.50	1.35	50.63
Sweet Potato	2.25	0.90	2.03
Spices	600.00	0.90	540.00
Vegetables	300.00	0.90	270.00
Sugarcane	1.50	0.85	1.28
Tobacco	45.00	0.90	40.50
Irrigation (Tk/ha)			
Traditional	1200.00	0.79	948.00
Modern	3500.00	0.79	2765.00
Others			
Labour (Tk/per day)	50.00	0.85	42.50
Bullock (Tk/per day)	45.00	0.90	40.50
Pesticide (Tk/kg)	559.7	0.90	503.73

Notes: Details of derivation of these estimates are provided in Annex A.

Group Conversion Factors (GCF) have been estimated for the project inputs; regulators, permanent bank protection, river training and slope protection (hard). The relative weights of the major components and the estimated

conversion factors are provided in Annex C. Group Conversion Factor is defined as the weighted average of the conversion factors of its traded and non-traded components. SCF can be used for the nontraded goods included in the weighting system for which conversion factors are not available. It is adequate to use GCF, except for some key commodities in a project. The advantage is that its estimates may be based on weights of its major components derived from a readily available data and need not to be project specific weights.

The estimated conversion factors for project inputs (both individual and group) are presented in Table II.3 and the details are provided in Annex B (Tables B-1 through B-8) and Annex C (Tables C-1 through C-3), as mentioned above.

Table II.3 : Estimated Conversion Factors for Project Inputs

Standard Conversion Factor (SCF)	0.90
Project Inputs	
Skilled Labour	0.90
Unskilled Labour	0.84
Cement	0.71
Steel (Basic Metal)	0.73
Liner, Screen (Metal Products)	0.67
Vehicle and Component (Transport Equipment)	0.61
Machinery : Normal Duty	0.67
Machinery : Concessionary Duty	0.86
Engine, Pump and Accessories (Pump Motor)	0.77
Pumping Cost, Minor Irrigation	0.79
Diesel, Petroleum	0.72
Bricks (SCF)	0.90
Dredging (SCF)	0.90
Regulators (GCF)	0.82
River Training (GCF)	0.77
Earthwork (SCF)	0.90
Permanent Bank Protection (GCF)	0.75
Slope Protection, (Hard) (GCF)	0.75
Physical Contingencies (SCF)	0.90
Engineering and Administration (SCF)	0.90

Note: Details of derivation of these estimates are provided in Annex B, Tables B.1 through B.8 and Annex C (Tables C-1 through C-3).

The Estimated Standard Conversion Factor (SCF)

The SCF is a group conversion factor for which the group covers all comodities produced or consumed in the economy. Hence, it should be ideally calculated as the weighted average of the conversion factors for all specific commodities or group of commodities. However, since this is not generally feasible, certain shortcuts can be used for calculating the SCF.

The commodities produced or consumed in the economy include both traded and nontraded commodities. The conversion factors for nontraded commodities could in principle be derived by decomposing these into traded commodities. However, a suitable weighting system need to be established. Ideally, a weighting system derived from input-output tables may be used. However, the latest available input-output table for Bangladesh was of 1981/82 during the time of this study. Another possible option is to use the trade weights which are easily available for more recent years. Shahabuddin and Rahman (1992) also used trade weights to estimate the SCF. The SCF was estimated using the following formula:

$$SCF = \frac{M + X}{M(1+r_m) + X(1-r_x)} \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where M and X represent the value of imports and exports, and r_m and r_x are the import tax rate and export tax rate, respectively. If the actual values of import and export taxes are considered instead of tax rates, the calculation gets even simpler. In fact, for purposes of simplicity Shahabuddin and Rahman (1992) considered the actual value of taxes rather than the tax rates. The SCF in that case is given by:

$$SCF = \frac{M + X}{(M+T_m) + (X-T_x)} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where T_m and T_x are the revenue from taxes on imports and exports, respectively. In the above, the numerator represents the value of traded goods at border prices, while the denominator indicates the value of the same goods at domestic prices excluding transport, handling and trade margins.[2]

