Government of the People's Republic of Bangladesh

Flood Plan Coordination Organisation,
Ministry of Irrigation, Water Development and Flood Control

BANGLADESH FLOOD ACTION PLAN

FAP 12
FCD/I AGRICULTURAL STUDY

RAPID RURAL APPRAISAL OF BRAHMAPUTRA RIGHT EMBANKMENT KAMARJANI REACH

December 1991

Hunting Technical Services Limited

in association with

Bangladesh Institute of Development Studies
Flood Hazard Research Centre
Hunting-Fishtech
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under assignment to
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Sanyu Consultants Inc.
under assignment to
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The present report is one of a series being produced by Flood Action Plan components 12, the FCD/I Agricultural Study and 13, the Operation and Maintenance Study.

The full series is expected to comprise the following reports:

FAP 12

Inception Report (joint with FAP 13)
Methodology Report (2 Volumes)
Rapid Rural Appraisals Overview

Project Impact Evaluation studies of:

* Chalan Beel Polder D
* Kurigram South
* Meghna Dhonagoda Irrigation Project
* Zilkar Haor
* Kolabashukhali Project

Rapid Rural Appraisal Studies of:

Protappur Irrigation Project
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Improvement of Sukunia Beel
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Konapara Embankment [1]
Polder 17/2
BRE Kamarjani Reach [1]
BRE Kazipur Reach [1]

* Draft Final Report (3 Volumes)
* Final Report (3 Volumes)

FAP 13

Methodology Report
Appraisal of Operation and Maintenance in FCD/I Projects (2 volumes)
Draft Final Report
* Final Report

Note: * Report not yet available

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[1] Revised versions of these RRA reports were issued in December 1991.

BRAHMAPUTRA RIGHT EMBANKMENT

Project Summary Sheet

Project Name	: Brahmaputra Right Embankment, Kamarjani Reach
Project Type	: Flood Control and Drainage
Location	
FAP Region	: North-West
District	: Gaibandha
Area (ha.)	: 10,100 ha.(gross) (Kamarjani Reach)
Funding Agency	: IDA
Implementing Agency	: BWDB
Construction started	: 1963 original 1974 rehabilitation
Scheduled Completion	:
Actual Completion	: 1970 original 1975 rehabilitation
Original Cost Estimate	: Tk.78.95 million (1963-68) for the entire BRE
Final Cost Estimate	: Tk.395.8 million (1974-85) for the entire BRE
Major Flood Damage	: 1984
Repair/rehabilitation	: Major work in 1974-85 period, frequent erosion and construction of retired embankments, particularly since rehabilitation.

BRAHMAPUTRA RIGHT EMBANKMENT - KAMARJANI REACH

SUMMARY OF FINDINGS

Introduction

The BRE is one of the oldest FCD projects in Bangladesh. It was originally started in 1963 to build 225 km of embankment to protect about 240,000 ha from flooding by the Brahmaputra. Major rehabilitation was carried out from 1975 onwards.

The Kamarjani reach of the Brahmaputra Right Embankment (BRE) is located between BRE mileage-29 at Sripur in the upstream direction (North) and mileage-41 at Rasulpur in the downstream direction (South), covering a gross area of about 10,100 ha. The study site is bounded by the Gaibandha - Sundargonj road in the west, the BRE in the east, the Gaibandha - Rasulpur road in the south and the Dharmapur - Sripur road in the north.

Kamarjani reach has been a relatively stable section of the BRE, so far. There have been few embankment retirements and the benefited area slopes towards the Brahmaputra. However, during the RRA in early June, 1991, the embankment near the Kamarjani Bazar was found to be only a few meters away from the river bank, which was eroding very fast.

Prior to the construction of BRE the area used to be submerged due to onrush of water from the Brahmaputra river and remained inundated for 2-3 days, after which water started to recede. This sudden inflow of water used to cause damage to the major standing crops such as B. Aus, B. Aman and Jute. The intensity of crop damage was more severe along the river side and less towards the interior villages.

The construction of BRE was expected to provide a flood free and well drained environment and permit a shift from long stem broadcast paddy to transplanted varieties and thus increase yields and production levels.

The BRE in this reach has generally achieved its primary objective of protecting the study area from flooding, except that 1988 breaches along the Teesta right embankment inundated the area. The BRE has however, aggravated the drainage congestion problem, because of the reduced capacity of sluices after embankment retirements in a number of places.

Engineering

The primary objective of protecting the study area from Brahmaputra floods has been achieved, except in the 1988 flood when a number of major breaches of the embankment occurred along the Teesta river, to the north of Belka, causing inundation. The presence of the embankment has improved living conditions and minimized damage to lives and property during the rainy season.

The BRE has however aggravated drainage congestion problems in the monsoon through the reduction of drainage provision/outlets in the retired embankment and through silting up of khals and rivers (eg. the canal from Matherhat bridge down to Sarai sluice gate near Kamarjani Bazar). In years of heavy and continuous rains, water congestion stays for weeks and causes damage to crop production as follows:

- T. Aman plants go under water and are damaged;
- jute plants are submerged and jute production is affected both quantitatively and qualitatively;
- sometimes, water congestion due to early monsoon rains damages ripening HYV Boro and Aus.

The embankment in the Kamarjani reach is very poorly maintained and supervised. There was no O&M committee, although this was proposed in the PP.

There was no instance of consultation between the beneficiaries and the agencies at any stage of planning or implementation of the Project.

There was no instance of public participation in the repair and maintenance of the embankment or structures, except that people affected by serious drainage congestion organize themselves to make public cuts in technically appropriate locations.

Agriculture

The embankment has given protection to the area from monsoon flooding and led to a reduction in flood depths facilitating more intensive crop cultivation, especially paddy cultivation in the monsoon season. The major impact of the Project is confined to the main monsoon season rice production. The protection from floods by the BRE has led to a substantial shift of acreage from B. Aman or mixed B. Aus-B. Aman or Local T. Aman to HYV T. Aman. Total paddy production in the post-Project monsoon season is estimated to be about 28 percent higher than in the pre-Project situation.

Aman rice production on high and medium high land areas has increased because B. Aman has been replaced by T. Aman giving higher yields and a significant proportion of T. Aman land is covered by HYVs as well. In medium low land, B. Aman has also been replaced by HYV T. Aman but in most years this crop is partially damaged due to drainage congestion of monsoon rain water.

Production of pulses and oilseeds, especially mustard, has decreased as a result of delayed drainage or congestion of water in low and medium low lands.

The protection of high, and medium high lands from normal flood has provided some opportunities for intensifying vegetable production, but the monsoon drainage congestion partly due to the Project has limited the scope for expansion, especially in low and medium low lands.

Livestock

The cattle population has declined by 20-35 percent due to :

- increased cost of keeping large animals;
- shortage of feeds, especially green grasses, rice straw and pulses bran;
- decrease of grazing land in char areas.

This has led to a decline in milk production of about 50 per cent.

Availability of draft power has decreased due to the decline in the cattle population, although the total draft power requirements went up in response to intensification of crop production.

The general health condition of animals has deteriorated due to shortage of feeds and infestations of parasitic diseases such as liver fluke.

The chicken and duck populations have increased by about 15-25 percent through:

- protection of homeyards from flood inundation;
- increase in seasonal foodgrain production;
- increased vaccination programmes.

Fisheries

Open water fish production in the floodplain, beels and khals has decreased by at least 300 MT per annum as a result of :

- elimination of annual flooding on over 8000 ha;
- low water in beels;
- interrupted fish migration from and to the river due to regulators;
- reduction of major carps.

The decline in open water fish production has in effect intensified fishing in the rivers, meaning that fish stocks in the Brahmaputra river have declined by 35-40 percent.

As a direct consequence of the decline in open water fish production, there has been a loss of employment and income of full time and part-time fishermen, many of whom have left the traditional fishing villages for non-fishing work elsewhere.

The prevalence of rain water through surface run-off from the north and west of the Project area causes inundation in low and medium low areas, as a result of which opportunities for pond fish culture have not expanded in these areas.

However, the flood protection has provided effective preconditions for pond fisheries in the high and medium high land areas. The potential has not yet been harnessed due to the inadequacy of support services such as fish feed and fisheries extension services.

Women and Nutrition

The Project has led to increased employment for women in the post-harvest processing of increased rice production, e.g. drying, parboiling and husking of paddy.

To the extent that the protection of floods by the embankment has created opportunities for homeyard vegetable cultivation, women have gained some extra opportunities for self-employment. But their movement is also restricted when there is severe drainage congestion of monsoon rain water.

In some sections, women were also reported to have obtained some work in the repair and maintenance of the embankment. The development activities of the government and the NGOs directed toward women have also been facilitated by the improved communication system, partly accomplished by the embankment.

The Project appears to have had some impact on nutritional status . The increased rice output has helped to increase food intake to some extent, although the poorer households do not have enough rice to eat during most of the months of the year.

Environment

The Project has had some positive impact on living conditions through the protection of the area from flooding.

The embankment has also proved to be a barrier to sand deposition, which in effect has helped rice production, but in sections which experience frequent breaches due to river erosion, sand deposition still occurs leading to a shift of rice acreage to sugarcane cultivation.

The protection of the Project area from the Brahmaputra river flood has created preconditions for tree plantation, although one sees few old or large trees in the area.

Social Aspects

Despite the construction of retired embankments in a number of places, the BRE has generated positive benefits for transport and communication through its function as a road.

The BRE, as well as the internal village roads which are linked with the BRE, has facilitated the development activities of GOs and NGOs in the Project area.

Additionally, the BRE has generated considerable positive benefits as the embankment is commonly used as a flood shelter for human and animal populations.

River erosion has led to unauthorised settlement by affected people on the BRE. The housing, habitation and banana plantations along the embankment have not only undermined the strength of the embankment but also jeopardize normal traffic in many reaches of the embankment.

Conflicts of interest were apparent in the southern portion of the RRA study area, where another polder, called the Sonali polder, constructed a few years ago, aggravated drainage congestion in the northern villages. This led to socio-political conflicts between the opposing groups and consequently to public cuts of the Sonali polder.

Economic Impact

From a provisional and partial economic re-assessment based on agricultural and fishery impacts only, the Project appears to have been economically non-viable. However this conclusion is quite sensitive to relatively small changes in assumed T. Aman yields and the embankment would have achieved its economic aims if it had fully protected the T. Aman HYV crop.

The Project impact on employment appears to be positive and most of the employment created by the construction, repair and maintenance of the embankment went to the poorer section of the population.

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ABBREVIATIONS AND GLOSSARY

BWDB	Bangladesh Water Development Board
BIDS	Bangladesh Institute of Development Studies
BRFE	Brahmaputra Right Flood Embankment
BRTS	Brahmaputra River Training Studies
BRE	Brahmaputra Right Embankment
Bazar	Market place
CARE	Cooperative for American Relief Everywhere
crore	Ten million (10,000,000)
C/S	Country side (of embankment)
DAE	Department of Agricultural Extension
DLS	Directorate of Livestock Services
EPWAPDA	East Pakistan Water and Power Development Authority
FAP	Flood Action Plan
FCDI	Flood Control Drainage and Irrigation
ghog	Animal burrow in embankment
IECO	International Engineering Company, Inc.
JICA	Japanese International Cooperation Agency
khas	Publicly administered (land, fishing area)
LV	Local Variety (esp. of paddy)
lakh	One hundred thousand (100,000)
LDL	Leedshill De Leuw
MPO	Master Plan Organisation
NEDECO	Netherlands Engineering Company
NGO	Non-governmental Organisation
ODA	United Kingdom Overseas Development Administration
PIE	Project Impact Evaluation
RRA	Rapid Rural Appraisal
R/S	River side (of embankment)
SO	Section Officer
STW	Shallow tube well (with suction pump)
SDE	Sub-Divisional Engineer (BWDB)
UNO	Upazila Nirbahi Officer (principal staff officer of Upazila Parishad)

1 INTRODUCTION

1.1 THE FAP 12 STUDY

The FAP 12 Study is one of the 26 numbered component studies of the Bangladesh National Flood Action Plan, and is jointly supported by the United Kingdom Overseas Development Administration (ODA) and the Japan International Cooperation Agency (JICA). It is led by a group of Bangladeshi and international consulting organisations, involving Hunting Technical Services Limited of the United Kingdom, Sanyu Consultants Inc. of Japan, the Bangladesh Institute of Development Studies (BIDS), the Flood Hazard Research Centre of Middlesex Polytechnic, UK, Hunting Fishtech of UK, and Technoconsult International Limited of Bangladesh.

The objective of FAP 12 is to conduct post-evaluations of a total of 17 projects, representative in type and location, of the FCDI projects so far executed in Bangladesh (see Figure 1.1). The results of these evaluations will be passed to other FAP components for guidance in developing strategies for improved flood control and management for the future.

Of the 17 projects for study, 5 will be assessed mainly by Project Impact Evaluation (PIE) methods, using a formal questionnaire approach and probability sampling. The remainder will be assessed by Rapid Rural Appraisal (RRA) methods, and RRA has also been used for preliminary reconnaissance of the 5 PIE projects. The present report describes the findings of the RRA of the Brahmaputra Right Embankment (BRE), Kamarjani reach.

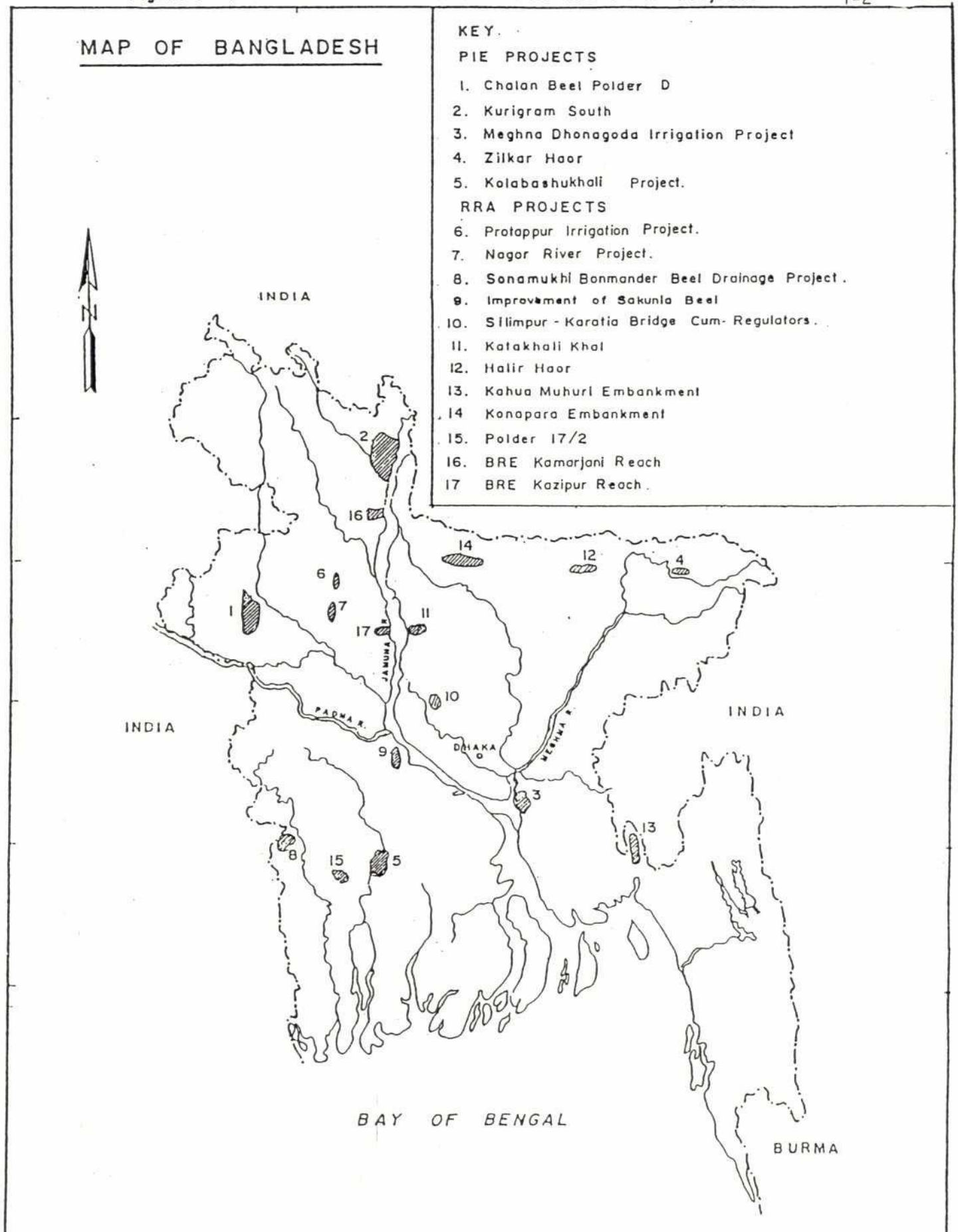
1.2 RAPID RURAL APPRAISAL

RRA is a technique of project assessment intended to produce results more quickly than formal interview surveys, while avoiding biases in the data collected. RRA consists of selective direct observation and interviews of informed respondents from representative areas of the project by a small team of well-qualified and experienced specialists who can reach informed judgements quickly in the field. Maximum use is made of documentary sources to minimise the amount of data which have to be collected by interview and to obtain guidance on the location and content of interviews.

In well-conducted RRAs great care is taken to avoid both locational biases (for example observing and interviewing only in easily accessible areas) and socio-economic biases (for example, omitting coverage of women, landless people, and other groups which are difficult to identify, locate or obtain access to).

By its nature RRA is better at obtaining qualitative data rather than quantitative data, though it is generally possible to obtain fairly good quantitative data on key agricultural parameters for the selected locations. What RRA cannot do (in contrast to PIE methods using probability sampling) is provide statistical validation of how far observations can be generalised over the project area, or of differences between areas and time-periods. Its findings must therefore always be interpreted as informed judgements, not as precise statements with known margins of error. Further background to RRA will be found in the FAP 12 Methodology Report.

Figure : 1.1 Location of Selected PIE and RRA Projects 1-2



Source: Consultants

1.3 DESCRIPTION OF THE PROJECT

The Brahmaputra Right Embankment (BRE) is one of the oldest FCD projects in Bangladesh. In 1957, the then Irrigation Directorate constructed the 50 km flood embankment between Belka-Fulchhari along the Brahmaputra Right Bank, but the embankment was not fully closed and could provide only limited local flood protection (EPWAPDA, 1968). The full-fledged Brahmaputra Flood Embankment Project (BFEP) was started in 1963 to construct 225 km of flood embankment and was completed in 1968. The major purpose was to protect about 240,000 ha. from Brahmaputra and Teesta flooding. Major rehabilitation work was started from 1974 and completed in 1985.

