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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

17

# RAPID RURAL APPRAISAL OF KAHUA-MUHURI EMBANKMENT PROJECT

September 1991

Hunting Technical Services Limited

in association with

Bangladesh Institute of Development Studies  
Flood Hazard Research Centre  
Hunting-Fishtech  
Technoconsult International Limited

under assignment to

**UNITED KINGDOM  
OVERSEAS DEVELOPMENT ADMINISTRATION**

Sanyu Consultants Inc.

under assignment to

**JAPAN INTERNATIONAL COOPERATION AGENCY**



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A-494(1)  
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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
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- Protappur Irrigation Project
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- Improvement of Sukunia Beel
- Silimpur - Karatia Bridge cum Regulators
- \* Katakhal Khal
- Halir Haor
- Kahua Muhuri Embankment**
- Konapara Embankment
- Polder 17/2
- BRE Kamarjani Reach
- BRE Kazipur Reach
- \* Draft Final Report (2 Volumes)
- \* Final Report (2 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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**KAHUA - MUHURI EMBANKMENT PROJECT****Project Summary Sheet**

**Project Name** : Kahua-Muhuri Embankment Project

**Project Type** : Flood Control, Drainage and Irrigation

**Location**

**FAP Region** : South-East  
**District** : Feni

**Area (ha.)** : 2,638 (Gross)  
2,024 (net cultivable)

**Funding Agency** : Not available

**Implementing Agency** : EPWAPDA, BWDB

**Construction Started** : Not available

**Scheduled Completion** : Not available

**Actual Completion** : Not available

**Original Cost** : Not available

**Final Cost Estimate** : Not available

**Major Flood Damage** : Not available

**Repair/rehabilitation** : Not available



## KAHUA-MUHURI EMBANKMENT

### SUMMARY OF FINDINGS

#### BACKGROUND

The Kahua-Muhuri River Project is located in the Upazila of Parsuram in the District of Feni in a part of the flood plain of the R. Muhuri. The Upazila is a valley wedged inside the hills of the State of Tripura of India. The Muhuri is a highly meandering river which defines the boundary of the Project on three sides - north, south and west. The eastern side is bounded by the Kahua, originally a small stream formed by the joining of several smaller water courses coming down from the hills (charras). Surface run-off due to rain, particularly heavy rainfall, in and around the hills quickly finds its way into the Muhuri River. The Muhuri, due to its highly meandering character, is unable to drain off the water quickly and spills on to the adjacent areas causing serious damage to crops and property. Flash floods both during the pre-monsoon period and the monsoon were common in the area.

Since the British period there had been embankments constructed by the local people to protect their crops and property. In pursuance of the local endeavour, the then government, in 1965, connected the Kahua to the Muhuri River and also reexcavated it in order to release excess water from the Muhuri along its course and relieve the drainage congestion in the Muhuri. The subsequent result was that the Kahua discharge exceeded expectations, and the Kahua started overspilling its banks. Subsequently flood protection embankments were constructed on both sides of the Kahua River in 1980-81. No drainage, or flushing structures were constructed. A weir was constructed across the Kahua in 1985-86. The only drainage canal within the Project area is the Chithalia Khal which drains into the Kahua. At present a regulator is being built at their meeting point.

The land elevation is between 21.5 ft to 36.5 ft PWD and slopes from the north to the south and from the west to the east. The soil is mostly grey flood plain and non-calcareous, having silty clay to sandy loam characteristics. Available information indicates fifteen percent of the area to be high land where vegetable is the main crop in the rabi season. In the medium high land which covers some fifty percent of the land area, B. Aus once used to be the main crop. The rest of the area was low lying, growing no crop.

The Project was implemented in different phases according to the local needs. As relevant documents were not available, nor could the concerned officials offer much background, the RRA team had to rely almost exclusively on observations in the field and interviews with local people to form an understanding of the Project objectives. These indicate that the objectives of the Project were :

- to drain off excess water from the Muhuri to protect the Project area from flood and thereby save T. Aman from flood damage; and
- to facilitate irrigation for HYV Boro cultivation.