The SCF also bears a close relationship with the shadow exchange rate (SER). The precise relationship is given by:

$$SCF/OER = 1/SER \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where OER is the official exchange rate. Thus, the SCF translate domestic prices into the border prices expressed in units of domestic currency, and division by the OER expresses these in units of foreign exchange. The SER combines these two steps. Thus the standard conversion factor can be estimated by rearranging the equation.

$$SCF = \frac{OER}{SER} \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

or,
$$SCF = \frac{OER}{OER\,(1 + FXP)} \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

where, FXP is the foreign exchange premium expressed in decimal terms

Thus,
$$SCF = \frac{1}{(1 + FXP)} \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Estimation of SCF are provided in Table II.4, using both the methods discussed above, i.e. using equation (2) and equation (6) respectively.

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[2] It may be mentioned here that the above formula used in this study to estimate the SCF and also in the earlier study is a rather crude approximation because (1) it assumes that the share of various commodities in the total value of trade approximates the shares in production (or consumption) and (2) it does not take into account the possibility that for some commodities the spread between domestic prices and border prices is greater than the net border tax.

Table II.4: Estimation of Standard Conversion Factor (SCF)

Method 1

Items	1992/93	1993/94	1994/95	3 Year Average
1. Value of Total Imports (M)	138198	150599	210917	166571
2. Value of Total Exports (X)	88215	100976	139285	109492
3. M + X (1+2)	226413	251575	350202	276063
4. Import Duty	27650	29700	36278	31209
5. VAT on Imports & Supp. Duty	17629	17821	24067	19839
6. Total Tax on Imports (4+5)	45279	47521	60345	50148
7. Average Tax on Imports	0.33	0.32	0.29	0.31
8. Export Duty	250	400	488	379
9. Sales Tax/VAT on Exports	0	0	0	0
10. Total Tax on Exports (8+9)	250	400	488	379
11. Average Tax on Exports	0.003	0.004	0.004	0.003
12. SCF [3/(3+6-10)]	0.83	0.84	0.85	0.84

Source: Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Various Years.

Method 2

SCF = 1/(1+FXP) where, FXP = Foreign Exchange Premium = 5%
SCF = 1/(1+.05) = 0.95

Standard Conversion Factor (SCF) in this study has finally been computed as an average of SCF estimated using method 1 and 2. In other words,

Estimated SCF = (0.84 + 0.95)/2 = 0.90

Estimation of Shadow Wage Conversion Factor for Rural Unskilled Labour

Following Rab (1984, 1986), as well as Shahabuddin and Rahman (1992), shadow wage rate conversion factor for rural unskilled labour in this study has been computed as:

$$SWR = mp + (w-m)(1 - 1/v)c \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

In the formula, the first term, mp represents the economic cost of using labour in a particular project in terms of foregone output in its best alternative use. The second term, (w-m) (1-1/v)c indicates the increase in consumption resulting from labour's employment in new project, expressed in border prices and evaluated in terms of the value of investment relative to consumption (v). Once a shadow wage rate has been estimated, its corresponding conversion factor was estimated as SWR/W where SWR is the shadow wage rate and W is the money wage paid in the project. It may be emphasized here that since the oppurtunity cost of labour employed in the farm will differ from these who are employed in the project, two sets of conversion factors for rural unskilled labour have been estimated in this study. A brief description of how different components of shadow wage conversion factor have been estimated is provided below.

For estimating the marginal product of rural labour, available relevant information about the employment and labour situation in rural areas, underemployment during the slack season, wages received in the peak season and wages received during the slack season in Food for Works and other related activities have been scrutinised. The marginal product of rural labour has been derived as weighted average of the observed wages during the peak and the slack seasons of work, after some allowance is made for long term movement in real agricultural wages in Bangladesh. For valuing the marginal product of rural labour at border prices (p), the border to domestic price ratio of rice and wheat has been used. For valuing increase in consumption at border price (c), a consumption conversion factor was estimated by looking at their consumption basket as reported in the latest available Household Expenditure Survey. Finally,

the shadow price of investment relative to consumption (v) was estimated using the following formula:

$$v = \frac{mpk\ (1-s)}{CRI - mpk \times s} \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

where mpk = marginal product of capital

s = rate of savings

CRI = consumption rate of interest

Following the methodology outlined above, shadow wage rate conversion factor for rural unskilled labour have been estimated and the estimates are presented in Table II.4. As mentioned earlier, two sets of conversion factor have been estimated for rural unskilled labour since their opportunity costs differ depending on whether they are used in crop cultivation or project construction work. The detailed procedure involved in the estimation of these alternative values of shadow wage rate conversion factor is provided in Annex C.