The length of the BRE is 225 km. between Kaunia in the District of Rangpur and Bera in the District of Pabna. The benefitted area of the project covers parts of 14 Upazilas, i.e. Kaunia, Pirgachha, Sundarganj, Gaibandha, Fulchhari, Shaghatta, Sonatola, Sariakandi, Dhunat, Kazipur, Sirajganj, Belkuchi, Chowhali and Shahjadpur.

There are various estimates of the area protected by the BRE. These are summarised in Table 1.1. All these estimates fail to analyse the gross area by flood levels or other flooding criteria, and therefore their estimates can not be related to degree of protection in any way. The estimate by Dhaka University is particularly low as it deducts the area lost due to severe erosion, "mainly in Sirajganj Division but partly also in Bogra and Gaibandha O&M Divisions" (DU, 1986).

Table 1.1 : Estimates of Area Protected by the BRE

Source	Acres		Hectares	
	Gross Area	Net Cultivated Area	Gross Area	Net Cultivated Area
IECO, 1962 (BRE Proposal)	593500	393700	240186	159328
EPWAPDA, 1988 (PCR)	641000	428000	259409	173209
BWDB, 1985 Project Proforma	558000	180000	225820	72845
Dhaka University, 1986 (Evaluation)	303000	n.a	122622	n.a
FAO (PCR)	-	-	n.a	72800

Sources : As indicated.

Since BRE is a huge project, two sections were purposively chosen for two separate RRAs - one in Kamarjani reach in Gaibandha and the other in Kazipur in Sirajganj. The rationale for selecting Kamarjani reach is that this section of the BRE has been relatively stable so far. However, during the RRA in early June, 1991, the embankment near the Kamarjani Bazar was found to be only a few meters away from the river bank and was eroding very fast. In this section, the benefitted area slopes towards the Brahmaputra and there have been few embankment retirements.

In contrast, Kazipur reach is in an unstable section of the BRE. There are frequent breaches and embankment retirements and because the land slopes away from the embankment the breaches cause severe damages to a large area.

This report presents the results of the RRA of Kamarjani reach of the BRE. References to "the Project" indicate the BRE rehabilitation during the period from 1974 to 1985. There is a separate report on the RRA of BRE Kazipur reach.

1.3.1 Location of BRE, Kamarjani Reach

The study area for the RRA of the BRE Kamarjani reach covers nine Unions, partly or fully. These are Kholahati, Ghagoa, Laxmipur, Gidari, Kamarjani and Malibari Unions of Gaibandha Upazila, Kanchipara Union of Fulchhari Upazila, and Sripur and Kapasia Unions of Sundarganj Upazila. The Kamarjani reach stretches from BRE mileage 29 at Sripur in the upstream direction (North) to BRE mileage 41 at Rasulpur in the downstream direction (South), lying between the longitude 89°3'11" to 89°8'56" and latitudes 25°3'33" to 25°12'40". The gross area benefited by the Kamarjani reach is estimated to be about 10100 ha. The area is bounded by the District Board road in the West, the BRE in the East, the Gaibandha-Rasulpur road in the south and the Dharampur-Sripur road in the North (Figure - 1.2)

1.3.2 Land Slopes and Elevation

The project area consists of a gently sloping alluvial plain which varies in elevation from about 73 feet PWD datum in the north at Dharampur to about 62 feet in the south at Rasulpur. The area has a slope of 1:7,500 from north to south. The land is subdivided into three categories - high, medium and low, covering 2,020 ha, 5050 ha. and 3030 ha. respectively.

1.3.3 Floods and Drainage

In the pre-project period the study area under the Kamarjani reach used to be inundated due to inflow of flood water from the Brahmaputra river and remained submerged for 2-3 days. Peak flows in the rivers Teesta and Brahmaputra occur during the months of June, July, August and September. In the post-project period, the BRE has been largely successful in protecting the monsoon floods from the Brahmaputra, but the problem of drainage congestion of rain water as well as of water flowing from the western areas has become increasingly aggravated, often damaging T. Aman crops.

1.3.4 Crops Grown

In the Kamarjani reach, the major crops grown in the pre-project period were B. Aus, B. Aman, mixed B. Aus - B. Aman, T. Aman (local) and jute. In the post-project situation, there has been a remarkable shift of acreage from B. Aus (local) to T. Aus/Boro (HYV) and from B. Aman (local) to T. Aman (HYV). The expansion of HYV Boro production is considered to be independent of BRE and has been facilitated by the introduction of tubewell irrigation.

1.4 OBJECTIVE OF THE PROJECT

The overall objective of the BRE was to build up a flood-free and well-drained environment to accelerate crop production. The project was to provide flood control permitting

a shift from long stemmed paddy to transplanted varieties and thus promote higher yields and production levels. The major objectives were:

- facilitating a shift of cropping patterns from local varieties to high yielding varieties;
- facilitating a move from B. Aman to T. Aman and HYV T. Aman; and
- increasing the area and output of rabi crops.

These objectives are also considered relevant for the BRE, Kamarjani reach.

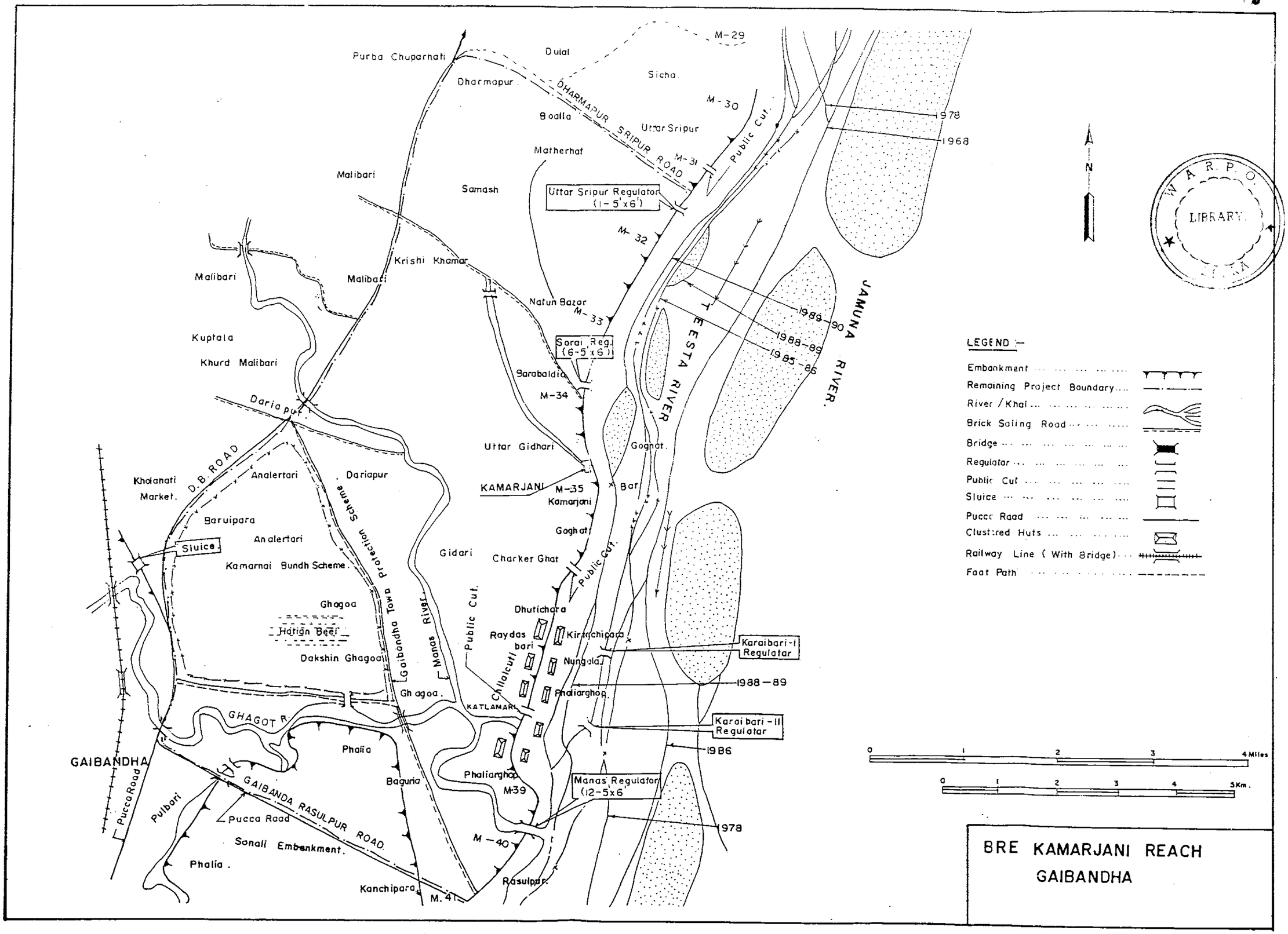
1.5 BRE, KAMARJANI REACH RRA PROCESS

The RRA of the BRE, Kamarjani reach was conducted during the period from 1-6 June, 1991. The RRA team consisted of an Agricultural Economist (Team Leader), Agronomist, Fisheries Specialist, Livestock Specialist, two Engineers, Sociologist and a Women's issues Specialist.

The team members were provided accommodation at the BWDB guest house and a local hotel at Gaibandha town which were close to the study area. Although the kutcha approach roads to Kamarjani from Dharampur or Malibari or the embankment section from Sripur to Rasulpur were in very bad condition, use of 4-WD vehicles allowed extensive field visits in different mouzas of 9 Unions covered in the study area. Individual interviews as well as group discussions were held with the officials of BWDB, DAE, DLS, Fisheries, BRDB, UNO, and NGOs as well as with farmers, fishermen, wage labourers, regulator operators, settlers on the embankment and women's groups. Detailed sources of RRA data are noted in individual chapters.

The team received very active cooperation from the officials and farmers. Especially, the Executive Engineers of BWDB at Bogra and Gaibandha were very helpful in providing project maps. The active cooperation of the SDE-I of BWDB, Gaibandha Division, in personally accompanying the team in the first day of the field visit was very helpful.

Figure 1.2 Main Features of BRE Project, Kamarjani Reach



2 ENGINEERING

2.1 PRE-PROJECT SITUATION

2.1.1 Flood Control and Drainage

During the pre-Project period the entire area used to be submerged to a depth of 2-3 feet in normal floods and 5 feet in abnormal flood due to inflow of flood water from the Brahmaputra river, and remained inundated for about 2 to 3 days, after which the water started to recede. The Manas and Ghagot rivers and some low lying areas were the main drainage channels to drain out accumulated water from the catchment area into the Brahmaputra river. During the pre-Project period the flood was not controlled as there was no barrier along the right side of the Brahmaputra river to prevent the sudden inflow of water.

In the post Project period the flood has been controlled due to construction of the BRE along the right bank of the Brahmaputra river. However, the drainage problem has been aggravated due to siltation of the internal drainage channels and also by the intervention of other polder construction including Sonali Bund. The water way of the Manas river is now confined between the sides of Sonali Bund and Komarnai Bund schemes and water flows towards the Manas regulator raising the water level significantly.

2.1.2 Irrigation System

During the pre-Project period groundwater irrigation was not practised to any significant scale. Only surface irrigation was practised during that period. In the post-Project period, shallow tube wells (STW) are the chief means of irrigation both in the Project area and in the periphery, although deep tubewells (DTW), low-lift pumps (LLP), hand tubewells and other indigenous methods are also in use. It is estimated that 93 percent of the irrigated area in the Project area is served by shallow tubewells .

2.2 PROJECT OBJECTIVES

The salient feature that can be extracted from the Project documents and the field visit by the RRA team is that the main objective of the Brahmaputra Right Flood Embankment was to provide a flood free and well drained environment on the right side of the Brahmaputra river in which accelerated agricultural activity would be enabled to increase food grain production, consistent with national objectives. In the pre-Project period, the Brahmaputra river usually over-spilled its bank and caused much damage to crops, property and livestock within the Project area. The Brahmaputra Right Flood Embankment has provided flood control in the Project area, permitting achievement of long term goals such as improvement of agricultural production, creation of employment opportunities and improvement of living conditions.

2.3 SOURCES OF DATA COLLECTED

The following reports and Project documents were reviewed in connection with the RRA of BRE Kamarjani reach.

- Feasibility Report on Brahmaputra Right Flood Embankment Project (rehabilitation and drainage) November 1977 by DPS, BWDB.

- Brahmaputra Flood Embankment Project (Phulchari to Sirajgonj) in February 1962 by EPWAPDA and IECO Inc.

- Project Proforma on BRFE Project (Rehabilitation and Drainage) Phase I, June 1985 by BWDB.

- Project Proforma on BRFE Project (Rehabilitation and Drainage) Phase-II, May 1987 by BWDB.

- Report on Completion of Construction of the Brahmaputra Flood Embankment Project (Kaunia to Hurasagar River), December 1968 by EPWAPDA.

- Project Completion Report by Food and Agriculture Organization of the United Nations, Rome, January, 1989

- Project Completion Report of BRE (Rehabilitation and Drainage) under 864-BD.

- Evaluation Study of BRE Sub-project under DFC-I by the Chairman, Department of Economics, University of Dhaka, November 1986.

2.4 PROJECT STRUCTURES

The parts of BRE Kamarjani reach that were visited by the RRA team extended from Mileage M-29 to M-41 covering a total length of 19.308 km of embankment along with three regulators in operative condition within this part of the embankment. The present conditions of the different structures are described below:

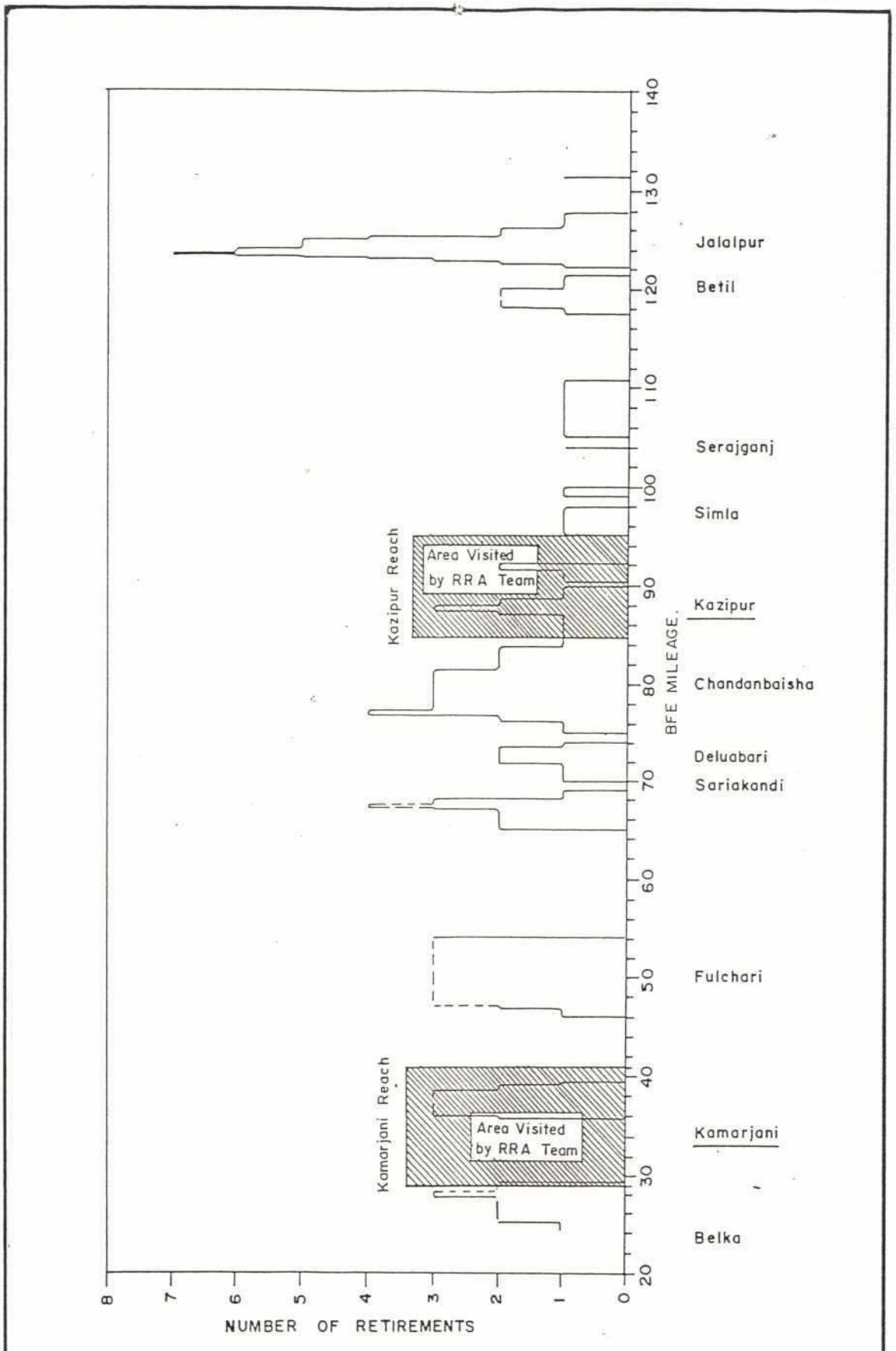
2.4.1 Embankment

The parts of the embankment which were visited by the RRA team were constructed in conformity with the design criteria set forth in the detailed design, keeping conformity with the values of C/S and R/S slopes, the crest width and crest elevation. However, these were found to be poorly maintained.

a) Embankment Retirements

The Brahmaputra Right Flood Embankment is a unique project from the view point of river bank erosion by the Brahmaputra. This has resulted in several retirements up to a maximum number of seven along the BRE at some places such as Jalalpur (downstream). A maximum of three retirements were constructed in the Kamarjani reach and are shown in the shaded part of Figure 2.1. The general history of retirement is given in Table 2.1.

Figure 2.1



NUMBER OF RETIREMENTS ALONG BRE

Source : BRTS. First Interim Report (Four Volumes) – FPCO.

TABLE 2.1 RETIRED EMBANKMENTS CONSTRUCTED ON THE BRE UP TO 1989-90

SL. NO.	NAME	YEAR	IN BETWEEN MILEAGE	LENGTH (MILES)
1.	LALCHMAR	1971	27-30	2.88
2.	KARAIBARI	1971	37-38	1.20
3.	BELKA	1974	19-22	3.29
4.	HARIPUR	1974	25-28	2.32
5.	MAIZBARI	1974	87-89	1.35
6.	SIRAJGONJ STEAMER GHAT	1974	100-103	3.72
7.	BONBIRIA	1974	106-110	2.72
8.	MALIPARA	1976	124-127	3.20
9.	BELKA	1977	120-122	1.60
10.	FULCHARI	1977	49-50	0.80
11.	FULCHARI	1979-80	50-53	1.39
12.	KALAPANI	1980-81	48.50-53	3.06
13.	BHARATKHALI	1983-84	51-52	0.39
14.	KATLAMARI	1984-85	46-48	2.00
15.	BANGLABAZAR	1984-85	23.65-25	1.40
16.	KATLAMARI TO GAZARIA	1985-86	46-49	3.00
17.	KARAIBARI	1986-87	35.71-38.8	3.09
18.	GAZARIA TO KATLAMARI	1986-87	46.4-48.5	2.10
19.	PAINALGHAT	1987-88	9-11	2.00
20.	KATLAMARI	1987-88	47.8-49	1.20
21.	KATLAMARI TO KUKRAHAT	1988-89	46-49	3.00
22.	KARAIBARI	1989-90	37-39	1.00

Source : Project Index Map,Brahmaputra Right Flood Embankment Project,BWDB.

b) Cuts and Breaches

In the 1984 flood from July to September, there were several breaches in the embankment at a number of places throughout the length of 135.00 miles. In the study area covered by the RRA team, there were breaches between M-23.65 and M-25.00.