Both objectives have been achieved to a limited extent, but the annual cycle of embankment breaches and rehabilitation cast some doubt on the economic viability of the approach adopted to fully control the heavily silt-laden flash floods.





## PROJECT STATUS

The flood control embankments encircling the Project area (of 2638 ha.) were constructed in different phases. Resectioning is carried out every year. Due to the highly meandering nature of the Muhuri, severe scouring occurs every year in different places, decreasing the set back distance in such places to virtually nil. Moreover, local people cut the embankment to install low lift pumps or to permit gravity irrigation. Later, they seal these cuts with loose sandy soil which undermines the strength of the embankment. As a result, the embankment is breached quite easily during the following monsoon and flood water enters through those breaches damaging the T. Aman crop. Along with the flood water comes the silt, heavily laden with sand from the hills raising land levels and reducing fertility. During the next Boro season, the gap remains unfilled and when pre-monsoon flash floods occur the Boro crop is also damaged.

On the Kahua River side local people cut the embankment during floods to save their houses and crops.

The only drainage canal, the Chithalia Khal, was re-excavated in 1990, but still appears to be silted up in most places. Poor drainage due to the silted up canal causes water congestion in the low-lying areas. A 3-vent drainage-cum-flushing sluice at the outfall of Chithalia Khal is under construction. Fifteen new irrigation/flushing inlets were recently proposed to be constructed but none have been built yet. The existing inlets have either silted up or are inactive.

## PROJECT PERFORMANCE AND IMPACTS

### Agriculture

Agriculture in the Project area is dominated by the predominance of Boro HYV during the rabi season. Practically all available land is cultivated, Boro in the low-lying and medium high land and sweet potato, potato, chilli and vegetables on higher ground where irrigation may be needed due to soil moisture stress.

The increased area under Boro HYVs may or may not be a direct impact of the Project but it is clear that, due to the weir on the Kahua River, gravity irrigation is facilitated and farmers are able to cultivate Boro HYV and winter vegetables at a lower production cost.

There are almost annual rises in land levels due to silt deposition from the Muhuri, as breaches are a common phenomenon and these lead to changes in the locations of land devoted to T. Aman HYVs during the monsoon period. The general pattern is that wherever water logging does not prevent it, T. Aman is cultivated and an increased area now seems to be under such cultivation.

Local varieties have been replaced by HYV varieties. This results in increased yield. If there were no breaches in the embankment the farmers could harvest as much as 75 maunds of Boro rice per acre of land. Yields of T. Aman are high as farmers have now switched to HYVs. All these together indicate a positive impact of the Project, provided there is no public cut or breach on the embankment.

Potato, sweet potato and groundnut are cultivated near the river banks. Winter vegetable cultivation is widespread in the homestead areas and on other high lands.

The use of inputs has increased enormously with the cultivation of high yielding varieties. The use of fertilizer, pesticides, power tillers and mechanical threshers increases the marketing of those commodities and encourages non farm economic activities.

### **Livestock**

The cattle population has decreased in the Project area for several reasons. These include:

- a) shortage of green fodder due to increased crop cultivation;
- b) increased cultivation of HYVs which yield less straw, and are low in feed value;
- c) increased crop failure due to repeated flood.

Power tillers have now mainly replaced bullocks as the source of draught power. The fall in the cattle population, and reduced availability of green fodder, have resulted in reduced milk production.

The goat population has decreased due to non-availability of feed and shelter during flood, while the chicken population has increased. Cross breed chickens are common in the Project area. One also finds a lot of ducks there. In general animal health is very poor due to the lack of feed and prevalence of parasitic diseases.

### **Fisheries**

Inside the Project area, the Chithalia Jala remains the major open fishery. The construction of the embankments, in general, would be expected to have had an adverse impact on such fishing grounds, provided no attempts are made to stock them. As the embankments have been found to fail frequently, one might expect that this has not happened. The situation is quite the opposite. The deposition of silt noted earlier is raising the level of the ground every year, thus restricting the habitat and free movement of fish. The decreasing depths and areas of the water bodies are adversely affecting production from the open water fishery in the area.