Table II.4

Shadow Wage Rate Conversion Factors for Rural Unskilled Labour

Labour Use in Project Construction	Labour Use in Crop Production
0.84	0.85

Note: For details, of computation, see the worksheet at Annex D.

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Annex A

Derivation of Economic Prices of Internationally Traded Commodities

AT IMPORT PARITY	Unit	Agricultural Output				Agricultural Input	
		Rice/Paddy	Wheat	Oilseeds/ Soyabean	Sugarcane	TSP	MP
1. Projected FOB value: year 2000 Source (1)	US$/M. Ton	296	175	253	277	145	117
2. Adjustment to quality differential		0.80	0.90	0.90	1.00	1.00	1.00
3. Adjusted FOB value		236	157	288	277	145	117
4. Freight and Insurance Source (2)		41	76	72	76	72	76
5. CIF value at entry port Chittagong/Chalna		278	233	300	353	217	193
6. CIF value at entry port Chittagong/Chalna @US$ 1.00 = Taka 40.00	Tk/M. Ton	11114	9338	11991	14130	8668	7720
7. Port dues, storage, handling, transport etc. up to CSD.LSD/Primary distribution point (PDP)/ National Market (NM) Source (3)		1537	1537	1537	1537	1057	1057
8. Transport, handling, storage etc. from CSD/LSD/ PDP/NM to secondary market (Thana headquarter) Source (4)		549	549	549	549	394	317
9. Value ex-store/market		13199	11424	14077	16216	10119	9094
Transport, handling, storage, processing etc. from farmgate to secondary market (Thana head quarter/milling centre/ procurement centre) (Source (5)		656	656	656	5079	394	394
10. Processing Ratio		0.67	0.9	1	0.09	1	1
11. Farmgate price	Tk./M. Ton	8404	9690	13420	1002	9725	8700
12. Farmgate price	Tk./kg	8.40	9.69	13.42	1.00	9.73	8.70
13. Financial price Source (6)	Tk/.kg	6.44	6.98	17.33	1.18	8.31	7.43
14. Conversion factor	12/13	1.31	1.39	0.77	0.85	1.17	1.17

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Annex A (Contd.)

Derivation of Economic Prices of Internationally Traded Commodities

AT EXPORT PARITY	Unit	Agricultural Output		Agricultural Input
		Rice/Paddy	Jute	Urea
1. Projected FOB value Source (1)	US $/ M. Ton	236	321	157
2. Projected FOB value @ US$ 1.00 = Taka 40.00	Taka/M. Ton	9440	12858	6272
3. Port dues, handling, storage, transportation etc. up to bailing point/PDP Source (3)		1193	1634	837
4. Transport, storage, processing, handling etc. from bailing centre/PDP to secondary market/thana headquarter or local procurement centre Source (4)		0	747	0
5. Value ex-store/market		8247	10478	5435
6. Transport, handling, storage etc. including profit margin from farmgate to local procurement centre/thana headquarter Source (5)		656	203	394
7. Processing Ratio		0.67	0.85	1
8. Farmgate price	Taka/M. Ton	5086	8734	5829
9. Farmgate price	Taka/kg	5.09	8.73	5.83
10. Financial price Source (6)	Taka/kg	6.44	6.47	5.56
11. Conversion factor	9/10	0.79	1.35	1.05

Annex B

Table B-1 : Worksheet for Estimation of Conversion Factor for Cement

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	39.38
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	147.88
7. Trade margin at domestic price (16% of landed cost)	23.66
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	177.54
10. Trade, transport & handling charges at world price [(7+8) x SCF]	26.69
11. Border price [1 + 10]	126.69
12. Conversion factor [11/9]	0.71