In the 1985 flood from July to October about 90 miles of the embankment out of 135 miles of BRE in the Upazilas of Kaunia, Pirgachha, Sundarganj, Fulchhari, Shaghatta, Sariakandi, Dhunat, Sirajganj, Belkuchi and Shahjadpur were more or less affected by natural breaches.

In 1986, about 100 miles of the embankment in the Upazilas of Kaunia, Pirgachha, Sundarganj, Fulchhari, Shaghatta, Sariakandi, Sirajganj and Belkuchi were more or less affected by natural breaches. In the area studied by the RRA team, the embankment from M-30.00 to M-38.00 was severely damaged by the flood of 1986 which finally resulted in the construction of a retired embankment.

In the 1987/1988 flood, there were no breaches and public cuts to the embankment though it was the highest flood for the decade. The area was however flooded in 1988 due to breaches upstream, in the Teesta embankment.

In 1990, there was no severe flood in the country but four public cuts were made along the entire embankment in 1990, of which three cuts were within the Kamarjani reach.

The first cut, about 31.00 metres long, was made between mileage M-30 to M-31 at Uttar Sripur. The second cut, about 25.00 metre long, was made between mileage M-36.00 to M-37.00 at Charkerghat.

The third cut, about 191.00 metres long, was made between mileage M-37.00 to M-39.00 at Katlamari. All these cuts were made by the local people to get rid of the local drainage congestion problem as water remained stagnant in these areas due to inadequacy of the drainage structures.

BWDB referred these to the police but nothing happened. There was no disagreement or controversy about the public cuts - those outside the BRE were not (said to be) disadvantaged by public cuts.

c) Condition of the Embankments

The overall condition of the embankment in the visited area was found to be vulnerable. The homeless people coming from the river side have taken shelter by constructing small huts in clusters by cutting the slopes and excavating the toe area of the embankment. This type of linear housing is significantly deteriorating the stability of the embankment. Rain cuts and ghogs were also found throughout the entire Kamarjani reach and indicated the urgent need for resectioning of the embankment for its greater durability and stability during the peak flow period. The embankment is severely damaged at the Phaliarghop/Raydasbari area, as shown in Figure 2.1, as clusters of huts were made on both sides of the embankment.

2.4.2. Irrigation Inlets/Drainage Outlets

In the Kamarjani reach only three drainage regulators are now in operative condition. These are at Uttar Sripur, at the Sarai River outlet at Natun Bazar and the Manas River outlet at Rasulpur.

The one vent regulator at Uttar Sripur drains out water from the villages of Matherhat, Sicha, Chandipur etc.. It is insufficient to drain out water rapidly as it is installed in a relatively higher elevation than the actual invert level to be set. The downstream side apron, wing wall and gate are severely damaged and need urgent repair for their stability. The six vent regulator at Natun Bazar across the Sarai spill channel is in good condition except that some minor preventive repair works are needed.

The largest regulator, the Manas Regulator (ie the twelve vent regulator at Rasulpur over the Manas River spill channel) drains out water from areas such as Kholahati; Ghagoa, Gaibandha, Phalia etc. in the upstream and western areas of the Project. The operating systems of three of the gates were found to be in defective condition and were being repaired by the BWDB. All these structures were constructed in accordance with design criteria but with minor modifications to keep up with the site requirement. The regulator was in serious risk of elimination in 1991 (see Section 2.8).

2.5 PROJECT SUCCESS IN ACHIEVING OBJECTIVES

Achievement of full project benefits is a function of several variables that must function well after the execution of the Project. Benefits can only be quantified if the criteria set forth in the planning and design concept are consistent with the execution and remain the same during the life span of the Project. The Project success and lack of success are detailed below in terms of positive and negative aspects.

2.5.1 Positive Aspects

- the primary objective of protecting the study area from the Brahmaputra floods has been achieved, except in the 1988 flood when a number of major breaches of embankment along the Teesta river to the north of Belka, caused inundation;

- the BRE has improved living conditions and minimized damage to lives and property during the peak flow period of the year;

- the embankment is strong enough to withstand the normal floods and to safe guard the protected area although the lack of maintenance has deteriorated its quality. However, linear housing must be discouraged in this regard;

- despite the construction of retired embankments in a number of places, the BRE has generated positive benefits in the form of roads for transport and communication and it has also been linked with internal roads;

- the BRE has generated a considerable positive benefit as the embankment is commonly used as a flood shelter for human and animal populations;

- the BRE has proved to be a barrier to stop sand deposition, which has helped rice production;

- the protection of the Project area from the Brahmaputra river floods has created preconditions for tree plantation.

2.5.2 Negative Aspects

a) Impact on the Embankment from riverside which subsequently affects the Project area

i. River Bank Erosion: The river bank of the Brahmaputra is significantly unstable causing the subsequent loss of cultivable area by construction of embankments along new alignments.

ii. Breach of Embankment: The embankment is adversely affected by the wave action of the river Brahmaputra, which causes the embankment to breach at the weaker sections. Erosion of the embankment on a particular length leads to the construction of a new retired embankment.

iii. Recurrent Retirement of Embankment: The retirement of embankments is a very common phenomenon for the BRE Project, and has caused a loss of 314 ha of land in the Kamarjani reach since 1975. Table 2.1 shows the retirements for the period from 1971-1990.

b) Impact on the embankment from country side and subsequently to the Project area

i. Along the Kamarjani reach there were three public cuts in 1990 as the water level inside the Project was about 5 feet higher than the river side. Water accumulated at the areas where there were previously drainage regulators.This caused severe damage to crops.

ii. The CARE roads, which are constructed without any drainage provision, create a major local drainage congestion problem in the Project area. It was observed that CARE has made an intensive effort for this particular area to construct 124 km. of kutcha roads over the last three years (1988/89 to 1990/91), in Gaibandha Upazila alone allocating 1233.34 Metric Tons of wheat.

c) Condition of the Embankment

i. Poor Maintenance:The lack of maintenance has led to severe damage to the embankment.

ii. Development of Rain Cuts and Ghogs: Rain cuts and ghogs reduce the embankment stability and thereby threaten human lives and crops in the Project area.

iii. Lack of Compaction: The retired embankments were constructed without any compaction, causing the loose soil to be eroded by the smallest shower of rain. This causes the embankment to be damaged which in turn damages the crops inside the Project area.

iv. Inadequate Capacity of Regulators: In the Kamarjani reach, there were originally two more regulators, Karaibari I and Karaibari II, in addition to the Uttar Sripur, Sarai and Manas Regulators. After retirement in 1986 these two regulators were abandoned. The drainage congestion problem in the monsoon was therefore aggravated through the reduction of drainage outlets in the retired embankments and through silting up of khals and rivers (e.g. the canal from Matherhat bridge down to Sarai sluice gate near Kamarjani Bazar). In years of heavy continuous rains, water congestion stays for weeks and causes damage to Aman production.

v. Linear Housing Development: The linear housing development along the embankment has damaged the embankment to a great extent by excavation of side slopes and hindering O & M activities.

d) Increased Water Levels

Poldering inside the Project area has raised water levels as the water way is confined and water cannot flow through the Sonali Embankment Project area. A surface run off of about 61,3529,532 cft. could (a depth of 1 foot) be spread over this area which used to substantially reduce the depth of water along the BRE.

e) Siltation

Siltation of the existing drainage channels and of low lying areas such as khals and rivers has decreased the drainage capacity causing damage to crops.

f) Reduction of Benefited Area

The benefited area is decreasing steadily due to subsequent retirements of the embankment which are undesirable from the economic view point.

2.6 RELATED OBSERVATIONS AND CONCLUSIONS

i. River erosion has led to unauthorised settlement of the affected people on the BRE. Housing and banana plantations along the embankment have not only undermined the strength of the embankment but also hindered normal traffic and maintenance activities in many reaches of the embankment.

ii. The embankment reaches studied by this RRA are very poorly maintained and supervised. There was no O & M Committee, although this was proposed in the Project Proforma and other project documents.

iii. There was no consultation between the beneficiaries and the executing agencies at any stage of planning and design or implementation of the Project.

iv. There is no public participation in the repair and maintenance of the embankment or structures, except that when people are affected by serious drainage congestion, they organize themselves to make public cuts in technically appropriate locations.

v. The indiscriminate construction of kutcha village roads under FFW programmes with virtually no drainage provisions or culverts leads to localised drainage congestion and sand washing occurs during heavy rainfall.

vi. The intervention of polder construction (e.g. Sonali Polder) within a polder area has aggravated the drainage problem significantly.

2.7 RECOMMENDATIONS

i. To understand the river erosion behaviour, rigorous river morphological studies should be executed to permit identification of measures to prevent the erosion which is causing the series of retirements to the embankment.

ii. Linear housing construction must be restrained in order to prevent deterioration of the embankment.

iii. The landless settlers could be rehabilitated within the boundary of the land acquired by BWDB for the embankment under certain rules and regulations such as:

- earth raising for homesteads would be done by beneficiaries under the guidance of BWDB.
- O & M of the relevant reaches of embankment would be done by the beneficiaries.
- social forestry along the embankment could be done by the beneficiaries.

iv. The existing drainage channels and rivers need to be re-excavated to augment their capacity.

v. Dredging of the Brahmaputra river could be a measure to divert the flow channel away from the embankment.

vi. The internal communication network should be improved by proper coordination of the executing agency with BWDB.

vii. The public cuts and subsequent repairs to the embankment may appear to be low cost but in spite of this the newly repaired parts can never be like the consolidated part of the embankment which was cut.

2.8 ADDITIONAL NOTES ON MANAS REGULATOR

The following points emerged through the return visit to BRE, Kamarjani Reach on 9th September, 1991.

2.8.1 Embankment Retirements and the Manas Regulator

There have been numerous embankment retirements just north of the Manas Regulator (five since 1978 between mileage 40 and mileage 35). The Manas Regulator was originally protected by a 3100 foot long guide embankment on the river side which extended East to the original main river bank. At the beginning of July, according to the BWDB Section Officer, the river side guide embankment had been cut to 1200 feet. The Gaibandha BWDB office had received a letter from FAP 1, indicating that the Manas Regulator appeared from aerial reconnaissance to be at risk of failure "within five years". This letter recorded the guide embankment as being reduced to 856 feet. At the time of the visit the river side guide embankment had been reduced to 500 feet, and was rapidly eroding. As it has lost 700 feet in 2 months the chances of it surviving another five years appear meagre. The Gaibandha office of BWDB has been requested by the Director Planning to prepare estimates of the cost of replacing the regulator plus construction of a new retired embankment, and of the benefits associated with this.

2.8.2 Comments on the Embankment Retirement

Under the present rate of erosion the chance of survival of the Manas regulator even for a year is very doubtful. The situation may be tackled in two ways:

- protection of the existing regulator and the embankment with necessary river training and bank protection works; and

- replacement of the regulator to a new location and construction of a retired embankment (as proposed by Director Planning BWDB).

The first proposal, if applicable, may cause financial problems but the entire benefitted area will remain free from flood hazards.

The second proposal may create a series of adversities, as follows:

- financial problem for the construction of a very large regulator (12 vents) and the construction of a new retired embankment;

- valuable agricultural land will be used for embankment;

- time factor - if the existing Manas regulator/retired embankment is washed away before the completion of the proposed regulator and retired embankment, the entire benefited area will face the threat of floods;

- a large portion of the present benefited area will be permanently changed to disbenefited area as it will be kept outside the proposed retired embankment;

- the past experience of frequent erosion of regulators/ embankment in this region indicates the possibility of further replacement of both the proposed retired embankment and the regulator in the near future.

As such, a team of experts should thoroughly study the situation and carefully examine the proposals before taking any final decision.

2.8.3 Operation of the Regulator

The regulator is operated for drainage only by a khalashi who has been there for over twenty years. During the rainy season it is opened whenever the country side water level exceeds the river side water level - generally from the first rains to around the end of October. It is then closed until the start of the next rains, to retain water. At the time of the visit the vents were all open and water was draining out, with a head of about 4 inches.

Just north of the regulator it was observed that there had been a sequence of embankment retirements in Raidasbari village. People were still living on the remaining spurs of the original BRE and the second retirement, but these were being extremely rapidly eroded, with houses moving almost daily from the second retirement (of which very little was left) to the present embankment. However the present embankment itself is seriously threatened to be eroded in the near future. Villagers whose original homes had been half a mile away to the east, had already moved from the original BRE to the second retirement, and were expected to move again within 24 hours.

It was observed that if the present retired embankment fails there will be heavy sand deposits on the currently cultivated Aman area and the present crop will be lost. The failure of the embankment at Raidasbari would allow the river flow to attack the Manas Regulator from the country side, rendering it useless for protection of all areas to the east of Gaibandha.

3 INSTITUTIONAL ASSESSMENT

3.1 PROJECT INITIATION

Against a background of severe damage caused to the embankment and structures completed in 1968, BWDB initiated the Rehabilitation Project of the BRE in 1977 with the assistance of NEDECO. The World Bank appraised the scheme in 1977 and financed the Project together with other two projects - the Chenchuri Beel (CCB) and Kolabashukhali (KBK) projects under IDA credit No 864 BD. Accoroding to the PCR supplied by the SE, BWDB, the rehabilitation Project was started in 1974 and completed in 1985.

3.2 INSTITUTIONAL ARRANGEMENTS

The Kamarjani reach of the BRE falls under the jurisdiction of the O&M sub-division 1 of Gaibandha division.

The BWDB officer directly in charge of the embankment in Kamarjani reach is the Sub-Divisional Engineer (SDE). He may delegate his authority to the Sectional Officer (SO). The next immediate charge is with the Work Assistant who is authorised to operate the regulator. Each regulator has one Khalashi for guarding and taking care of regulator. Actually the Khalashis operate the regulators with the cooperation of the local people.

Maintenance of the earthworks of the embankment is carried out by BWDB. The organisation of this work is such that BWDB contracts local UP members to enrol labourers for the earth work, with supervision by Work Assistants and Section Officers.

3.3 INSTITUTIONAL PERFORMANCE

i. The embankment reach studied by this RRA is very poorly maintained and supervised. There was no O&M committee, although this was proposed in the PP.

ii. There was no public participation in the repair and maintenance of the embankment or structures, except that people affected by serious drainage congestion organize themselves to make public cuts in technically appropriate locations.

iii. There was no consultation between the beneficiaries and the agencies at any stage of planning or implementation of the Project.

iv. In 1990 four public cuts were reported by BWDB and by local informants. These cuts were made for removing drainage congestion. The repair works on public cuts were done by BWDB in time.

v. The level of repair and maintenance work depends on the availability of wheat under the FFW programme. According to BWDB officials the O&M budget for this section has been as inadequate as for other sections of the BRE.

3.4 RECOMMENDATIONS

i. There should be local committees including representatives of the benefitted mouzas and BWDB for the maintenance of the embankment and operation of the regulators.

ii. There should be a formal institutional framework for liaison between BWDB, District, Upazila and Union Parishad representatives and local farmers representatives.

iii. In order that the linear housing does not damage the embankment, the landless settlers can be rehabilitated within the boundary of the land acquired by BWDB for the embankment under rules and regulations such as:

- additions to the embankment cross - sections for homesteads could be done by beneficiaries under the guidance of BWDB (see Chapter 2);
- O&M of the relevant reaches of the embankment will be done by the beneficiaries;
- social forestry along the embankment will be done by the beneficiaries.

4 AGRICULTURAL IMPACT

4.1 PRE-PROJECT SITUATION

4.1.1 Land Type

The Project area has a gentle slope of about 1:7500 from the north (Sripur Union) to the south (Kanchipara Union). The land area was classified into three broad categories as high land, medium land and low land, and the distribution of land by these categories was roughly estimated by the Consultants as follows:

High land (occasional flood of 1-2 ft)	-	20 per cent
Medium land (3-6 ft flooding)	-	50 per cent
Low land (>6 ft flooding)	-	30 per cent

The land use pattern of the Project area is presented in Table 4.1. About 88 per cent of the area was under crop cultivation. The agricultural land was divided into innumerable small plots, heterogeneous in shape and size. However, the land was sufficiently fertile due to silt deposition to grow any kind of crops. In some areas, the land surface was irregular due to presence of pockets and depressions. Parts of the agricultural lands were lost every year due to bank erosion of the river Brahmaputra. The erosion pattern, flooding characteristics and sedimentation process of the river influenced the composition of the agricultural land of the area visited.

4.1.2 Flood Condition and Drainage

About 30 per cent of the land area used to receive about 6 ft of flood water during the monsoon season (July-October). About 50 per cent of the area was flooded by 3-5 feet water during monsoon time. Out of the remaining 20 per cent of land, about 10 per cent land remained almost flood free. This mainly consisted of homesteads, markets, schools, roads and towns. The remaining 10 per cent of the land was occupied by fruit trees, bamboo bushes and growing some spices and vegetable crops.

The local people advised that, during the flood season, the river Brahmaputra overflowed the bank and inundated the large portion of the area (approx. 80 per cent). The flood water normally came in July and gradually (but within a short time) receded in September/October. The flood water used to drain out easily through the Manas, Sarai and Ghagat rivers and did not stand for a long time and cause any serious damage to the growing crops. However, crop damage used to occur due to the sudden inflow of river water, and the extent of damage to the major crops - Aus, Aman, Jute and Vegetables - might have been up to 25 per cent (as reported by the local people). The intensity of crop damage was greater along the river side and less towards the interior.

Small rivers namely the Manas and Ghagat, flow through the Project area. The monsoon rain water of the area of Kholahati Union as well as its surrounding areas moved towards the south-east and accumulated in the Hatia Beel, from where the water easily drained out through the above mentioned rivers. Therefore, in the past, no serious water congestion occurred to cause significant damage to crops.

Table 4.1 : Land Use Pattern of the Project area of BRE Kamarjani Reach.