Pond fish culture is common in the Project area. It has increased to a great extent and new ponds have also been excavated. Although closed water fish culture has expanded, improved cultural methods are infrequently followed. Due to the repeated breaches in the embankment pond fishery faces problems as sometimes the ponds are overtopped and the farmers lose their fish and income.

### **Environment**

The most important environmental issues in the Project area are regular sedimentation, increase in land elevation and bank erosion. The sediment load of the two rivers, particularly of the Muhuri when it overflows, result in the raising of land elevation, deposition of sand, reductions in the area of habitat for wild fish and creation of pockets of waterlogging and moisture stress affecting crop agriculture adversely.

There are problems of environmental hygiene in many places. Waterlogging in small pockets creates ideal grounds for mosquito breeding and consequently one hears complaints about increased infestation of mosquitoes. Although one finds hand tubewells being used for



drinking water, ponds are still used for all other types of washing. It is not surprising that the incidence of skin diseases is rather high.

### **Women**

The Project appears to have had no significant impact on women except probably among those who are or have been involved in making fishing nets. The decrease in fishery output and activity is almost bound to have reduced their income except in the case where these are exported to areas outside the Project. Other traditional activities like mat-making do not seem to have been affected at all.

### **Social and Institutional Aspects**

As has been stated above, resectioning goes on at one place or another along the embankment almost every year under the Food for Work programme. Such activities create seasonal opportunities for labour employment. On the other hand there is a large demand for labour in agriculture which cannot be met from the available supply of local labour. This creates opportunities for migrant labour from outside, who have been found to be employed by many households during both the Boro and the Aman seasons.

There are quite a few informal samitis in the area which are active in organising people for voluntary labour to make bamboo spurs for use against bank erosion. In many places one finds collective activities by people or their samitis for provision of permanent irrigation inlets.

Such activities are voluntary, without any attempt by state agencies to coordinate them. Nor does one find any inter-agency cooperation among such bodies. The only evidence of state intervention is the resectioning of the embankment for which Project Implementation Committees have been formed in some places. State intervention has not necessarily been helpful everywhere. At the site where a weir has been constructed, one particular individual has usurped the function of the irrigation committee and collects rent at a high rate from the farmers.

### **Economic Impact**

The project, despite the problems of breaches and erosions has benefited the people in the area by substantially raising income from crop agriculture. As a result, despite the loss in fisheries, the Project has been found to be economically viable. The estimated EIRR is 96 per cent while the NPV is Tk.130 million (at 1991 prices).



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## ABBREVIATIONS AND GLOSSARY

BIDS	Bangladesh Institute of Development Studies
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
CARE	Cooperative for American Relief Everywhere
DTW	Deep tube-well (with positive-displacement pump)
EIP	Early Implementation Project
FAP	Flood Action Plan
FAO	Food and Agricultural Organisation
FCD/I	Flood Control Drainage and Irrigation
FPCO	Flood Plan Coordination Organisation
HYV	High yielding variety
JICA	Japan International Cooperation Agency
khal	Natural channel
Khalashi	Cleaner (actually guard) of regulator
LLP	Low Lift Pump
LV	Local Variety
LIV	Local Improved Variety
Madrasah	School for religious education
MBSS	Mahila Bittahin Samabaya Samity
NGO	Non-government Organisation
ODA	United Kingdom Overseas Development Administration
PP	Project Proforma
PWD	Public Works Department
Parishad	Council
SDE	Sub-Divisional Engineer
SE	Superintending Engineer
STW	Shallow tube-well (with suction pump)

## 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 Kahua-Muhuri Embankment Project.

### 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.





### 1.3 THE AREA

The area between the Kahua and the Muhuri Rivers is situated in the Upazila of Parshuram in the District of Feni. The Upazila is wedged between the hills of the State of Tripura, India. The area enclosed by the two rivers is rather small, only about 2600 ha encompassing 14 mouzas of varying size. The boundary of the Project area is defined completely by the two rivers.