Annex B

Table B-2 : Worksheet for Estimation of Conversion Factor for Steel (Basic Metal)

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	34.08
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	142.58
7. Trade margin at domestic price (16% of landed cost)	22.81
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	171.39
10. Trade, transport & handling charges at world price [(7+8) x SCF]	25.93
11. Border price [1 + 10]	125.93
12. Conversion factor [11/9]	0.73

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Annex B

Table B-3 : Worksheet for Estimation of Conversion Factor for Metal Products (Liner, Screen)

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	51.38
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	59.89
7. Trade margin at domestic price (16% of landed cost)	25.58
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	191.46
10. Trade, transport & handling charges at world price [(7+8) x SCF]	28.42
11. Border price [1 + 10]	128.42
12. Conversion factor [11/9]	0.67

Annex B

Table B-4 : Worksheet for Estimation of Conversion Factor for Cement

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	70.13
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	178.63
7. Trade margin at domestic price (16% of landed cost)	28.58
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	213.21
10. Trade, transport & handling charges at world price [(7+8) x SCF]	31.12
11. Border price [1 + 10]	131.12
12. Conversion factor [11/9]	0.61

Annex B

Table B-5 : Worksheet for Estimation of Conversion Factor for Machinery (Normal Duty)

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	51.48
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	159.98
7. Trade margin at domestic price (16% of landed cost)	25.60
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	191.58
10. Trade, transport & handling charges at world price [(7+8) x SCF]	28.44
11. Border price [1 + 10]	128.44
12. Conversion factor [11/9]	0.67

Annex B

Table B-6 : Worksheet for Estimation of Conversion Factor for Machinery (Concessionary Duty)

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	9.10
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	117.60
7. Trade margin at domestic price (16% of landed cost)	18.82
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	142.42
10. Trade, transport & handling charges at world price [(7+8) x SCF]	22.33
11. Border price [1 + 10]	122.33
12. Conversion factor [11/9]	0.86

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Annex B

Table B-7 : Worksheet for Estimation of Conversion Factor for Engine, Pump & Accessories (Pump Motor)

Items	Taka
1. CIF Value	100.00
2. Landing charge (1% of CIF)	1.00
3. Observed effective tax rate during 1994/95 (Source: National Board of Revenue)	25.38
4. Licence Fee (2.5% of CIF)	2.50
5. Observed effective development surcharge (Source: National Board of Revenue)	5.00
6. Tax paid landed cost (1+2+3+4+5)	133.88
7. Trade margin at domestic price (16% of landed cost)	21.42
8. Transport & handling charges at domestic prices (6% of CIF)	6.00
9. Domestic price (6+7+8)	161.30
10. Trade, transport & handling charges at world price [(7+8) x SCF]	24.68
11. Border price [1 + 10]	124.68
12. Conversion factor [11/9]	0.77

Annex B

Table B-8 : Worksheet for Estimation of Conversion Factor of Diesel (Petroleum Products)

Items	Unit	Taka
1. Projected long term FOB price for Light Crude Petroleum	US$/barrel	19.0
(S Arabia) during 2005 at 1995 constant price	US$/mt	140.0
2. FOB price for diesel after adjustment (Adjustment factor: 1.5 (1992)	US$/mt	210.0
3. Freight (1995 US $)	US$/mt	25.0
4. CIF Chittagong	US$/mt	235.0
5. CIF Chittagong: Conversion to Taka @ US$ 1 = Taka 40.00	Taka/mt	9410.0
6. Transport & handling charges at domestic prices (6% of CIF)	Taka/mt	565.0
7. Local distribution charges at domestic prices (1% of CIF)	Taka/mt	94.0
8. Transport, handling & local distribution at world prices ([(6+7) x SCF]	Taka/mt	593.1
9. Border price	Taka/mt Taka/litre	10003.1 10.0
10. Domestic price	Taka/litre	13.8
11. Conversion factor (9/10)		0.72