Landuse	Pre-Project [1]		Post-Project[2]	
	Area (ha)	%	Area (ha)	%
Net cropped area	9165	88	8783	87.0
Homestead	729	7	611	6.0
Road, market, school, etc.	156	1.5	192	1.9
Fallow land	52	0.5	30	0.3
Other use (orchards, bamboo bush, etc.)	312	3	484	4.8
Total	10414	100	10100	100

Source : Consultants Estimates through interview, 1991.

Now more time is needed to drain out the rain water from the said area through the one-vent regulator of Uttar Sripur, and as a result water congestion occurs and causes damage to crops. The situation was so hazardous in 1990 that the people cut the embankment near Chapra village of Uttar Sripur. Under a similar water congestion situation, the local people also cut the embankment at another three places as mentioned in Chapter 2.

4.1.3 Crops and Cropping Pattern

The estimated net cropped acreages in the Project area are 9165 ha. and 8783 ha. in the pre-Project and post-Project situations respectively (Table 4.1). The majority of the people of the Project area are dependent directly or indirectly on agriculture for their livelihood. As many as 19 crops were grown in the area. Broadcast Aus, Broadcast Aman, Mixed B. Aus-B. Aman, T. Aman (local) and Jute were the most important crops both in terms of acreage and production in the pre-Project situation. Broadcast Aus and Jute were grown on non-flooded and moderately flooded lands and covered about 67 per cent of the total cropped area (Table 4.2). B. Aus and Jute were sown in March and harvested in June (Fig. 4.1). T. Aman (Local), a rainfed crop, was transplanted in June/July and harvested in November/December and occupied about 58 per cent of land. Aman paddy was also sown as broadcast in March either as a sole crop or as a mixed crop with B. Aus. In this case, B. Aus was harvested in June allowing the Aman to grow normally and be harvested in November/December. Mixed B. Aus-Aman covered about 12 per cent of the land. Jute, an

[1] Pre-project period refers to the period preceding 1974 when the major rehabilitation work started.

[2] Post-project period refers to the period following 1985 when the construction of the rehabilitation phase was completed.

important cash crop, was sown in March and harvested in June/July, and covered about 35 per cent of the area. Besides paddy and Jute, pulses, oilseeds, wheat, and various kinds of summer and winter vegetables were grown. For identical land types, crops grown and cropping patterns over the area were almost similar. Cropping patterns followed by the farmers in some low lying areas were dependent mainly on flood and drainage conditions. No HYV crops were grown in the area in the pre-Project situation.

4.1.4 Inputs Used

In the pre-Project situation, fertilizers and agro-chemicals were not at all used for growing crops (Table 4.2). However, farmers applied cow dung in the soil before the final land preparation at the rate of 100-150 mds./acre or 9-14 tons/ha..

4.1.5 Crop Management

In the pre-Project period, farmers generally practised a low labour input management system in growing paddy and other crops. Land preparation was done by country plough. Ploughing and weeding were done 2-5 times depending on the nature of the crops (Table 4.2). Less ploughing, weeding and labour (manday per ha.) were required for pulses and oilseed crops, while more was required for jute, bittergourd and palwal. For sugarcane, a crop of eleven months, the labour requirement was more than that of other crops. Earthing up was done for prevention of water logging and soil moisture preservation in sugarcane.

4.1.6 Yield

The yield of different crops was lower than at present, mainly due to use of local varieties, limited use of fertilizers, following of low labour input management system and unfavourable climatic conditions. The yield of Broadcast local Aus was on an average only 1.1 ton/ha.(Table 4.2). The average yields of B. Aman and T. Aman were 1.28 and 1.74 tons/ha. respectively. The average yield of jute was 1.1 ton/ha. It was estimated that higher average yield (1.65 tons/ha.) could be obtained simply by following the proper time of sowing and better management practices. Millet, a drought resistant crop, produced an average yield of 0.83 tons/ha. Brinjal, bittergourd and palwal were important vegetables, covered about 3 per cent of the area and contributed significantly to total production.

4.2 OBJECTIVES OF THE PROJECT

The objective of the Project was to build a flood free and well drained environment where accelerated agricultural activity would be possible to increase crop production. The Project provided flood control permitting a shift from long stemmed paddy to transplanted varieties and thereby promoted higher yields and production levels.

The Project was also intended to facilitate reduction in flooding depths and protection of river banks through prevention of erosion caused by the river Brahmaputra.

Table 4.2 : Inputs, Area and Production of Crops Pre-Project.

Crops	Area (ha)	Yield ton/ha	Production (ton)	No. of Plough	No. of weeding	Labour used man day/ha
B. Aus L	3294	1.10	3623	3	2	74
B. Aman L	206	1.28	264	3	3	87
B.Aus-Aman Mixed	1235	1.65	2038	3	3	87
T. Aman L.	5971	1.74	10390	3	3	124
Jute	3603	1.10	3963	4	3	148
Wheat	113	0.92	104	3	2	37
Millets	103	0.83	86	3	2	49
Pulses	391	0.73	285	2	1	25
Oilseeds	319	0.73	233	2	1	37
W. Chilli	82	0.92	75	3	2	74
S.Chilli	82	0.92	75	3	2	74
S.Vegetable	10	1.10	11	3	2	74
Palwal	124	9.45	1172	5	4	250
Potato	52	9.63	501	3	3	185
S. Potato	31	10.09	313	3	2	74
Bitter-gourd	82	5.50	451	3	3	250
Brinjal	103	5.32	548	3	3	99
Sugarcane	154	41.17	6340	3	3	272
Others	402	1.83	736	3	3	87
Total	16550	-	-	2-5	1-4	-

Source : Consultant's Estimates through interview, 1991.

4.3 SOURCES OF DATA

Sources of data collection were as follows :

- interview of officials including Upazila Agricultural Officers, Deputy Director of Agriculture (Gaibandha) and BWDB Engineers to learn the pre-Project conditions and the impact of the Project and the conditions within and around the Project area;
- interview of farmers in different parts of the Project area, namely Purba-Komornoi, Dakkhin Ghagoa, Analertori, Taltala, Dakkhin Gidari, Raidashbari, Kismat Malibari, Goghat, Satarkandi, Kellabari, Chapra and Kamarjani. Farmers were interviewed in groups and also individually;
- interview with traders at several market places including Kamarjani, Dariapur, Rasulpur and Kholahati to know their opinions regarding pre- and post-project condition in the area;
- direct personal observation of land type, crops grown, varieties of crops grown, inputs used and prevalence of pests and diseases;
- project documents including Project Proposals, Feasibility Report, Evaluation Study Report and Project Completion Report;
- official publications including Bangladesh Statistical Year Book and BWDB reports.

4.4 THE VALUE AND FEASIBILITY OF THE PROJECT OBJECTIVE

The embankment has given protection to the area from monsoon flooding and led to a reduction in flooding depths facilitating more intensive crop cultivation, especially paddy cultivation in the monsoon season. Total paddy production in the post-project monsoon season is estimated to be about 28 per cent higher than in the pre-Project situation.

Aman rice production on high and medium high land areas has been increased because B. Aman has been replaced by T. Aman giving higher yields, and a proportion of T. Aman land is covered by HYVs as well. In medium low land, B. Aman has also been replaced by T. Aman but in most years, this crop is largely damaged due to monsoon drainage congestion. Although the Project has yet to make optimum production facilities available to the Project area, the area protected by the embankment provides some benefits. Flood protection has allowed more land to be brought under crop cultivation, thus intensifying production of paddy and other crops during the monsoon season. Farmers are showing interest in growing HYV Aus/Boro if irrigation is available, as well as T. Aman HYV, if assured of safe harvest (Fig. 4.1). Farmers are also using fertilizers and other inputs to increase crop production. However, the yield of T. Aman (HYV) is far less than 2.77 tons/ha as expected in the PP (Annexure-8). This is due to the fact that in most years about one-third of the T. Aman crop is damaged due to drainage congestion or embankment breaches/flooding. However the BRE has proved to be a barrier to sand deposition, which has helped rice production.

The protection of high and medium high lands from normal flooding has provided opportunities for intensifying vegetable production, which is consumed locally and also transported elsewhere on a commercial basis (Tables 4.2 and 4.3). Homeyard vegetable production by women has also increased, especially in areas where NGOs have undertaken programmes.

4.5 PROJECT SUCCESS IN MEETING THE OBJECTIVES

The objective of the Project was to protect the area from flood water, thereby increasing agricultural production to support the plan of the Government of Bangladesh for increasing food production through agricultural development. Due to construction of the embankment the flood level has decreased and the land type has changed bringing a change in crop cultivation and cropping patterns (Tables 4.2 and 4.3, and Fig. 4.1). Cultivation of high yielding paddy varieties has increased substantially. In some areas, three crops are grown (winter vegetables/Rabi crops-Jute/HYV paddy-T. Aman HYV). This has increased cropping intensity from 188 per cent to 199 per cent.

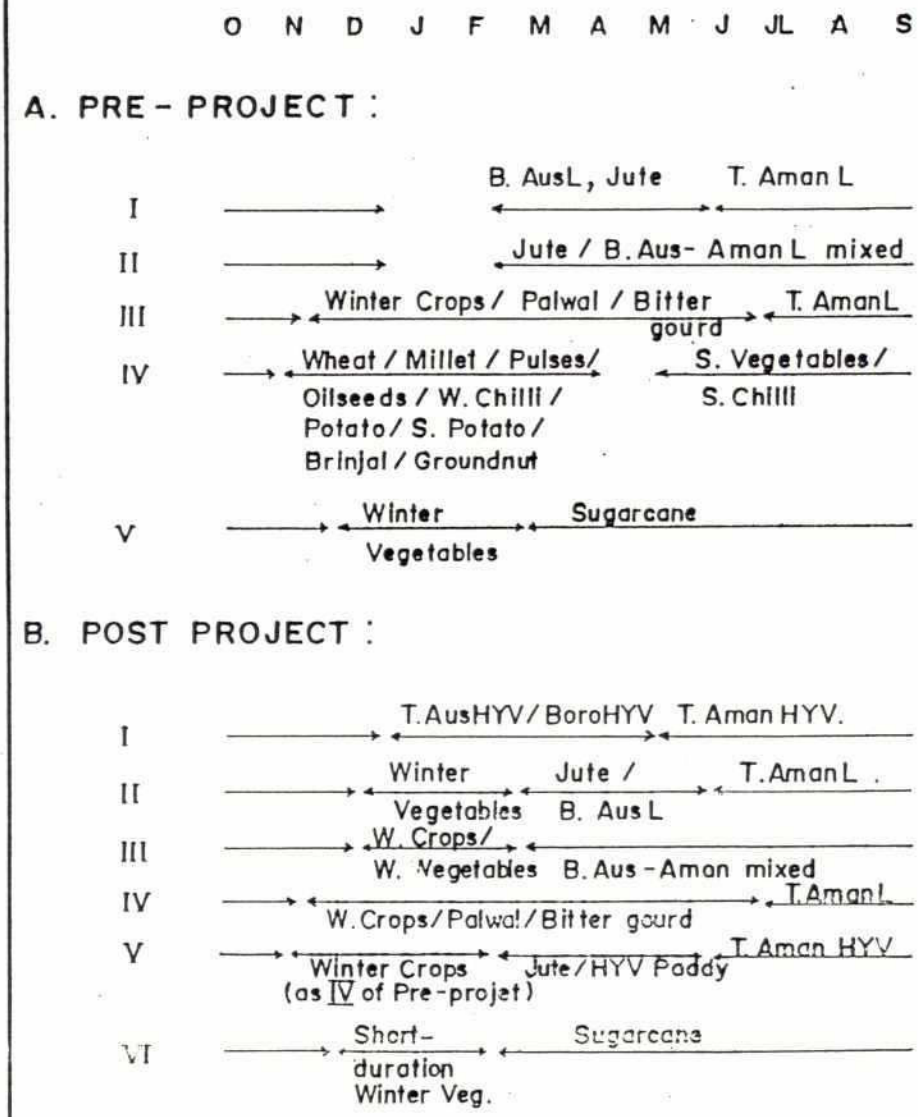
One significant change in cropping pattern is that HYV Boro cultivation has taken place entirely in the post-project area. Table 4.3 shows that 17066 tons of HYV Boro paddy accounts for about 51 percent of total paddy production in the post-project period. Since this crop is grown in the normally flood free pre-monsoon season, the changes in output due to Boro rice is independent of BRE. This is also corroborated by the Project Proforma, which assumed a constant area of 4047 ha under Boro rice cultivation with or without the Project (PP 1985, Annexure 8).

The major impact of the Project is confined to the main monsoon season rice production, i.e. the production of Aman crops. The protection against floods by the BRE has led to substantial shift of acreage from B. Aman or mixed B. Aus-B. Aman and local T. Aman to HYV T. Aman.

This has caused an increase in monsoon rice production from 12692 tons on 7412 ha in the pre-Project period to 16259 tons on 7185 ha in the post-Project period, an output increase of about 28 per cent (Tables 4.2 and 4.3).

Due to introduction of the HYVs, yield per hectare has also increased, especially in the Aus, Aman, Palwal and Bittergourd crops (Tables 4.2 and 4.3). Since high yielding varieties are grown, rates of application of fertilizers and intensity of crop management practices have increased, and, due to this, total crop production has increased.

Fig . 4.1 Pre - and Post- Project Cropping Patterns



CROPPING PATTERNS IN RETIRED EMBANKMENT.
Similar to No. I and V of the Post- Project

Table 4.3 :Inputs, Area and Production of Crops Post-Project.

Crops	Area (ha)	Yield ton/ha	Production (ton)	Urea	TSP	MP	No. of Plough	No. of weeding	Labour used man day/ha
B. Aus	299	1.20	359	30	15	9	3	2	119
T.Aus HYV/ Boro HYV	4890	3.49	17066	60	60	30	3	3	148
B.Aus-Aman Mixed	100	1.74	174	30	15	9	3	3	124
T. Aman L.	1198	1.83	2192	18	-	-	3	3	119
T. Aman HYV	5887	2.36 (3.58)*	13893 (21076)*	70	40	30	3	3	129
Jute	2594	1.28	3320	18	30	9	4	3	148
Wheat	300	1.10	330	24	30	9	3	2	119
Millets	100	0.92	92	5	3	2	3	2	49
Pulses	180	0.83	149	-	-	-	2	1	25
Oilseeds	120	0.83	100	15	30	9	2	1	25
W. Chilli	80	1.01	81	5	3	2	3	3	74
S. Vegetables	100	1.20	120	30	15	5	3	3	74
S. Chilli	80	1.10	88	5	3	2	3	2	74
Palwal	200	9.72	1944	30	10	5	5	4	250
Potato	30	10.00	300	30	15	10	3	3	198
S. Potato	10	10.36	104	5	3	2	3	2	74
Bitter-gourd	150	5.69	854	30	10	5	3	3	87
Brinjal	180	5.41	974	30	-	-	3	3	99
Sugarcane	40	40.53	1621	30	10	5	3	3	272
Others	708	1.93	1366	30	10	5	3	3	87
Total	17445								

Source : Consultant's Estimates through interview, 1991.

* Figures in parentheses indicate yields/output if there is no damage. In most years about one-third of crop is damaged due to embankment breaches/flooding or drainage congestion.

4.6 NEGATIVE EFFECTS

i. The BRE has aggravated drainage congestion problems in the monsoon through the reduction of drainage provision/outlets in the retired embankment and through silting up of khals and rivers (e.g. the canal from Matherhat bridge down to Sarai sluice gate near Kamarjani Bazar). In years of heavy and continuous rains, water congestion stays for weeks and causes damage to crop production as follows:

- T. Aman is submerged and damaged;
- jute is submerged and production is affected both quantitatively and qualitatively;
- sometimes, water congestion due to early monsoon rains damages ripening HYV Aus/Boro crops.

ii. Production of pulses and oilseeds, especially mustard, has decreased as a result of delayed drainage of congested water in low and medium low lands.

iii. The local peoples' perception is that the BRE has caused a decline in soil fertility in the Project area due to prevention of deposition of alluvial silts, which used to be carried by flood water before the construction of the embankment. The discontinuation of silt deposition may have adverse effects on the availability of phosphorus and potash in the soil. However, because clean rain water congestion has been aggravated by the BRE, this has favoured the growth of blue-green algae, improving nitrogen in the soil (Rogers etal. 1989, p.34).

4.7 RECOMMENDATIONS

The soil of the area is good and fertile and suitable for growing most crops. With provision of drainage and irrigation, T. Aus HYV/Boro HYV followed by T. Aman HYV could be grown on about 60 per cent of the land to get higher production. For the drainage of internal surface run off during the monsoon, existing canals/channels should be developed into an efficient drainage system. Balanced use of fertilizers and modern management of all soils would be necessary to increase the yield of crops.

Table 4.4 : Miscellaneous Information on Seven Villages of the Project area.

Name of Village	% of Landless People	% of people have own plough	% of people who hired plough	Rate of hiring per plough Tk.	Name of Weeds available (local names)
Komornoi	5	12	88	40	Dubba, Moyna, Chaicha, Sunsia
Taltala	5	40	60	30	Dubba, Gobra, Chaicha
Gidari	5	40	60	25	Dubba, Kella, Chaicha
Roydashpur	75*	20	80	30	Moyna, Gobra, Chaicha, Moshma
Malibari	25	25	75	25	Gobra, Chaicha, Amrul
Satarkandi	40*	25	75	25	Dubba, Moyna, Gobra, Kella
Chapra	25	25	75	35	Dubba, Moyna, Gobra, Chaicha, Andua
Average	27.5	32.4	73	30	

* due to serious river erosion.

Source: Consultant's Estimates through interview.

5 IMPACT ON LIVESTOCK

5.1 PRE-PROJECT SITUATION

Agriculture was the main occupation of the people in the Project area and about 80 per cent of the total households were engaged in agriculture. As in other parts of the country, livestock was an integral part of the farming system in the Project area. Livestock were kept as a supporting activity to crop production and as a secondary source of income. In general, each household had a small number of livestock. The most important types of livestock in the area were cattle, goats, chickens and ducks. Buffaloes, horses and sheep were very rare.

According to the Agriculture and Livestock Census of 1983/84, about 51 per cent of total households and 70 per cent of all farm households had cattle. However, 82 per cent of total households and 89 per cent of all farm households had poultry (Table 5.1). Cattle were the most important livestock in the Project area. Bullocks were kept mainly for draft purposes and cows for production of milk and calves. Except under special circumstances cows were not used for draft purposes. In fact, there was no shortage of draft power in the area under the prevailing cropping practices.

Paddy straw, pulse straw and grasses were the main feedstuffs for cattle. However, a small quantity of oilcakes, rice bran and salt were fed with the straw by rich farmers. B. Aus and B. Aman were the main sources of paddy straw. Roadside grasses and weeds from crop fields and fallow land were the main sources of green feedstuffs. However, sugarcane tops and pulses, which were grown in the area, were also fed to the cattle.