### 1.4 THE PROJECT

The Muhuri originates in the hills of the State of Tripura in India and enters Bangladesh near Belonia, alternatively called Majumderhat (Figure 1.2). The river runs along the length of the Upazila of Parshuram of the District of Feni from the north to the south before entering the adjacent Upazila of Chhagalnaiya and turning westward and meeting the Bay of Bengal. Within the Upazila of Parshuram, the Muhuri exhibits a highly meandering behaviour. Given that the Upazila is a valley between the hills (of the State of Tripura, India) heavy rain in and around the hills turns rather quickly into flash floods of the Muhuri which cannot drain the water quickly due to its meandering character and often overflows the banks into the surrounding areas damaging crops and property. There have been several attempts to overcome the problem of flash floods in the past.

The Kahua was previously a small stream created by several *chharas* (hilly streams) coming down from the hills. At its northernmost point it was very close to the Muhuri. One logical way of lessening the drainage congestion in the Muhuri and thereby lowering the chance and/or severity of the flood from that river was to divert a part of the water into the Kahua. Accordingly a diversion channel was built over some 7 to 8 years during 1958-65. It was envisaged that of the 5000 cusec of water the Muhuri carries, 1000 cusec would be so diverted. It is not clear whether the flow refers to the peak monsoon flow or the average flow.

An embankment existed along the Muhuri since the British period. Apparently, it was later reconstructed during the late sixties and certainly before Bangladesh came into existence. During 1980-81, an embankment was put in place along the banks of the Kahua. Over time small repair and maintenance works have been carried out utilising wheat under the Food for Works Programme. Such works include attempts at loop cutting at certain locations along the Muhuri.

Over time other add-on structures have also been put in place. A weir was constructed in 1985-86 to help in surface water irrigation. As has been seen in the case of other projects like the Chalan Beel Polder D, the state-provided resource has been put to use for private profiteering by locally powerful people. Recently, some re-sectioning of the embankments and attempted construction including the provision of a regulator at the outfall of the Chitholia Khal have been going on for a few months under the "Structures for Kahua River Sub-Project".

The above description indicates that there has been no single flood control project in the Project area. From time to time, there have been *ad hoc* add-ons in terms of structures. There seems to have been little thought of any integrated attempt at solving the problem of water management in the area. Although the water control structures along the Kahua are of comparatively recent origin, those along the Muhuri date back to periods about which people can say little or nothing. As we have found out it is the Muhuri which is the real source



of the problems of water management in the area and which regulates the hydrology in the region. Thus what the RRA team has actually been forced to do has been to find out about the problem in the area and judge the impact of the water control structures by looking at differences in response of people in locations at eroded parts of the embankment and those which seem to be in good order.

### **1.5 TWO CAVEATS**

The RRA team faced two major problems in evaluating the Project. One has been that of defining the Project as described above. The other had been a complete lack of any project related documentary information. Some data related to the Project area do exist. These have been used. In any case the lack of direct Project-related data forced the RRA team to depend on people's description of the past without any means of verification or cross-checking. The impact of the Project as described under different sections below should therefore interpreted cautiously.