Annex C

Table C-1: Estimation of Group Conversion Factors: Regulators

Components	Weights (%)	Conversion Factors	GCF
Cement	27	0.71	0.19
Bricks (SCF)	22	0.90	0.20
Sands (SCF)	6	0.90	0.05
MS Rod (Steel)	15	0.73	0.11
Skilled Labour (SCF)	21	0.90	0.19
Unskilled Labour	9	0.84	0.08
Total	100	-	0.82

Table C-2: Estimation of Group Conversion Factors: River Training*

Components	Weights (%)	Conversion Factors	GCF
Cement	65	0.71	0.46
Sand/Gravels	5	0.90	0.05
Skilled Labour	20	0.90	0.18
Unskilled Labour	10	0.84	0.08
Total	100	-	0.77

* River training works use C. C Blocks or Boulders. Use of Boulder Revetments require more skilled labour. Conversion factor of C.C Blocks have been used as Representative of Boulders.

Table C-3: Estimation of Group Conversion Factors: Permanent Bank Protection & Slope Protection (Hard)

Components	Weights (%)	Conversion Factors	GCF
Cement	70	0.71	0.50
Sand/Gravels	5	0.90	0.05
Skilled Labour	15	0.90	0.13
Unskilled Labour	10	0.84	0.08
Total	100	-	0.75

Annex D

Worksheet for Estimation of Shadow Wage Rate Conversion Factor for Rural Unskilled Labour

Peak Season			
a	Market wage	50	Taka/pd
b	Estimated marginal product of labour	40	Taka/pd
c	Marginal value product in peak season [(a+b)/2]	45	Taka/pd
Lean Season			
d	Food for Works wage rate (amount of wheat)	5	Seers
e	Leakage	10	Per cent
f	Discrepency - market wage in lean season & FFW wage	20	Per cent
g	Marginal product of labour in lean season (amount of wheat) [d(1-e)(1-f)]	3.6	Seers
h	Average price of wheat (1991/92-1994/95) adjusted to 1995 prices	7.5	Taka/seer
i	Marginal product in lean season [g x h]	27.1	Taka/pd
Unemployment & Under Employment			
j	Un/Under employment in a whole year	10	Per cent
k	Un/Under employment in months [j x 12]	1.2	Months
l	Total lean months	7	Months
m	Employment in lean season in months [l - k]	5.8	Months
n	Employment in lean season as % of total lean season [(m/1) x 100]	82.9	Per cent
o	Marginal product of labour in lean season adjusted for un/under employment [i x n]	22.5	Taka/pd
Marginal Product of Labour			
p	Marginal product in peak season [c]	45	Taka/pd
q	Marginal product in lean season [o]	22.5	Taka/pd
r	Months in peak season	5	Months
s	Months in lean season	7	Months
t	Marginal product: weighted average of peak & lean season [{(pxr)+(qxs)}12]	31.9	Taka/pd
Marginal Product in Border Prices			
u	Share of rice in foodgrain consumption	85	Per cent
v	Share of wheat in foodgrain consumption	15	Per cent
w	Conversion factor of rice	1.05	
x	Conversion factor of wheat	1.39	
z	Conversion factor in foodgrain consumption [{(u x w) + (v x x)]	1.10	
aa	Marginal product of labour expressed in border prices [t x z]	35.1	Taka/pd
Social Cost of Consumption			
ab	MPK	16	Per cent
ac	Savings rate(s)	11	Per cent
ad	CRI	11	Per cent
ae	Social value of investiment relative to consumption (v) [{ab x (1-ac)}/ {ad-(ab x ac)}]	1.54	
af	Border to domestic price ratio for labour's consumption (c)	1.06	
ag	Social cost of consumption : 2nd term in SWR expression [(a-t)x(1-1/ae)x af]	6.75	Taka
Shadow Wage Rate			
ah	Shadow wage rate for unskilled labour in project construction [aa + ag]	41.8	Taka/pd
ai	Shadow wage rate for unskilled labour in crop cultivation [{b x (1-j) + ag]	42.7	Taka/pd
Shadow Wage Conversion Factor for Rural Unskilled Labour			
aj	Market wage [a]	50	Taka/pd
ak	Conversion factor for unskilled labour in project construction [ah/aj]	0.84	
al	Conversion factor for unskilled labour in crop cultivation [ai/aj]	0.85	