Goats, the second most important ruminant in the area, were kept by all types of households. About 54 per cent of all farm households possessed goats (Table 5.2). Sheep were very rare in the area. Most of the households kept one or two goats as scavenging animals. No special attention was given to their feeding and management.

Chickens were quite common in the Project area. About 89 per cent of all farm households possessed chickens. However, ducks were kept mostly in the low lying areas, where more natural feeds were available. Both chickens and ducks were kept in small numbers as scavenging birds. Sometimes a handful of grains or waste food was given to the birds. Diseases like Ranikhet (Newcastle disease) and fowl cholera were quite common and took a heavy toll every year.

5.2 OBJECTIVES

The main objective of the Project was to protect the land from flood water intrusion and thereby save lives, properties and livestock from flood damage and make the land suitable for cultivation of T. Aman in place of B. Aman. However, the possible impact of the Project on livestock was overlooked. In general, more and more fallow lands have been brought under cultivation through the FCD/I projects which causes shortage of animal feeds and thereby affects the health and productivity of the animals. The Project should have included an objective to improve availability of feed resources for livestock in the Project area.

Table 5.1: Cattle Population in Selected Upazilas and its Distribution Based on Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Gaibandha Sadar Upazila					
No. of Households	23,933	6,441	813	31,187	15,799
% of Households	50.9	13.7	1.7	66.4	33.6
Household with Cattle	14,759	6,129	793	21,681	2,448
% of Household with Cattle	61.7	95.2	97.5	69.5	15.5
No. of Cattle	36,141	25,603	5,743	67,487	4,110
No. of cattle per household	1.51	3.96	7.06	2.16	0.26
Net cultivable area (ac) per household	0.85	3.60	9.82	1.6	-
Fulchari Upazila					
No. of Households	9,609	4,032	811	14,452	5,683
% of Households	47.7	20.0	4.0	71.8	28.2
Household with Cattle	5,964	3,827	798	10,589	890
% of Household with cattle	62.1	94.9	98.4	73.3	15.7
No. of Cattle	15,297	16,855	6,613	38,765	1,594
No. of cattle per household	1.59	4.18	8.15	2.68	0.28
Net cultivable area (ac) per household	0.92	3.71	11.72	2.30	-
Sundarganj Upazila					
No. of Households	28,769	8,908	1,152	38,829	16,635
% of Households	51.9	16.1	2.1	70.0	30.0
Household with Cattle	18,250	8,499	1,122	27,871	2,682
% of Household with Cattle	63.4	95.4	97.4	71.8	16.1
No. of cattle	46,117	38,489	8,295	92,901	4,426
No. of cattle per household	1.6	4.32	7.20	2.39	0.27
Net cultivable area (ac) per household	0.85	3.63	9.68	1.75	-

Source : BBS Census of Agriculture and Livestock 1983/84, Zila Series - Gaibandha.

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Table 5.2: Goats, Sheep and Poultry Population in Selected Upazilas and their Distribution Based on Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Gaibandha Sadar Upazila					
No. of Households	23,933	6,441	813	31,187	15,799
Households with goats+sheep	12,014	4,108	592	16,714	5,076
% of H. hold with goats+sheep	50.2	63.8	72.8	53.6	32.1
No. of goats+sheep	27,772	12,529	2,425	42,726	9,810
No. of goats+sheep /H. holds	1.16	1.95	2.98	1.37	0.62
Household with Poultry	20,840	6,070	778	27,688	10,621
% of H. hold with Poultry	87.1	94.2	95.7	88.8	67.7
No. of Poultry	1,36,144	62,457	11,880	2,10,501	48,693
No. Poultry/household	5.69	9.70	14.61	6.75	3.08
Fulchari Upazila					
No. of Households	9,609	4,032	811	14,452	5,683
Households with goats+sheep	5,811	2,960	637	9,408	2,105
% of H. hold with goats+sheep	60.5	73.4	78.5	65.1	37.0
No. of goats+sheep	15,775	10,722	3,429	29,926	4,453
No. of goats+sheep /H. holds	1.64	2.66	4.23	2.07	0.78
Household with Poultry	8,578	3,811	790	13,179	4,198
% of H. hold with Poultry	89.9	94.5	97.4	91.2	73.9
No. of Poultry	57,585	38,497	12,009	1,08,091	20,697
No. Poultry/household	5.99	9.55	14.80	7.48	3.64
Sundarganj Upazila					
No. of Households	28,769	8,908	1,152	38,829	16,635
Households with goats+sheep	16,514	6,263	849	23,626	6,117
% of H. hold with goats+sheep	57.4	70.3	73.7	60.8	36.8
No. of goats+sheep	38,227	19,614	3,540	61,381	11,381
No. of goats+sheep /H. holds	1.33	2.20	3.07	1.58	0.68
Household with Poultry	24,571	8,238	1,080	33,889	10,814
% of H. hold with Poultry	85.4	92.4	93.8	87.3	65.0
No. of Poultry	1,50,241	80,088	15,430	2,45,759	45,084
No. Poultry/household	5.22	8.99	13.39	6.33	2.71

Source : BBS Census of Agriculture and Livestock 1983/84, Zila Series - Gaibandha.

5.3 SOURCES OF DATA

For rapid rural appraisal of the Project extensive field visits were made in the study area. During the field visits data were collected from farmers and knowledgeable persons of the area, including school teachers and village leaders, through individual and group interviews. Information was also collected from the District and Upazila Officials including the Livestock Officer, Statistical Officer, Agricultural Officer and UNO, as well as BWDB Officials. Moreover, direct observations of livestock, their management practices and performance in the Project area were also recorded.

5.4 PROJECT IMPACTS

5.4.1 Positive Impacts

Construction of the embankment and drainage structures have led to a change in water regime and eco-system. This has led to intensified use of fallow and cultivable land, and change in cropping pattern and cropping intensity. As a result feed resources as well as the production system of livestock have been affected. The following are the major findings, not all of which may be the direct impact of the Project:

i The BRE has effectively protected the Project area from flood water intrusion coming from the rivers Teesta and Brahmaputra and has thereby saved livestock and property from flood damage. However, there are a number of breaches near Belka, which were caused by the 1988 flood. Flood water from the river Teesta now enters into the Project benefited area through these breaches and causes damage to crops and property.

ii The BRE has been acting as a temporary shelter for people, livestock and property during severe floods like those of 1988 or heavy drainage congestion caused by excessive rainfall as in 1990.

iii There are some indications that chicken and duck populations in the Project area have increased by around 20% and 10% respectively. This increase in poultry population may be due to better health protection and greater availability of poultry feeds, particularly insects and food grains, in the homestead. Farmers indicated that women vaccinators come to their villages and vaccinate their birds at regular intervals.

iv Farmers and livestock officials indicated that the number of goats in the Project area has increased by 5-10%. However, the sheep population appears to be more or less the same as before. The increase in goat population may be due to a number of factors, namely:

- increased availability of grasses on the road sides and embankment slopes favours goat rearing;

- maintenance of goats is easier than that of cattle. No special attention is required for goat rearing;

Table 5.3: Estimated Straw Production and Availability before the Project.

Crop	Before the Project							
	Area (Ac)	Yield/ acre (mds)	Total production (000 mds)	Grain* to straw production	Gross straw production (000 mds)	Approx. loss due to rain	Other losses	available straw for cattle (000 mds)
B. Aus	8,235	12	148.2	1:1.5	222.3	50%	10%	88.9
Mixed B. Aus+Aman	3,088	18	83.4	1:1.3	108.4	25%	10%	70.5
B. Aman	515	14	10.8	1:1.2	13.0	-	10%	11.7
T. Aman L	14,927	19	425.4	1:1	425.4	-	10%	382.9
T. Aman HYV	-			1:0.9		-		
Boro L	-			1:1				
Boro HYV	-			1:0.8				
					769.1			554

Table 5.4: Estimated Straw Production and Availability after the Project

Crop	After the Project							
	Area (Ac)	Yield/acre (mds)	Total production (000 mds)	Grain* to straw production	Gross straw production (000 mds)	Approx. loss due to rain	Other losses	available straw for cattle (000 mds)
B. Aus	748	18	13.5	1:1.5	20.3	50%	10%	8.1
Mixed B. Aus+Aman	249	19	4.7	1:1.3	6.1	25%	10%	5.5
B. Aman	-							
T. Aman L	2,994	20	59.9	1:1	59.9	-	10%	53.9
T. Aman HYV	14,718	48	706.5	1:0.9	635.9	-	10%	572.3
Boro L	-			1:1				
Boro HYV	12,224	45	550.1	1:0.8	594.1	50%	10%	237.6
					1,316.3			877.4

Source : Estimations are based on the result of RRA field survey

* : Grain to straw ratio estimated by the consultant.

- an increased number of NGOs like Grameen bank, BRAC, Proshika, etc., are now providing credit to landless and destitute people for livestock rearing.

v Rice bran and wheat bran are important concentrate feeds for cattle. With the increased production of rice and wheat in the Project area, production of rice bran and wheat bran has also increased. However, pulse bran and oilcake production has decreased.

5.4.2 Negative Impacts

During the RRA a number of negative developments were observed in respect of livestock production, some of which are related to or the result of BRE, as given below:

a) Feedstuffs for Livestock

i. Availability of cattle feeds, particularly green feedstuffs, has decreased significantly due to reduction of fallow land and change in cropping pattern and cropping intensity. B. Aman, which was the dominant crop in the low and medium land in the pre-Project time, has been replaced by HYV-Boro or T. Aman depending on irrigation facility. The area of B. Aus and Jute has also been reduced. Previously just after rainfall in April/May, a large quantity of weeds grew in the B. Aus, B. Aman and Jute fields. During weeding a significant quantity of rice plants and weeds were removed, which became one of the major sources of green feedstuffs for cattle. Moreover, rice plant leaves were cut and fed to the cattle during the flood season. With the shifting of cropping pattern from B. Aus and B. Aman to HYV-Boro and T. Aman, this source of green feedstuffs has been seriously reduced.

ii. Under favourable conditions total production of paddy straw would be significantly increased. This is mainly due to increased cultivation of HYV Boro and T. Aman and reduced cultivation of B. Aus and B. Aman (Table 5.4). During the field visit it was found that in spite of having good yields of HYV Boro, farmers could not dry and preserve the straw due to frequent rain. It was estimated that about 50 per cent of total Boro and Aus straw is spoiled by the rain each year. Moreover, due to rainfall in the month of Ashwin (Sept.-Oct.), serious drainage congestion occurs in the low, medium low and medium high land. This causes damage to the T. Aman crop and thereby reduces production of T. Aman straw. However, availability of total straw for cattle in the area has been increased by 160 per cent due to HYV Boro and HYV T. Aman production. An estimate may be seen in Table 5.3.

iii. Quality of paddy straw varies with the paddy varieties. B. Aus straw has the highest digestibility and palatability followed by B. Aman, and T. Aman. Local Boro has low digestibility and palatability. HYV Boro has lower digestibility and palatability than the local varieties. With the increased cultivation of HYV varieties, particularly HYV Boro, which is now the predominant crop in the area, the overall quality of paddy straw in term of digestibility and palatability has significantly decreased. It is a general complaint of the farmers that the cattle pass loose stools and become emaciated with the consumption of HYV straw.

iv. In the pre-Project period pulses were grown in the low and medium low land as relay crops and mustard was cultivated in the medium high and high land. Some pulse plants were fed to the cattle as green feed and the rest were ripened and used as human food. Moreover, after the Project the cropping pattern in the area has changed. Cultivation of HYV-Boro has increased, which has practically

replaced pulse and oilseed cultivation. This reduced cultivation of pulses and oilseeds has led to a decrease in availability of green plants as well as nutritious crop by-products like pulse straw, pulse bran and oilseed cake for cattle.

b) Livestock Population

i. Available information indicates that there is a significant decrease in cattle numbers in the Project area. This decrease is more noticeable in the areas where drainage congestion was severe in the last few years. Farmers indicated that the decrease in cattle number may be as high as 50-60 per cent, but after careful cross checking it appears that the cattle population in the Project area may have decreased by 25-40 per cent in the last 8-10 years. This decrease in cattle numbers may be due to the following:

- whenever there is any crop failure or financial difficulty, the farmer sells his cattle to overcome the crisis. But many of those farmers could not buy their animals again in time of need;

- shortage of animal feeds caused by reduced area of fallow land and change in cropping pattern and cropping intensity in the Project area;

- incidence of parasitic and viral diseases of cattle has apparently increased significantly. Farmers complain that quite a number of cattle die each year due to diarrhoea. Occurrence of foot and mouth disease is very common in the winter months.

ii. Cattle are the main source of draft power in the Project area. According to local farmers and livestock officials there is a decrease in cattle population by 25-40 per cent. According to the Census of Agriculture and Livestock 1983/84 there were about 2.16-2.68 head of cattle per farm household with a net cultivable area of 1.6 acres (Table 5.1). Considering that 50-75 per cent of total cattle are draft animals then 1.08-1.62% head of draft cattle were available for cultivation of 1.6-2.3 acres of land. Since one pair of good bullocks can cultivate 4 acres of land, there was apparently no overall shortage of draft power in the area. However, there was some shortage of draft power among the small farmers, because 38 per cent of them did not have any cattle and they were dependent on hired plough for cultivation of their land. Also, most of the small farmers have only one animal, and have to share with others for ploughing. After the Project the draft power situation in the Project area has been aggravated due to the decrease in cattle population and increase in cropping intensity. Small farmers, who are dependent on hired plough, are more affected by the draft power shortage. However, cultivation of HYV-Boro has extended planting time to 65 days from 15 days in case of B. Aus and B. Aman crop which eases the draft power situation to some extent. Moreover, a limited number of power tillers have been bought by the rich farmers as well as by the Grameen Bank, who provide services on a hire basis. These have greatly eased the draft power situation in the area.

c) Livestock Health

i. In general the physical condition of cattle in the Project area has deteriorated, apparently due to scarcity of nutritious feeds and increased parasitic infestation. However, there is variation in cattle health within the Project area and between farm households. In general large farmers, who feed their cattle with oilcake, rice

bran and wheat bran together with rice straw and a liberal quantity of grasses, have better looking animals than the small and marginal farmers who cannot afford to feed oilcake and rice bran to their cattle. Because of increased cultivation of HYV-Boro, the animals are getting more and more Boro straw as their main feed. Only a limited number of farmers provide oilcake and rice bran to their cattle. It has been observed that feeding paddy straw, particularly Boro straw, causes loose stools and gradual emaciation of the cattle mainly due to the high lignin and silicate content of the straw.

ii. Available information indicates that the incidence of parasitic diseases, particularly round worm infestation in calves and fluke infestation in adult cattle, have increased. This may be related to increased drainage congestion in the area and availability of shallow water level in beels and in low-lying areas, which act as breeding grounds of snails. DLO, Gaibandha district and ULO, Gaibandha Sadar Upazila have indicated the same views.

5.5 1988 FLOOD DAMAGE

There are no accurate statistics on the extent of 1988 flood damage to livestock. According to farmers and officials there were no dry places in the Project area except the BRE. Most of the internal roads, community centres and homesteads went under several feet of water. People took temporary shelter on the embankment with their livestock and property. However, after the flood, many farmers had to sell off their cattle and goats due to acute shortage of livestock feeds as well as scarcity of human food.

5.6 RECOMMENDATIONS

In general FCD/I Projects have an adverse impact on livestock feed resources through reducing fallow and grazing land and by changing the cropping pattern. This has led to deterioration of livestock health and productivity. Measures which could be taken to overcome the adverse effect of the Project and improve livestock production in the area are suggested below:

a) Improvements to Green Fodder and Protein Feed Resources

i. A programme may be undertaken to cultivate some high biomass yielding forage crop such as Napier or para grass on the slopes of embankments, roadsides and railway lines, which will not only produce green feedstuff but also reduce soil erosion. Para grass can be planted on the lower part of the embankment slopes and on the borrow pits. Normally para grass has better growth on wet land. On the top side of the road and embankment some fruit trees like Jackfruit, Mango, or fodder trees like Ipil-ipil may be planted, whose leaves will be nutritious feeds for goats, fruits will be human food and branches may be used as domestic fuel.

ii. Some cultivable fallow land may be used for food and forage crop (maize, sorghum, khesari, cowpea etc.) cultivation in order to minimize feed shortage. A forceful extension and motivational drive will be required for this purpose.

iii. Pulses and oilseeds cultivation may be encouraged through introduction of a crop diversification programme which will help in improving nutritional status of the people, providing nutritious cattle feed and increasing soil fertility.

b) Improvements in Feeding Value of Paddy Straw

i. During selection of HYV paddy some considerations may be given to straw quality because straw of some HYV has higher digestibility than the other. This will help to improve straw quality along with increase in rice production.

ii. Paddy straw is the main feedstuff of cattle, which is low both in digestibility and nutrient content. It is established through research that urea treatment of straw improves both N-content and digestibility of straw. So an extension programme may be taken to popularize urea treatment of straw for improving cattle nutrition in the Project area.

iii. A programme on introduction of urea-molasses blocks for feeding cattle with the straw ration may be launched. Urea molasses blocks are a good source of energy and nitrogen for rumen micro-organisms, which in fact, digest fibrous feeds. Moreover, rumen micro-organisms are good source of protein for the ruminant. So feeding urea molasses blocks as supplemental feed for cattle on straw based ration will not only improve digestibility and palatability of the straw but will also improve total nutrient intake of the cattle.

c) Improvements to the Veterinary Services

i. The extension programme of the Department of Livestock Services should be extended and strengthened in the area under the FCD/I Project. Provision should be made to provide routine vaccination and mass anthelmintic doses in the Project area to protect animals against prevalent infectious and parasitic diseases.

6 IMPACT ON FISHERIES

6.1 PRE- PROJECT SITUATION

Necessary documents and reports related to project were collected to provide information about the pre-project situation. The Feasibility Report should have baseline information on fisheries, but there is hardly any information about the fisheries situation of the Project area in the relevant documents.

It is reported that the fisheries were adversely affected by the Project. The construction of embankments has reduced the incidence, depth and duration of flooding and has thus had an adverse affect on production from natural fisheries in the Region (Table 6.1). The annual loss of fish production due to the entire BRE was estimated earlier to be 210 tons based on the estimate of 25 per cent of natural cultivable area affected by BRE (FAO, 1989). It has also been reported that a significant number of households earned their living out of fishing prior to the construction of the embankment. Therefore, as a side effect of the embankment a section of the population of the Project area were forced to abandon their traditional occupation and turn to day-labour for their living.

During the RRA study the fishermen, fish traders and villagers reported that the beels and rivers were abundant with different species of fish before the Project and that these species started declining after the implementation of the Project. They also stated that there was surplus production of fish in Gaibandha district before the Project and that now they have to depend to a considerable extent on the fish supply from other parts of the country. A declining trend in the production of capture fisheries of greater Rangpur district has been shown in Table 6.1.