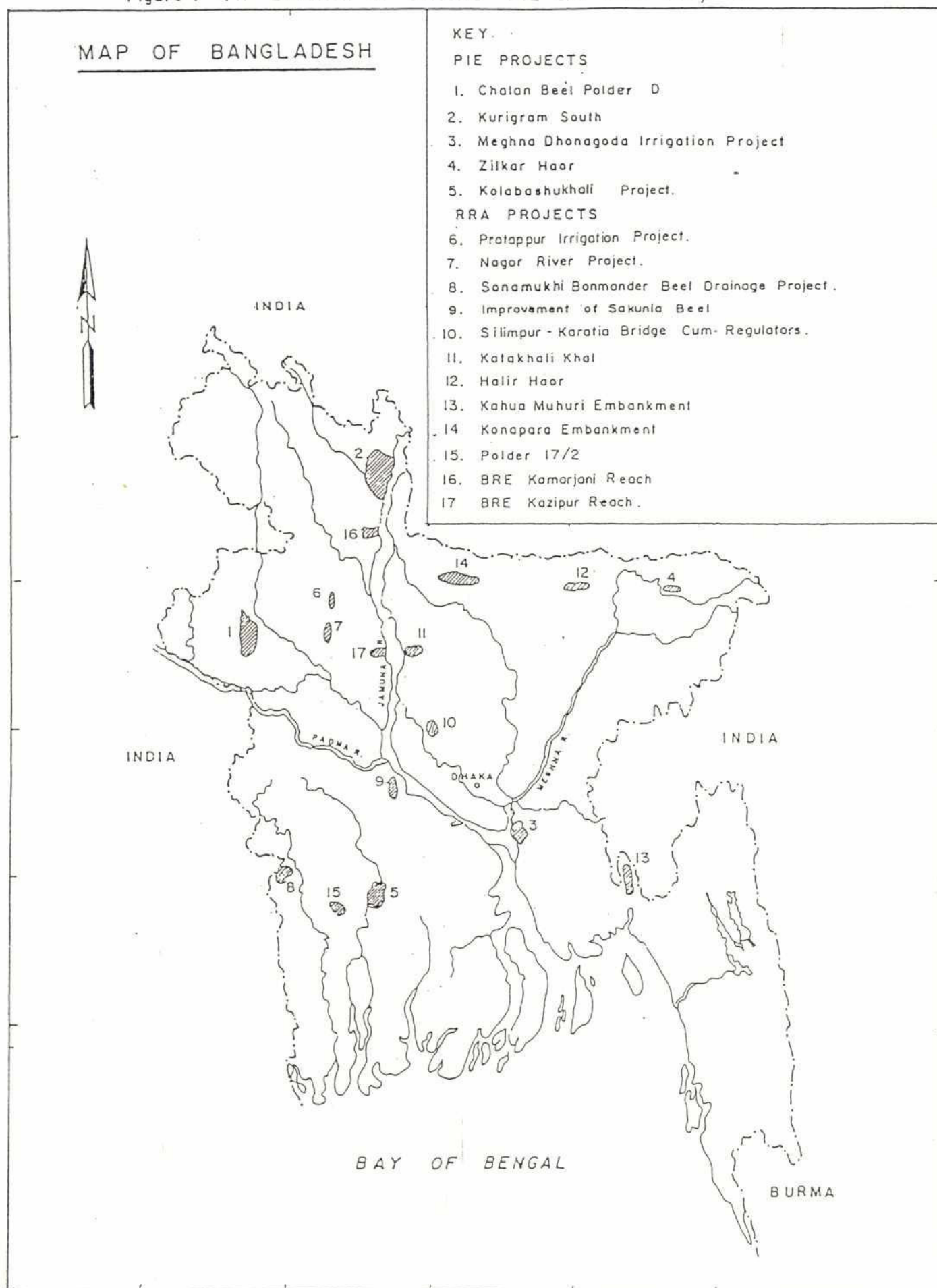
### **1.6 ACKNOWLEDGEMENTS**

The RRA team has been cordially received everywhere. The BWDB officials, especially the S.E. and Executive Engineers of Muhuri Project helped the team with available information and also arranged for its accommodation.

The Upazila Chairman of Parshuram and other Upazila officials including the UNO, the UAO, UFO and the LGEB engineer at Parshuram all had gone out of their way to share information and discuss problems of the Project area at length with the RRA team. All of them deserve special thanks.

We thank the personnel of the BDR who took us to the border point where Muhuri enters Bangladesh and brought us safely back. The village people in the Project area deserve our most sincere thanks because they provided us with the most vital information for understanding the operation and impact of the Project. Special mention here must be made to the office bearers of the Chagram Samabaya Samity and the boys of the local club at Paschim Ghoniamora.

Figure 1.1 Location of Selected PIE and RRA Projects





## 2 ENGINEERING DESIGN, IMPLEMENTATION AND PERFORMANCE

### 2.1 THE PROJECT

The Kahua-Muhuri Embankment Project, encompasses an area surrounded by the Muhuri River on the north-west, the south and the south-west and the Kahua River on the north-east and the south-east. The Project area measures 2638 ha of which 24 per cent may be categorised as high land (elevation > 31.5' PWD), 38 per cent as medium land (elevation in the range of 26.5' - 31.5' PWD) and 38 per cent as low land (elevation between 21.5' - 26.5' PWD). From the general direction of the north the land gradually slopes down towards the central region, Chithalia *Jala*, (see Figure 1.2) and then towards the south-eastern side of the Project area.