6.2 OBJECTIVES

In the project planning no specific objective was set for fisheries development. BWDB did not undertake any development programme on fisheries in the subsequent Projet planning of the BRE Project. BWDB could have defined objectives for the development of fisheries in the Project planning. This would have helped to a significant extent in mitigating the losses incurred due to the Project. However, BWDB was indifferent to fisheries and ignored them in all the Project planning for the BRE Project.

6.3 SOURCES OF DATA.

The present RRA study was conducted in the northern part of the Brahmaputra Right Embankment Project from 1st June, 1991 to 7th June, 1991. This study covered an area about 10,100 ha. out of the total area of 225,911 ha. (558,000 acres) of the BRE Project. During the field visit attempts were made to collect information from officials, fishermen, fish traders, farmers, pond fish culturists, local leaders, NGOs and local elites. All these personnel were interviewed individually and in groups along the road side, at their homesteads, by the side of rivers and beels and in the field and market wherever it was feasible. To judge the reliability of the information, data collected from one person or group were cross checked with other persons and groups. Data were also recorded from actual physical observation of the existing Project situation. Relevant documents and reports were consulted to gather necessary

information on fisheries. Some of the data on fisheries obtained from the Upazila Fisheries Officer of Gaibandha and from the field visit are presented in Tables 6.2 and 6.3.

Table 6.1 Fish Production Trends - Rangpur District

Major group of fish	Year wise catch (In metric Ton)				
	1983/84	1984/85	1985/86	1986/87	1987/88
Major carps	690	428	76	104	119
Other carps	6	2	91	40	37
Catfish	562	578	328	288	288
Live fish	72	14	0	1	0
Hilsa	72	86	116	163	105
Big shrimp	0	34	93	18	20
Small shrimp	970	767	169	99	102
Other spp.	5,225	4,238	2,811	2,044	1,521
Total	7,597	6,147	3,684	2,757	2,192

Source: Department of Fisheries, Fish Catch Statistics of Bangladesh, 1983-84 to 1987-88.

6.4. POSITIVE EFFECTS

The Project seems to have no direct positive effects on fisheries, but one indirect positive effect can be traced on the Project.

The Project embankment has effectively prevented the inflow of flood water within the Project area from the Brahmaputra river during the monsoon; however, insufficient drainage facilities cause severe water congestion within the Project area every year during the monsoon. The inflow of large amounts of drainage water into the Project from the north and west coupled with localised heavy rainfall during the monsoon causes floods within the Project. These internal floods inundate annually almost all the ponds except a few located in sufficiently high land. Therefore, the Project has failed to provide better scope for pond fish culture and consequently this has not yet gained any importance within the Project area.

However, the sharp decrease in fish production and the relatively better protection of ponds from inundation in highland areas have created awareness by some pond owners of the possibility of fish culture in their ponds. Very recently a few farmers have started stocking their ponds with indigenous and exotic carp fry by raising the dyke height of the ponds above the flood level. They do not follow any improved method of fish culture and the yield obtained by them was found to be 1060-1110 kg/ha./year. The non-adoption of improved fish culture methods might be attributed to lack of technical knowhow and to the inadequacy of support services such as quality fish seeds, feeds and extension service.

6.5 NEGATIVE EFFECTS

The Project has badly affected the capture fisheries within the Project area and some of its negative effects on fisheries are given below.

Fish production of capture fisheries has decreased greatly since Project implementation. The construction of the embankment along the right bank of the Brahmaputra river and sluices over the rivers (Manas, Sarai) and khals has blocked the migration routes of the major carps and other migratory fishes and hence the availability of these fishes has sharply declined since construction of the Project. Besides, waterlogging encourages siltation within the Project and thus the khals, rivers and beels are now being greatly silted up. The rain water run-off from the upper catchment areas of the Project carries silt and sand, and coupled with the localised erosion of newly constructed roads causes heavy siltation within the Project. As a result the water bodies, which used to hold water round the year, now dry up every year. Surface water irrigation from these water bodies to the HYV Boro paddy fields is also contributing greatly to their early drying. In this situation the fishermen catch whatever they can get and as a result no stock is left for breeding in the following year. In this way the fish stock is decreasing sharply within the Project area. It has been reported by the fishermen, fish traders and farmers that after the Project fish production has decreased by 70-75 per cent in beels and 65-70 per cent in the rivers and khals within the Project.

The Project has also affected the fish production of the Brahmaputra river adjacent to it. Due to the decrease in fish production and siltation of water bodies within the Project, the farmers are not allowing the fishermen to catch fish from most of the beels within the Project and thus most of the fishermen are now depending on the Brahmaputra river for fishing. This has greatly increased the fishing pressure in the Brahmaputra river, as a result of which fish production is also decreasing rapidly in this river. Fish production has now decreased by about 35-40 per cent from the pre-Project level as reported by the fishermen and fish traders. From Table 6.1 it can be seen how riverine fish production is declining in the greater Rangpur district.

The Project has reduced the catch and income of the fishermen. Due to the decrease in fish production, the catch per day and income of the fishermen have also gone down by about 70-75 per cent. The average catch per day has declined by 1-1½ kg (from 6-8 kg) in the beels and by 3-4 kg (from 10-15 kg) in the rivers.

The fishing period has shortened within the Project since its implementation. Before the Project the fisherman used to catch fish from beels and rivers almost round the year, but since the Project most of the beels and certain portions of the rivers now dry up every year which has limited the fishing period from October to January in the beels and from June to March in the river.

The Project has brought about a change in the species of fish within the Project area. Previously the capture fisheries were rich in different species of fish, but since Project implementation some species are now disappearing and some have already become extinct. The adversely affected and relatively less affected fish species have been listed in Table 6.3.

Table 6.2 : Fisheries information for Gaibandha Upazila, 1990

a) Water bodies with number, area and yield :

Name	Number	Area	Fish Yield(MT/YR)
Rivers	4	15 Km	145
Khals	2	7 Km	2
Beels	2	1200 acre	160
Total ponds	1992	362.5 acre	75
Cultivated ponds	1653	281.5 acre	----
Cultivable	254	57.0 acre	----
Derelict ponds	85	24.0 acre	----
Other water bodies	---	------	37
Total			442

b) Fishing community :

i).	No. of fishing families	533
ii)	No. of fisherman	1050
iii)	No. of fisherman co-operative	4
iv)	Co-operative membership no	211

c) Prices of fish

Rui and Katla (Big)	TK 80 - 100/Kg.
Rui (Small)	TK. 50 - 60/Kg.
Silver carp and small Katal	TK. 40 - 45/Kg.
Small fish	TK. 25 - 30/Kg.
Big shrimp	TK. 60 - 70/Kg.
Small shrimp	Tk. 10 - 15/Kg.
Magur and Koi	TK. 80 -100/Kg.

Sources : (a) and (b) from Upazila Fisheries Officer Gaibandha and c) from interviews and discussion with fisherman, fish traders and farmers.

The Project has also had adverse effects on the living and occupation of fishermen. Due to the decrease in fish production and income a large number of fishermen have left the Project area. It was reported by the fishermen that from Rasulpur village of Kanchipara Union alone about 125 fishing families had migrated to other districts. Besides, a large number of fishermen have in the meanwhile adopted subsidiary professions, such as day labour, crop production, petty trades, etc., in addition to fishing as their main profession. In some fishing villages, e.g. Dharmapur, Chaiani, Rasulpur, Bairal gram and Dhutichara, more than 50 per cent of the fishermen are now reported to have adopted other means of earning during lean fishing periods.

The income of fish traders has also gone down by 65-70 per cent due to the decrease in fish production. The quantity of fish handled by fish traders has decreased from 10-15 kg./day to 2-3 kg./trader/day.

6.6 MEASURES TO CORRECT NEGATIVE IMPACTS

The Project was started long before the emergence of Bangladesh as an independent country and thus its effects on fisheries are of long standing. It is therefore not possible to bring the fisheries back to their former state. However, some remedial measures could be taken to offset the losses incurred due to the Project.

To mitigate the losses due to the Project, improved methods of fish culture can be introduced in the ponds, beels and rivers.

i. The ponds should be protected from internal flooding due to severe water congestion by providing larger sluice regulators on the embankment where it is feasible. To facilitate the quick flow of water the existing drainage channels and rivers need to be re-excavated. This will help greatly in reducing the flood level within the Project as well as in holding sufficient water round the year. The pond owners should be motivated to adopt improved fish culture practices to their ponds instead of merely stocking them with fish.

ii. Arrangement should be made to hold more water in the rivers and beels by closing the sluice regulators and drainage channels before the dry season without affecting the Boro cultivation. This will help prevent the rivers and beels from drying up during the dry season and the rivers and beels will thus have more chance to hold some breeding stock for the following year.

iii. To prevent the beels from drying up annually re-excavation should be done by making dykes around their periphery. This will help the beels to hold more water and thus provide scope for fish culture. The fishermen or farmers can stock these water bodies with quality fish seeds of the major carps and catfishes. To restrain the fish from escaping from the beels the farmers will have to provide shelter for the fish by placing branches of trees, especially hezal and seora. Since the beels are owned by several farmers there will need be good co-ordination and understanding between them for this type of fish culture. For this purpose awareness among the farmers will have to be developed through motivation, and this can be achieved through intensive extension activities. At first a few pilot Projects can be established in certain

beels to motivate the farmers. In order to make such a Project effective and fruitful, adequate support services must be provided.

Table 6.3. Species of fish adversely affected and relatively less affected.

a)	Adversely affected species :		
i)	Major carps :	Labeo rohita	Rui
		Labeo calbasu	Kalibaus
		Catla catla	Katal
		Cirrhina mrigala	Mrigal
ii)	Minor carps :	Labeo gonius	Ghonia
		Cirrhina reba	Bagna
		Labeo nandina	Nandina,Nandil
iii)	Other fishes:	Mystus aor	Aeir
		Mystus seenghala	Guzi
		Notopterus chitala	Chital
		Notopterus notopterus	Fali
		Wallago atu	Boal
		Ompok pabda	Pabda
		Macrobrachium sp	
b)	Relatively less affected species		
	i) Snake head:	Channa punctatus	Taki
		Channa striatus	Shol
		Channa marulius	Gajar
	ii) Catfish:	Clarius batrachus	Magur
		Heteropneustes fossilis	Shingi
		Mystus tengara	Tengra
		Mystus sp.	
	iii) Other fishes:	Puntius spp.	Puti
		Amblypharyngodon mola	Mola
		Rohtee cotio	Dhela
		Esomus danricus	Darkina
		Oxygaster spp.	Chela
		Ailia coila	Kajuli
		Pseudeutropius atherinoides	Batasi
		Botia dario	Rani
		Lepidocephalus guntes	Gutum
		Colisa spp.	Kholisa
		Mastacembelus puncalus	Guchi Baim
		Anabas testudibeus	Koi

The present lease systems always deprive the genuine fishermen of their legal rights as they cannot compete with moneyed and influential persons to get leases of the water bodies. Arrangements should be made to provide fishing rights to all genuine fishermen by issuing fishing licences to them in accordance with the new fisheries management policy. The Upazila fisheries officer of Gaibandha reported that the fishermen are now given licence for one year to catch fish from the portion of the Ghagot river located within Sadar Upazila. Such a type of licence system should be introduced to all the rivers and khas beels. To increase fish production, fingerlings of carps will have to be released into the rivers and beels by the Government or by the fishermen. If fingerlings are released by the Government then the licence fees will need to be increased to meet the expenditure incurred for releasing fingerlings.

The sluice regulators provided in the embankment should be large enough to provide easy migration and movement of fish from the rivers to the Project area and vice versa. The regulators should be kept open during the early monsoon (as far as possible without affecting the Boro and Aus crops) so as to allow the migratory fishes, especially the major carps, to enter into the Project area.

6.7 LESSONS LEARNED

It is learnt from the Project documents and from the information gathered from the fishermen, fish traders and villagers during interview that the capture fisheries within the Project area were previously very rich with different species of fishes. After the implementation of the Project the fish production started declining sharply and has now been reduced to 70 -75 per cent of the pre-Project level.

It is ironic that BWDB, while knowing very well about the adverse effects of the Project on fisheries, did not undertake any development programme for fisheries in the subsequent Project planning of this Project to mitigate the losses. BWDB should take care in future Project planning that fisheries are as little affected as possible, and that if they are affected measures should be taken to mitigate the losses.

BWDB should involve all the concerned Departments and agencies such as Fisheries, Livestock, Agriculture, BRDB, LGRD and BADC from the outset in the future Project planning.

It is known from the fishermen that the extensive and intensive use of current jal (seine net with small mesh size) and chapra jal or mashair jal (with very small mesh size) by the farmers and certain fishermen is greatly responsible for the rapid decrease in fish stock in capture fisheries. They also suggested that use of these types of net be prohibited immediately in order to restore fish production in these fisheries. Therefore, Government should take effective steps immediately to ban the use of such types of net. If necessary, special regulations should be framed and enforced for this purpose.

7 IMPACT ON WOMEN

7.1 PRE - PROJECT SITUATION.

The pre - Project activities of women in the BRE area were mostly concentrated on housework. Apart from housework, women from the poor families used to engage themselves in paddy processing in other people's houses, especially in the post- harvest period i.e. in the months of Baishakh, Jaistha, Agrahayan and Poush. During the rest of the year these women had no occupation except growing vegetables in the homestead area, or poultry rearing. However, these activities were on a very small scale and were concentrated mainly in the dry season since the area used to be flooded every year. A small number of households (about 3 per cent) were involved in fishing. Women of these families were involved in net repairing.

7.2 PROJECT OBJECTIVE

There was no specific objective in respect of improving the condition of women through the Project. However, an implicit objective of the Project is, of course, increasing employment and income of women through increased agricultural production.

7.3 SOURCES OF DATA

Data have been collected through interviews with NGO and Government officials, discussion with female groups of Grameen Bank, CARE, Mahila Samabay Samity (MSS) under BRDB, and others. Interviews with the village women and personal observation were also important sources of data.

7.4 POST PROJECT SITUATION

7.4.1 Positive Impacts

BRE helped to raise total foodgrain production in the dry season which has had a direct impact on the employment of women during the post harvest period in the months of Baishakh, Jaishtha, Agrahayan and Poush. Women have to do various types of work which include parboiling and drying paddy, husking paddy by dhenki(foot-powered husker), threshing paddy and wheat and storing and preserving rice. These tasks require women's involvement for 10 to 12 hours a day. They are given food three times a day plus a certain amount (usually half a maund) of paddy for the whole season. To the extent that there has been an increase in monsoon paddy output, BRE has also increased employment and the cash or kind wages of women.

The flood protection measures under BRE have made it possible to increase homestead vegetable production and poultry rearing. These tasks are performed by women, and provide a means by which they can gain an income which is used for the welfare of the family. However, women's access to income in a male headed household is limited since marketing is mostly controlled by men. Nevertheless, some organizations in the area have assisted greatly not only

in creating employment opportunities for women but also in helping women in marketing of their produce. For example, Grameen Bank female group members are doing rice business on their own. CARE also helps women in marketing their produce.

A direct impact of the BRE is that it has created employment for women through embankment maintenance under the Food for Work (FFW) Programme. Beneficiaries are mostly distressed women, who get 30 seers of wheat a month for the work.

Improved communication facilities within the villages may be an indirect impact of the embankment. The road construction and maintenance work operated by CARE has created employment opportunities for distressed rural women. They earn Tk.720/- a month. Improved communication facilities have also helped to expand NGO and GO activities. In addition to Grameen Bank and CARE, a number of organizations including BRAC, RD-9 under BRDB, and World View International also have specific programmes to contribute to the generation of employment and earning capacity of poor women. Conscientization and motivational activities are also being performed by these organizations which have helped to create positive attitudinal changes in women regarding work outside home, education, family planning and the dowry system. A large number of females showed their eagerness to work outside the home, even in a remote place. However, the migration rate among female workers is not significant. Only a small number of women are reported to work outside the area.

The number of schools has increased in recent years which in turn has increased the enrolment of girls. This was possible partly because of improved communications, partly accomplished due to the embankment. It also helped girls to go to the town for higher education which is an important positive impact, despite the fact that this trend is limited only to well-off families.

7.4.2 NEGATIVE IMPACT

Drainage congestion due to BRE along with heavy rain and internal flooding not only affects production of crops but also causes a lot of suffering for women. They have to face serious problems in maintaining their day to day lives especially in terms of cooking, child care and sanitation.

Another group of women who were members of fishing households lost their job due to fish production in the beels and khals having been reduced to a great extent due to BRE. Previously these women helped their husbands in repairing nets and drying fish.

7.5 CONCLUSION AND RECOMMENDATIONS

There was no intention in the construction of the BRE for the development of women. The net impact of the Project on women's development has however been positive. For further development of women, the following suggestions are made:

i. Government and non-government activities should be expanded in order to enable women to engage in profitable employment;

ii. credit facilities through Government and NGOs should be increased to help women to become involved in self-employment. Credit should be accompanied by technological skill training for women. Some of the Grameen Bank group members reported that they surrender the loan to their husbands in lieu of handling the loan themselves, which does not at all serve the purpose of making the women self-reliant;

iii. the sustainability of developments achieved under the Government and NGO programmes must be ensured so that these women can maintain their livelihood on their own, even after the programmes are closed. One important criticism against the NGO activities is that their programmes are not sustainable since they cannot create entrepreneurship among the women. A CARE evaluation study found that after withdrawal of their programmes in an area all but one out of 30 group members returned to the position of destitutes (Amera, 1991).

8. IMPACT ON NUTRITION AND HEALTH

8.1 PRE-PROJECT SITUATION

The pre-Project nutritional status of the villagers is difficult to estimate, and there is large scope for miscalculation. Therefore, the pre-Project nutritional status could not be compared with the post-Project status. Health facilities may be supposed to have been poorer during the pre-Project period than the post-Project period.

8.2 PROJECT OBJECTIVE

There was no explicit objective for improving the nutritional and health status of the villagers through the BRE Project. However, the implicit objective which can be inferred from the Project objectives is that the improvement in employment and income through increase in production of foodgrain as well as vegetables would have an impact on nutrition and health.

8.3 DATA SOURCES

Data on Nutritional status and health condition have been collected from discussion with villagers. The Upazila Health Office, Family Planning Office and NGOs were other important sources of data. One limitation of the data on nutritional status is that these are only qualitative rather than quantitative. Quantification was not possible, mainly due to shortage of time.

8.4 POST-PROJECT SITUATION

8.4.1 Food Consumption

BRE helped to raise total foodgrain output which in turn may have helped to increase food intake to some extent. The well-off families, of course, are able to eat rice three times a day throughout the year. Increased food production due to BRE implies that the poor families can have at least two rice meals a day during the month of Baishakh, Jaistha and Ashar. However, for the remainder of the year most of these households can eat rice only once a day or even cannot eat rice at all during the day. This time they eat wheat, millet, sweet potato, etc..

Vegetable consumption is reported to have increased, which has been made possible through increased vegetable production both in the field and homestead areas and which has been facilitated by the BRE. However, the increase in chicken and duck population by 15-25 percent has not increased consumption of chicken or eggs to the same extent, since the purchasing power of the villagers has not increased.

Milk and fish consumption has decreased due to the decrease in cattle population and in open water fish production. Fruit consumption has not changed significantly.

8.4.2 Water Supplies and Health Conditions

The source of drinking water for almost all families is tube-wells. However, they use pond water for cooking, bathing and washing clothes. Most of the households possess katcha latrines which create health hazards.

About 90 per cent of children have had an EPI injection. The most common diseases from which the children of the area suffer are fever and diarrhoea. Volunteers from NGOs have been able to make the women conscious to some extent of the food value of vegetables. Weakness has been reported to be the most prevalent disease among the women and occurs mostly because of less food intake.

More than half the people do not go to the doctor or hospitals for normal diseases not only because of financial constraints but also because of lack of awareness. Those who go to hospital do not get medicine. Most of the children do not look healthy and they seem to suffer from malnutrition.

Family planning activities did not seem to be successful in the area where more than eighty per cent of couples had more than 5 children and in some cases even more than 10. However, family planning activities have improved over the years. For example, during 1986-87, 3600 persons were offered family planning facilities in Gaibandha Sadar Upazila. During 1990-91 the number increased to 17103. However, there is no relationship between the embankment and family planning activities.

8.5 RECOMMENDATIONS

Though nutritional and health status are closely related to the economic well-being of the household, they can be improved to some extent by other means. Consciousness about the source, effect and treatment of diseases will have a positive impact on health conditions. Adequate knowledge of dietary composition may help to reduce malnutrition. Therefore, health and family planning activities should be extended. The initiative of World View International which has been working in the area and has composed interesting songs on the dangers of and cure for various diseases is praiseworthy and helpful to motivate the rural people. Dramas are also played regularly by WVI in the villages on various diseases. Other NGOs and GO could also follow this effort. Moreover, these initiatives are not related to the embankment.

9 SOCIAL IMPACT

9.1 PRE-PROJECT SITUATION

Agriculture has traditionally been the dominant activity in the Project area. Fishing has also been another important activity in the Project area. The Brahmaputra river has always influenced the agro-socio-economic activities of the people in the Project area by flooding or by even distribution of water supply for crops and fisheries. Farming, fishing or farming cum fishing were the major occupations in the area. Cheap labour supply has always been another important aspect of the Project area.

As reported the land distribution has been highly skewed. A large proportion of the population in the area were landless.

Social infrastructure such as schools, madrashas, hospitals roads and transports systems was poorly developed and the level of literacy was very low.

In the pre-Project period a number of different types of co-operative societies were functioning inside the Project area under the supervision of rural development programme. These co-operatives were organized during the early 1960s when Gaibandha Upazila was included under the then Comilla Rural Development Programme.

9.2 SOCIAL AND INSTITUTIONAL CONDITIONS PREVAILING IN THE PROJECT AREA

The social situation at present appears to be little different from that prevailing before the Project. As far as social variables like occupational composition, demographic situation, social interaction in terms of leadership pattern, values, tastes and behaviour are concerned, these have more or less remained the same as they were in the past.

Group interviews in villages of the Project area indicated that there was a general increase in landlessness in the Project area after execution of the Project. Landlessness has increased in recent years. The major cause of landlessness had been erosion by the rivers which led to loss of cultivable land. Not insignificant, however, is the general vulnerability of poorer families to natural calamities after which they have often to sell their lands for survival.

Information obtained from the field visit indicates that a number of institutions such as the Grameen bank, CARE, WVI have been functioning since the Project was built.

9.2.1 BRDB Co-operatives of Gaibandha Upazila :

In Gaibandha Upazila the BRDB co-operatives were observed to function in the Project area. The current position is presented in Table 9.1.

Table 9.1 : Status of BRDB Cooperatives in Gaibandha Upazila

Types of co-operative	No. of societies	Enrolment/ Membership	Savings	Share	Loans	Recovery	Outstanding
K.S.S	232	10526	1164392	919421	27535954	7624464	19911490
B.S.S	18	325	70167	41806	338200	103408	234792
M.S.S	26	777	109867	45490	120170	692207	509493
M.B.S.S	9	110	--	--	8000	--	8000

Source : BRDB Gaibandha.

KSS = Krishi Samabay Samity.
BSS = Bittaheen Samabay Samity.
MSS = Mahila Samabay Samity.
MBSS= Mahila Bittaheen Samabay Samity.

Some of the BRDB co-operatives were found to function properly, while some of the societies were found to function well below their potential.

The chief function of the farmers co-operative societies is to promote agricultural output and marketing of agricultural products. This happens when farmers produce in excess of their consumption needs. As reported few farmers have an investible surplus while most of the farmers in the Project area were found to be at subsistence level.

Other types of BRDB sponsored co-operatives such as small trading, cattle raising, poultry, and handicrafts were reported to be quite active.

9.2.2 Traditional co-operatives

The activities of the traditional co-operatives obtained from official sources are shown in Table 9.2.

Table 9.2: Status of Traditional Cooperatives

Type of societies	No. of societies	Enrolment/ Membership	Savings	Share
Union Multipurpose	13	6640	35000	150,000
K.S.S	46	1770	15000	88320
Fishermen cooperative	4	135	7405	7500
M.S.S	11	442	6145	2325
Others	7	840	8102	17250

Source : BRDB, Gaibandha

Most of the traditional co-operatives are not operating properly and are facing difficulties in operation.

9.2.3 Other Institutions:

Grameen Bank located in Kamarjani Union has been extending its services by providing credit to disadvantaged groups. This type of bank was reported to favour women's income generating activities such as small-scale trading, poultry raising, cattle rearing, small cottage industries and handicrafts. In the Kamarjani and Gidari Unions area 260 groups comprising 1300 members are reported to function under the purview of Grameen Bank.

In addition CARE has been working for Women's Development Programme (WDP) in the Project area to promote unity and conscientization, to motivate the members to save and invest in various income generating activities and to motivate members for health and sanitation. There were other NGOs working for the Nutritional Blindness Prevention Programme.

9.3 PROJECT OBJECTIVES

The BRE was always expected to provide social benefits. IECO (1962) forecast a vastly improved road transportation system, protection for the towns of Gaibandha and Sirajganj, protection to villages, improved sanitary and health conditions and benefits to industrialisation through reduced flood hazard.

9.4 SOCIAL AND INSTITUTIONAL IMPACT

9.4.1 Positive Impact

i. The BRE has generated considerable positive benefit as the embankment is commonly used as a flood shelter for human and animal populations.

ii. The BRE and the internal village roads have facilitated the development activities of GOs and NGOs in the Project area.

iii. Despite the construction of retired embankment in a number places, the BRE has generated positive benefits as a road for transport and communication and it has also been linked with internal roads, which have facilitated distribution of inputs and movement of goods and services to and from the area. This has also promoted some occupational diversity such as rickshaw pulling, bullock cart driving and petty trades by poorer households.

iv. Now that some work opportunities for women are available due to increased rice production, earthwork, road maintenance and that some NGO income generating programmes are around, women especially distressed women, from poorer households appeared to be eager and conscious to work outside to supplement household income.

9.4.2 Negative Impacts

i. Conflicts of interest were apparent in the southern portion of the RRA study area, where another polder, called Sonali Polder, constructed a few years ago, has aggravated drainage congestion in the southern villages. This led to socio-political clashes between the opposing groups and consequently to public cuts of the Sonali Polder in a recent year.

ii. There has been a significant loss of land (homestead and cultivable) due to the construction of the embankment.

iii. The decline in T. Aman production in low lying areas due to drainage congestion has increased seasonal unemployment in the winter months and this might have intensified out migration of wage labourers from the Project area to Bogra, Rajshahi, Dhaka and Chittagong.

9.5 RECOMMENDATIONS

i. The landless settlers can be rehabilitated within the boundary of the land acquired by BWDB for the embankment under rules and regulations such as:

ii. There are many informal co-operative societies in the Project area. A provision should be made to involve NGOs/BRDB/co.op. or any other development agencies to work in this area to activate these informal groups for social and economic development in the Project area.

iii. Social welfare programmes should be sponsored so that social awareness of embankment occupants as well as of other beneficiaries of the Project grows and participation of local people for maintenance of the embankment can be ensured.

10 ENVIRONMENTAL IMPACT

10. 1 PRE-PROJECT SITUATION

In the pre-Project condition flood water from the rivers Teesta and Brahmaputra entered into the Project area by over-spilling its banks and caused much damage to crops, properties and livestock. The Project area has a slope from north-west to south-east in the northern part and north to south in the southern part of the Project. Because of the slope the flood water receded from the area quickly as soon as the water level in the river Brahmaputra went down. Because of bank erosion and scouring, sand deposition occurred in some areas near the river bank and alluvial silt deposition occurred all over the inundated areas. A large number of fishes and other aquatic species entered into the area which used to influence the ecological system in the area.

Water hyacinth, which normally entered into the area with the flood water, caused damage to B. Aman plants and thereby reduced B. Aman production. However, water hyacinth was also used as cattle feed in case of feed scarcity. Decomposed water hyacinth used to be a good manure and it contributed to improving soil fertility in the area.

Cultivation of pulses in the Project area during the pre-Project period helped in maintaining soil fertility.

10.2 OBJECTIVES

The main objective of the Project was to protect the land from flood water intrusion and thereby save lives, property and livestock from flood damage and make the land suitable for cultivation of T. Aman in place of B. Aman. However, the possible impacts of the Project on the environment and ecological system in the Project were overlooked or not adequately considered.

10.3 SOURCES OF DATA

For RRA of the Project extensive field visits were made to the Project area from June 1 to June 7, 1991. Data were collected from farmers, knowledgeable persons in the area including teachers, village leaders and retired officers, as well as Upazila officials including the UNO, Agricultural Officers and Statistical Officers. Personal experience gained during RRA field visits was also recorded. These data are the basis for preparation of this report.

10.4 PROJECT IMPACTS

10.4.1 Positive Impacts

i. In the pre-Project period the Project area was regularly inundated by flood water from the rivers Teesta and Brahmaputra, which caused damage to crops, lives and property. With the construction of BRE, the flood damage has been greatly reduced. This has led to improvement of living conditions in the Project area.

ii. The BRE has been acting as a barrier against the intrusion of sandy silt with flood water into the Project area and has thereby protected the cultivable land from sand deposition. As a result the BRE helps in maintaining the land in a suitable condition for cultivation.

iii. Under pre-Project conditions water hyacinth entered into the Project area with the flood water from the Brahmaputra river and caused serious problems to the paddy fields, with resulting crop damage. These problems have been substantially reduced with the construction of the BRE.

iv. The protection of the Project area from Brahmaputra river floods has created suitable conditions for tree plantation, although there are few old trees in the area. Farmers indicated that whenever there was any crop damage or financial problem they sold a tree or an animal to overcome the difficulty.

v. In the pre-Project period there was a limited number of hand tubewells in the area. Most of the people used water from dug wells, ponds and khals for cooking, bathing and drinking purposes. There was, therefore, a limited supply of pure drinking water. After the Project the number of hand tubewells has increased and consequently the supply of pure drinking water has increased. This is due to availability of inundation free locations for tubewell installation, and increased availability and distribution of tubewells both through agencies and the open market.

10.4.2 Negative Impacts

i. Sanitation, Health and Hygiene

In the pre-Project period flood water washed away all debris and other materials from the land surface. With the construction of the flood embankment this effect has been greatly reduced. Sanitation problems have been exacerbated. Surface water level in the ponds has been significantly lowered and water bodies in the khals and beels are becoming polluted. A complaint of skin eruption is common among the people. The mosquito population has greatly increased, probably due to the formation of an increased number of shallow stagnant water bodies.

The snail population has also increased in the beels and khals due to low water levels, which also leads to increased liver fluke infestation in cattle. Snails also cut rice plants and cause some damage to paddy production.

ii. Aquatic Ecosystem, Vegetation and Wild Life

After the Project, marshy areas and the whole aquatic ecosystem have disappeared. Almost all beels dry up during the dry months and are used for crop cultivation. The number of migratory birds has fallen. The number of different species of aquatic micro-organisms has also decreased.

The disappearance of the wetland ecosystem has significantly reduced the frog and snake populations. This has strongly increased the pest and insect populations in the fields. Therefore, the food chain in the ecosystem has been disturbed.

Seasonal localized drainage congestion due to heavy rainfall and inadequate drainage structures in the retired embankment has led to serious environmental problems. Kutcha latrines become flooded and the water becomes polluted with night soil.

iii. Soil Environment

The soils in the Project area belong to the alluvial flood plain. In the pre-Project condition, the variety of crop cultivation including pulses increased or at least maintained soil fertility. In addition seasonal flooding and decomposition of aquatic plants would have added large amounts of detritus and organic matter to the soil and thus enhanced soil fertility. Use of cowdung, primarily as domestic fuel, may have an adverse affect on soil fertility, but its status has not been affected by the BRE.

10.5 RECOMMENDATIONS

i. A programme of tree plantation on embankment with economically useful species should be initiated as soon as possible.

ii. On the upper slopes of the embankment Napier grass may be planted and on the lower slopes and borrowpits para grass may be planted. Para grass grows well on marshy land.

iii. Plantation of trees and grasses on the embankment slopes will help in reducing embankment erosion, solving the fire wood problem and reducing feed problems for ruminants in the Project area.

11 ECONOMIC IMPACT

11.1 PRE PROJECT CONDITIONS

During the pre-project period most of the farm income used to come from the production of rainfed rice crops such as B. Aus, B. Aman, T. Aman (Local), jute, pulses and oilseeds. The cropping intensity was as low as 147 per cent as estimated from the PCR of the Rehabilitation phase, but the RRA estimate shows the pre-project cropping intensity to have been about 188 percent (Chapter 4). The average financial return and economic return per hectare of net cropped area were estimated to be Taka 3008 and Taka 10945 respectively, presumably at 1985 prices, the year when the rehabilitation phase of the Project was declared completed (PCR, 1987, Table III).

Open water capture fishing in the river Brahmaputra and vast flood plains was the major source of income for the professional fishermen and the major source of protein in the diet of the people.

The sudden on-rush of flood water from the Brahmaputra during the pre-project period used to devastate the entire area causing severe damage to monsoon crops, human and animal lives and property. The widespread inundation, disruption of communication and massive economic loss used to worsen the living conditions of the people, especially the poorer sections of the population.

11.2 PROJECT OBJECTIVES

As evident from the project documents, the economic objective of the project was implicit in the declared objective of building a flood free and well drained environment. The underlying objective was to accelerate agricultural production and thus to raise economic returns from agricultural production.

The economic gains of the project were intended to come from increased crop production not only in the monsoon season rice crop but also in the pre-monsoon and post-monsoon season rice and other crops. This seems unrealistic because the Brahmaputra flood has been known to have only adversely affected the monsoon crops, mainly rice.

The tangible and intangible benefits such as the protection of lives, properties and infrastructure, and the improvement of road communication or the loss of captured fishery were not quantified in the calculation of the costs and benefits in the project documents.

11.3 DATA FOR ECONOMIC ASSESSMENT

Data for the pre- and post project crop production are drawn from Chapter 4. The pre-project period refers to the period preceding 1974 when the major rehabilitation of the project started and the post-project period refers to the period following 1985 when the construction was completed. Data with respect to input, output and prices were obtained from RRA field visits. The detailed sources of agricultural data are shown in Chapter 4. The costs of the project (BRE, Kamarjani reach) are estimated from the actual expenditures provided in the PCR, Table IV.

11.4 ECONOMIC IMPACT OF THE PROJECT

11.4.1 Cost of the Project

There are two problems in estimating capital costs of BRE rehabilitation attributable to the Kamarjani reach. The first involves identifying the costs of the BRE, the second identifying the proportion of those attributable to the Kamarjani reach.

Table 11.1 presents estimates of the total capital and O&M costs of the BRE, based on the 1987 BWDB Project Completion Report. These have been corrected to 1990/91 prices and then converted to economic prices using FPCO Standard Conversion Factors.

In Chapter 1 the difficulty was noted in determining the gross and net areas benefited by the BRE. This, combined with three possible parameters for Kamarjani reach, compounds the difficulty in ascribing costs. There are a range of options:

Based on embankment length:	19.3 km out of 225 km	-	8.6 per cent.
Based on gross area:	10100 ha out of 122622 ha	-	8.2 per cent
	10100 ha out of 259409 ha	-	3.9 per cent
Based on net cultivated area:	8783 ha out of 72800 ha	-	12.1 per cent
	8783 ha out of 173209 ha	-	5.1 per cent

In the subsequent analysis the figure of 8.6 per cent is used for the basic analysis, and the sensitivity of the results to using the figures of 4 per cent and 12 per cent is tested.

The capital and O&M costs derived appear reasonable, using the 8.6 per cent assumption.

Financial capital costs, at 1991 prices, are Tk 58.135 million, or Tk.6619 a hectare (net benefitted area). O&M costs are Tk.340 a hectare a year, or 5.1 per cent of capital costs.

11.4.2 Benefits from Increased Agricultural Output

In order to estimate incremental agricultural output the 'without project' scenario needs to be projected. The RRA concluded that rabi crops were generally unaffected by Brahmaputra flooding, and that only changes in monsoon season paddy output were attributable to the BRE.

The BRE has led to changes in cropping pattern and to increases in average harvested yields due to reduced damage from floods. In the case of T. Aman there are nevertheless significant annual losses to the floods that continue to affect the area (see Table 4.3).

Since rehabilitation of the BRE over 300 ha of land have been lost due to river erosion (Table 4.1). This area would also have been lost in the without project case - the RRA has assumed that the BRE controls flooding but neither promotes nor slows the rate of river erosion.