The Project area is completely surrounded by the embankments along the Muhuri and the Kahua Rivers. BWDB constructed a weir, a water retention structure, across the Kahua River at Berabaria in 1985-86.

### 2.2 PRE-PROJECT SITUATION

The Project area was and has remained a flood plain of the Muhuri River since the British period. Since then this area has been submerged time and again by the overflow in the river, particularly due to the flash flood, during the pre and the peak monsoon periods, of the Muhuri River. The Muhuri originates from the Tripura hills of the State of Tripura and carries water from an undefined and hilly catchment area. This area has a high level of rainfall, 3416 mm on an average per year. As a result of the nature of the terrain, whenever rainfall occurs in and around the region, the water quickly finds its way into the Muhuri and causes flash floods. The problem becomes more acute during the peak monsoon when the Muhuri, because of its highly meandering nature, cannot drain water quickly and easily overflows its banks causing widespread inundation, erosion and sand deposition.

On the eastern side of the Project area is the Kahua River, a small stream, originated from the combined flow of a number of small water courses (locally called *chharas*) carrying water from the hilly regions of State of Tripura in India. The river previously had no link with the Muhuri in the north but converged with the latter near Daulatpur at the southern tip of the Project area (see Figure 1.2).

Local people used to construct dwarf embankments along the Muhuri River in order to prevent submergence from flood water. They also used to construct earthen cross dams across the Kahua River for retaining water for irrigation during the dry season.

In the central region of the Project area there is a large low lying area (about 50 per cent of the Project area) called Chithalia *Jala* (literally meaning water-logged) which previously remained under water for most of the year precluding its use as agricultural land.

### 2.3 PROJECT HISTORY AND OBJECTIVES

In order to prevent flooding caused by overspilling from the Muhuri a flood embankment was constructed along the river in the late British period. Later when the flood



water discharge through the Muhuri River had become excessive, the Kahua was re-excavated and joined with the Muhuri River at its upper (near Purba Aloka) and lower reaches (near Jagatpur) with a view to bypass the excessive discharge through the latter. It was envisaged that some 1000 cusec of the flow of the Muhuri would be diverted in this manner. Apparently, the scheme became more than successful in that the Kahua began, as people claim, discharging more than the intended volume of water from the Muhuri and as a result a few years after the 'diversions', the Kahua began overspilling its banks. In response, a flood embankment was constructed along both banks of the Kahua by the BWDB in 1980-81. In 1985-86 BWDB constructed a water retention structure across the Kahua River at Berabaria in order to facilitate irrigation in the eastern part of the Project area.

The above section clearly indicates the objective of the Project(s). This has been to reduce the flow along the Muhuri, to check flood water from intruding into the Project area and prevent erosion and sand deposition. The objective of the construction of the weir has been to facilitate dry season irrigation. There was no objective related to drainage of water from the Project area, which is the objective of an on-going Project which aims at draining the water logged Chithalia Jala by excavating the Chithalia Khal which connects the Jala with the Kahua, and construction of a regulator at the outfall of the khal at East Ghaniamora.

## 2.4 DATA SOURCES

Despite every effort both at the BWDB headquarters in Dhaka and at the SE's office at Feni the RRA team failed to find any previous feasibility report or Project Proforma for any of the previous Projects which form the parts of the flood protection structures of the Kahua - Muhuri River embankment. Two reports which provided some glimpses into the problems of the area have been available, however. The first is a socio-economic feasibility report on a proposed (but never implemented) Project for flood control and drainage improvement of the area under the EIP programme. The second is a feasibility report on an on-going Project, "Structures For Kahua River Sub-Project".

In such a situation of almost complete absence of data, the RRA team had to rely mainly on discussions with officials and people in the area. The BWDB officials, of course, were a major source of information. Discussions with other Upazila officials including the Chairman of the Upazila Parishad of Parshuram, the Upazila Nirbahi Officer and the Upazila engineer provided additional insights. The most important source, however, was the people themselves who recounted stories and anecdotes related to the Project and helped in understanding the nature of the impact of the Project quite clearly.