Table 11.1 Financial and Economic Capital and O&M Costs
BRE Rehabilitation

	CAPITAL COSTS					OPERATION AND MAINTENANCE COSTS					TOTAL COSTS		
Year	Financial Costs in Current Prices (1) Tk '000	Construction Cost index (2) 1969/70 = 100	Financial Costs in 1990/91 Prices Tk '000	Economic Conversion Factor (3)	Economic Costs in 1990/91 Prices Tk '000	Financial Costs in Current Prices (1) Tk '000	Construction Cost index 1969/70 = 100	Financial Costs in 1990/91 Prices Tk '000	Economic Conversion Factor (4)	Economic Costs in 1990/91 Prices Tk '000	Financial Costs in 1990/91 Prices Tk '000	Economic Costs in 1990/91 Prices Tk '000
1975/76	653	531	1889	0.778	1470					0	1889	1470
1976/77	5087	474	16484	0.778	12825					0	16484	12825
1977/78		484		0.778	0					0	0	0
1978/79		509		0.778	0					0	0	0
1979/80		617		0.778	0					0	0	0
1980/81		724		0.778	0					0	0	0
1981/82	217026	889	374974	0.778	291730		889	0	0.71	0	374974	291730
1982/83	30652	833	56520	0.778	43973		833	0	0.71	0	56520	43973
1983/84	14850	856	26647	0.778	20731		856	0	0.71	0	26647	20731
1984/85	87709	960	140334	0.778	109180		960	0	0.71	0	140334	109180
1985/86	40000	1039	59134	0.778	46006	25522	1039	37730	0.71	26789	96864	72795
1986/87 +		1130	0	0.778		25522	1130	34692	0.71	24631	34692	24631
1990/91		1536					1536	34692	0.71	24631	34692	24631
Total	395977		675983		525915							

Sources: (1) Project Completion Report, BWDB Bogra, 1987
(2) Construction Cost Index, Dhaka, from BBS, July 1991 and BBS, December 1984 (National)
(3) Weighted average using FPCO, July 1991

In the without project case, in Table 11.2, it is assumed that the pre-project cropping pattern and yields would have continued, but that the area cultivated would have fallen to the same area cultivated in the with project case, due to river erosion.

The table shows that the project (BRE, Kamarjani reach) has achieved the primary goal of increasing rice production by protecting the area from the monsoon floods from the Brahmaputra. 3957 metric tons of incremental output from major monsoon rice crops are achieved annually from the project.

The major source of this positive incremental output is the shift of the long stemmed B. Aman acreage to HYV T. Aman due to the protection from floods by the BRE. The major sources of negative incremental output are the decrease in area and production of B. Aman, mixed B. Aus - B. Aman and T. Aman (Local).

The net incremental value of output (after deduction of production costs and net value of lost output) created by the project has been estimated to be about Taka 15.9 million per annum at 1991 financial prices (Table 11.3). Again, the major contributor to the net value of incremental output is HYV T. Aman.

For calculation of the incremental economic value of crop output due to the Project, a shadow conversion factor (SCF) of 0.97 has been applied to output (following FPCO 1991). Pre-Project production costs have been assigned an overall weighted SCF of 0.75, but post-Project costs are given an SCF of 0.85 in view of the growth in HYV T. Aman which uses larger amounts of fertilizer and chemicals. The net economic value of incremental crop output under these assumptions is TK. 13.6 million per year.

Table 11.2: Monsoon paddy production, pre-project, without and with project.

Item	Pre Project			Without Project			With Project		
	Area (ha)	Yield (t/ha)	Output (mt)	Area (ha)	Yield (t/ha)	Output (mt)	Area (ha)	Yield (t/ha)	Output (mt)
B. Aman L.	206	1.28	264	200	1.28	256	-	-	-
Mixed B. Aus-B. Aman	1235	1.65	2038	1197	1.65	1975	100	1.74	174
T. Aman (local)	5971	1.74	10390	5788	1.74	10071	1198	1.83	2192
T. Aman (HYV)	-	-	-	-	-	-	5887	2.36	13893
Total Paddy	7412	-	12692	7185	-	12302	7185	-	16259

Source Tables 4.2, 4.3 and Consultants estimates

Table 11.3 : Value of Incremental Output from major monsoon rice crops in BRE, Kamarjani Reach at 1991 (Tk.'000).

Crops	Without Project			With Project			Net Incremental Value of Output
	Gross Value of Output	Cost of Production	Net value of Output	Gross Value of Output	Cost of Production	Net value of Output	
B. Aman	1890	885	1005	-	-	-	-1005
Mixed B. Aus- B. Aman	14160	5297	8863	1239	564	675	-8188
T. Aman (Local)	81395	28361	53034	17543	6469	11074	-41960
T. Aman (HYV)	-	-	-	101703	34633	67070	+67070
Total (Financial)	97445	35543	62902	120485	41666	78819	+15917
Total (Economic)	94522	26657	67865	116870	35416	81454	+13589

Note i. Gross value of output includes value of both productions and by-products.
ii. Financial prices of inputs and outputs are based on RRA, 1991.
iii. Hectares under different crops, yield and gross output figures are taken from Chapter 4, Tables 4.2 and 4.3.
iv. For economic conversion factors see Section 11.4.2.

Source: RRA Results, 1991.

11.4.3 Disbenefits from Capture Fisheries

The Project has led to a substantial disbenefit in terms of annual loss of fish production. It is estimated in Chapter 6 that 80 per cent of the gross area (8080 ha) used to be floodplain and is no longer annually flooded. This gives an estimate of annual losses of 298.9 mt/yr. using the MPO guide of 37 kg/ha. This figure excludes losses from dried up beels, from rivers and khals within the project area and from the Jamuna, all of which are believed to be significant. An annual estimate of losses of 300 mt is therefore conservative.

Fisheries losses are valued in Table 11.4.

Table 11.4 : Unit Value of Fishery Losses

	1991 Prices	
	Financial Tk/kg	Economic Tk/kg
Average value of fish caught	55	55
Depreciation of equipment	10	7.1
Labour involved	30	21.3
Net value of losses	15	26.6 (say 27)

Source : Consultant's estimates.

The economic value of the annual fish loss is therefore estimated at Tk. 8.1 million.

11.4.4 Analysis

The economic cost benefit analysis using the basic assumptions described in the previous sections is presented in Table 11.5. The economic internal rate of return (EIRR) is 3 per cent and the benefit cost ratio (BCR) is 0.5.

Various sensitivity tests were then carried out. If Kamarjani costs were only 4 per cent of BRE costs, the EIRR would be just acceptable (12.9 per cent).

It was therefore decided to test what the EIRR would have been if the BRE had succeeded in protecting the T. Aman HYV crop every year. This would have increased the average annual yield from 2.36 mt/ha to 3.58 mt/ha (see Table 4.3) and increased the incremental monsoon paddy output from 3957 mt to 11139 mt. The incremental economic net benefits would have increased from Tk 13.6 million to Tk 64.6 million a year and as a result the EIRR would have been 38 per cent (Table 11.5) and the BCR an attractive 5.1.

An analysis of switching values shows that the EIRR is sensitive to quite small changes in assumed HYV T. Aman yields. If the average yield had been 2.50 ton/ha instead of 2.36 ton/ha an EIRR of 12 per cent would have been achieved (Table 11.7).

11.4.5 Impact on Employment and Income Distribution

The project has had a positive impact on creating additional employment in the construction and regular repair and maintenance of the embankment section. For example, a very rough estimation shows that the Kamarjani reach of the BRE (20 km) should have received about 1225 MT of FFW wheat during the construction phase, assuming that the total allocation of 13785 MT of wheat was uniformly used over the entire length of 225 km of BRE. Assuming that 278 man-days of employment of unskilled labour in earth work was created per metric ton of wheat, the total employment created by FFW wheat is likely to be about 933 man-year during the construction phase. Added to this is the employment of unskilled labour for repair and maintenance of the embankment sections, which is estimated to be about 70 man-year per annum for Kamarjani reach. These estimates are based only on assumed allocation of FFW, but there would be additional employment created for unskilled labour which was paid in cash as part of the construction as well as the O&M budget. It is important to note that the entire amount of this additional employment went to the poorer sections of the population.

Table 11.5 Economic Analysis of Cash Flows - BRE Kamarjani reach
Basic assumptions
(All figures in 1991 economic prices and Tk'000)

Year	Economic Costs of full BRE (1)	Cost attributed to Kamarjani (2)	Agricultural Benefits (3)	Fisheries Losses (4)	Net Cash Flow
1975 /76	1470	126			-126
1976 /77	12825	1103			-1103
1977 /78	0	0			0
1978 /79	0	0			0
1979 /80	0	0			0
1980 /81	0	0			0
1981 /82	291730	25089			-25089
1982 /83	43973	3782			-3782
1983 /84	20731	1783			-1783
1984 /85	109180	9389			-9389
1985 /86	72795	6260			-6260
1986 /87	24631	2118	13589	8100	3371
1987 /88	24631	2118	13589	8100	3371
1988 /89	24631	2118	13589	8100	3371
1989 /90	24631	2118	13589	8100	3371
1990 /91	24631	2118	13589	8100	3371
1991 /92	24631	2118	13589	8100	3371
1992 /93	24631	2118	13589	8100	3371
1993 /94	24631	2118	13589	8100	3371
1994 /95	24631	2118	13589	8100	3371
1995 /96	24631	2118	13589	8100	3371
1996 /97	24631	2118	13589	8100	3371
1997 /98	24631	2118	13589	8100	3371
1998 /99	24631	2118	13589	8100	3371
1999 / 0	24631	2118	13589	8100	3371
2000 / 1	24631	2118	13589	8100	3371
2001 / 2	24631	2118	13589	8100	3371
2002 / 3	24631	2118	13589	8100	3371
2003 / 4	24631	2118	13589	8100	3371
2004 / 5	24631	2118	13589	8100	3371
2005 / 6	24631	2118	13589	8100	3371
2006 / 7	24631	2118	13589	8100	3371

Calculations based on Kamarjani reach costs at: 8.60 percent of BRE costs

Economic Internal Rate of Return (%) : 3.02
Net Present Value of Benefits at 12 % discount rate: 11933 Tk '000
Net Present Value of Costs at 12 % discount rate: 23939 Tk '000
Benefit Cost Ratio at 12 % discount rate 0.50

Source: (1) Table 11.1
(2) Kamarjani reach costs at 8.60 percent of BRE costs
(3) Table 11.3
(4) See text

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Table 11.6 Economic Analysis of Cash Flows - BRE Kamarjani reach
High benefit (no flood damage) assumptions
(All figures in 1991 economic prices and Tk'000)

Year	Economic Costs of full BRE (1)	Cost attributed to Kamarjani (2)	Agricultural Benefits (3)	Fisheries Losses (4)	Net Cash Flow
1975 /76	1470	126			-126
1976 /77	12825	1103			-1103
1977 /78	0	0			0
1978 /79	0	0			0
1979 /80	0	0			0
1980 /81	0	0			0
1981 /82	291730	25089			-25089
1982 /83	43973	3782			-3782
1983 /84	20731	1783			-1783
1984 /85	109180	9389			-9389
1985 /86	72795	6260			-6260
1986 /87	24631	2118	64587	8100	54369
1987 /88	24631	2118	64587	8100	54369
1988 /89	24631	2118	64587	8100	54369
1989 /90	24631	2118	64587	8100	54369
1990 /91	24631	2118	64587	8100	54369
1991 /92	24631	2118	64587	8100	54369
1992 /93	24631	2118	64587	8100	54369
1993 /94	24631	2118	64587	8100	54369
1994 /95	24631	2118	64587	8100	54369
1995 /96	24631	2118	64587	8100	54369
1996 /97	24631	2118	64587	8100	54369
1997 /98	24631	2118	64587	8100	54369
1998 /99	24631	2118	64587	8100	54369
1999 / 0	24631	2118	64587	8100	54369
2000 / 1	24631	2118	64587	8100	54369
2001 / 2	24631	2118	64587	8100	54369
2002 / 3	24631	2118	64587	8100	54369
2003 / 4	24631	2118	64587	8100	54369
2004 / 5	24631	2118	64587	8100	54369
2005 / 6	24631	2118	64587	8100	54369
2006 / 7	24631	2118	64587	8100	54369

Calculations based on Kamarjani reach costs at: 8.60 percent of BRE costs

Economic Internal Rate of Return (%) : 37.54
Net Present Value of Benefits at 12 % discount rate: 122797 Tk '000
Net Present Value of Costs at 12 % discount rate: 23939 Tk '000
Benefit Cost Ratio at 12 % discount rate 5.13

Source: (1) Table 11.1
(2) Kamarjani reach costs at 8.60 percent of BRE costs
(3) See text
(4) See text

Table 11.7 : Results of Economic Analysis - Kamarjani Reach

Assumption	Kamarjani costs as Per cent of BRE costs	EIRR	BCR
Base Analysis (Table 11.5)	8.6	+3.0	0.50
Low cost assumption	4.0	+12.9	1.07
High benefit assumption (no flood damage) (Table 11.6)	8.6	+37.5	5.13
High benefit and high cost assumption	12.0	+31.7	3.68

SWITCHING VALUES

For the EIRR to exceed 12 per cent:

- Kamarjani costs would have had to be 4.2 per cent or less of BRE costs (49% of the base assumption);
- or annual agricultural benefits would have had to be at least Tk 19.2 million a year (41% over the base assumption). This would have been achieved if the average T. Aman yield had been 2.50 ton/ha, instead of 2.36 ton/ha;
- or fisheries losses would not have had to exceed Tk 2.59 million - 31% of the base assumption, or the equivalent of only 11.5 kg/ha, compared with the 37 kg/ha assumed.

Source: Tables 11.5 and 11.6 and Consultant's analyses.

The positive incremental output of major monsoon rice crops as discussed in the previous section generated additional employment of about 76,000 man-days (208 man-year) of employment a year (Table 11.8). As indicated earlier, the major source of this incremental employment was the additional production of T. Aman (HYV) in the post-project period.

It was not possible to estimate what proportion of this additional employment went to what socio-economic groups in the project area. However, it is understood that the additional employment was created in the post-harvest processing of rice, which went by and large to the women members of the households. Although the RRA could not quantify the magnitudes of such employment, it is clear that a significant proportion of additional post-harvest processing employment went to women of poorer households.

It was clear from the RRA that the loss of open-water capture fishery led to a substantial loss of employment of part-time and full-time fishermen, many of whom were forced to shift to other work at whatever wage they could get.

Although there has been some improvement in roads and transport due to the construction of BRE, the additional employment created in this sector appeared to be moderate. This is perhaps because the poorly maintained embankment section and the linear housing in most parts limited normal traffic.

11.5 CONCLUSIONS

The economic assessment of the project suggests that the BRE-Kamarjani Reach, has achieved a satisfactory increase in monsoon rice production. A provisional cash flow analysis indicates that the project is not economically viable.

The project has generated additional employment at an annual rate higher than the population growth rate. The overall equity implication of the project was not at all clear, although it was understood that a substantial portion of the additional employment created in the construction, repair and maintenance of the embankment went to the poorer section of the population.

Table 11.8 : Incremental employment from the major monsoon rice crops in BRE, Kamarjani Reach.

Crops	Without Project			With Project			Incremental employment (1000 md.)
	Ha	Md/Ha	Total Md. (1000)	Ha	Md/Ha	Total Md. (1000)	
B. Aman	200	87	17	-	-	-	- 17
Mixed B.Aus-B. Aman	1197	87	104	100	124	12	- 92
T. Aman (Local)	5788	124	717	1198	119	143	- 574
T. Aman (HYV)	-	-	-	5887	129	759	+ 759
Total	7185	-	838	7185	-	914	+76

Source : RRA Results, 1991.

12 THE PREVIOUS EVALUATIONS OF BRE

Three different previous reports contain discussions of the impact of the BRE. They are all associated with the completion of the Rehabilitation of BRE under IDA credit 864-BD, the first Drainage and Flood Control Project (DFC-1).

Only one of these reports was based on a field evaluation - the Evaluation Study by the Department of Economics of Dhaka University (DU, 1986). The FAO/World Bank Cooperative Programme used the Dhaka University data, and other information, in preparing a Project Completion Report (PCR) on DFC-1 (FAO, 1989). This material was then used by the World Bank Operations Evaluation Department in preparation of a Project Performance Audit Report (PPAR),(IBRD, 1990).

The Evaluation Study involved sample surveys in six purposively selected villages, three in the protected area and three in the "periphery". The logic in this is unclear. The "periphery" is presumably an area which was not threatened by flooding from the Brahmaputra. It is therefore by definition not a control area, as conditions there pre-project were totally different from those in the area that needed to be protected by the BRE. It may be argued that the objective of the BRE was to allow conditions (cropping intensities, cropping patterns) in the protected area to reach the same level as those in the periphery, but this is not explicit in the Evaluation Study. In practice the comparison of the project area and the periphery does not seem to have led to any firm conclusions about the impact of the BRE, although the DU team observed that in several key areas (cropping intensity in particular) the protected area had not yet reached the levels in the "periphery".

The main findings of the DU team on the impact of the BRE are:

- the proportion of the gross area cultivated had increased from 70 percent pre-project to 77 percent. This is a lower figure than the RRA figure (about 87 percent), and the Kamarjani RRA did not find any increase in cultivated area;

- the cropping intensity had substantially increased, from a range of 138 to 155 percent to an average of 191 percent. This change in cropping intensity was mainly due to an increase in cultivation of Boro. The link between this and flood control is not discussed in the report;

- yields had increased, as had use of fertilisers and irrigation;

- there was a negative fisheries impact, which was not quantified.

The FAO PCR used the DU data to derive an EIRR for the BRE. This produced the conclusion that the EIRR was 31 percent. In this calculation almost all the benefits were associated with increases in rabi season output - 50 percent from increases in Boro and 47 percent from increases in other rabi crops. This was noted by the PPAR, and its rationale was queried. Their doubts would be shared by the RRA team, who consider that in the Kamarjani area all BRE benefits relate to monsoon season cropping, as rabi crops are not threatened by flooding from the Brahmaputra.

The FAO PCR attempted to quantify the fisheries losses. As noted in Chapter 6 their estimates were far lower than those now being made.

Overall, as an evaluation of BRE impact the DU study was methodologically weak (in rationale for use of the "periphery" sample, in actual sampling methodology, in analysis of the results, and crucially, in any elaboration of the characteristics of pre and post project flooding and their association with project impacts) and its results were inconclusive. The study states that the original benefited area was 580 000 acres (234 000 ha) but that this had declined to 303 000 acres (122 622 ha). Although an "actual physical survey" is referred to, no maps or other data are provided to support this vital conclusion (which was ignored by the FAO PCR in its calculation of benefits).

Nevertheless the study included a number of observations on the infrastructure which deserve mention;

- the regular embankment retirements in the face of erosion from the Teesta and the Brahmaputra mean that the BRE does not provide a permanent solution to flooding problems in the area. The DU team found the situation "alarming" and were concerned at the possibility of the Brahmaputra joining the Bangali River and changing course substantially;

- the DU team made a number of specific engineering proposals, including groynes, cross bars, dredging, additional regulators and the introduction of surface and pumped irrigation facilities;

- the DU team, like the RRA team, were very concerned at the poor construction of the retired embankments - both in the quality of material used and in the lack of control over construction;

- the multiple uses of the embankment were observed. The DU team recommended that all illegal settlers be removed and resettled, and that bullock carts be banned from using the embankment;

- the value of the embankment as a road was noted and it was recommended that to facilitate this the crest width should be increased and that mechanical compaction techniques (road rollers) should be introduced;

- the harm done to navigation was also observed, and navigation locks were recommended;

- the low quality of O&M was observed and it was recommended that the procedures proposed in the O&M manual should be followed.

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