## 2.5 THE PRESENT SITUATION

The points that may be highlighted before a review of the present situation regarding the Project and Project area can be made are as follows:

- i. The original embankment along the Muhuri is of quite old vintage;
- ii. The joining of the Kahua with the Muhuri, the construction of the embankment along the Kahua and later a weir are comparatively recent phenomena; and



- iii. The problem of water-logging, till recently, has not received any major attention from the BWDB.

### 2.5.1 Embankment

Since the original construction of the embankment along the Muhuri, it has been reconstructed/resectioned several times. The RRA team observed several such on-going reconstruction/resectioning works.

During the inspections made of the embankment along the Muhuri, it became quite clear that the highly meandering nature of the river coupled with occasional high flash floods causes severe scouring in many places. As a result the embankment has been severely damaged in many places and also breached in 1990 in one place, Ratanpur, with an estimated 500 ft gap. Quite obviously, the set back distance in many places is practically zero. One finds evidence of damage in places like Purba Aloka, Rampur, Durgapur, Ratanpur and Joypur which have been repeatedly damaged by the flash floods.

The damage to the embankment has been found to be caused not only by natural factors like the flow of a very heavy volume of water. In places, rat infestations are very extensive thus making the embankments easily breachable as happened in the case of the Ratanpur breach mentioned above. But more interesting than such natural factors has been the ones caused by human interference.

During the post-monsoon period, local people install low lift pumps near the embankment to lift water from the Muhuri River for irrigation. As the water level in the Muhuri River is low during this time the local people cut the embankment at the pump locations to reduce the relative elevation of the discharge pipes to get a better discharge. Once the irrigation requirements are met they fill up the cuts in the embankment rather loosely, and the fill ultimately gets washed away by the subsequent flash flood or when there is heavy rainfall in the locality. Such damage occurred to the Muhuri River embankment in 1989 and 1990 at Purba Aloka and in 1991 at Ratanpur and Joypur.

During the field investigations, it was observed that the people are not completely dependent on the BWDB or other official organizations for the solution to their problems. People have constructed spurs made of bamboo, thatched sheets, tree trunks, etc., to reduce erosion and scouring. They have also become aware of the problem created by loose filling of cuts in the embankment made for irrigation purposes. As a result in some places one finds pucca irrigation inlets constructed by the people themselves. Cuts are no longer needed in such places.

The Kahua River is less meandering than the Muhuri, has a lower width to length ratio, and has been more stable than the Muhuri River. As a result, one does not find much of a problem of scouring or erosion of the embankment. Breaches and public cuts, however, are equally observed on the Kahua side of the embankment. Public cuts were found to have been made for dry season irrigation and also for draining out stagnant water. The RRA team found two public cuts on the embankment at Purba Ghoniamara made by the local people for drainage of excess water. Later the cuts developed into full-fledged breaches. Sometimes these breaches cause inundation within the Project area due to back flow of water from the Kahua River during the peak monsoon period when the river is high. This happened also in case of the Purba Ghoniamara breaches.





### **2.5.2 A Weir for Water Retention**

The local people in the villages along the banks of the Kahua used to construct earthen cross dams across the river for retaining water for dry season irrigation. In support of such local practices BWDB, in 1985 - 86, constructed a weir across the Kahua at Berabaria in order to retain water and control the discharge.

This structure functioned well as long as the stoplogs were in good condition. At present most of the stoplogs have been found to be damaged. The vents are closed by wooden planks and corrugated iron sheets which cannot effectively impound water behind them.

The river banks on the immediate down stream side of this structure, especially the left bank, have been severely damaged. This might have happened due to asymmetrical placement or removal of the stoplogs and/or temporary constrictions created by the failure of the slope of the right bank immediately downstream of the weir.

The structure is operated by a villager who is assisted by some others. It seems, however, that the state-provided resource has become a source for extraction of scarcity rent and thus become a focal point for social conflict as discussed later in Chapter 6.

### **2.5.3 The Kahua River Sub-Project**

This sub-Project aims to provide flood protection, drainage improvement and some irrigation facilities in an area of about 740 ha in and around the Chitholia Jala. In order to fulfill these objectives the sub-Project includes the implementation of a drainage-cum-flushing regulator, re-excavation of Chithalia Jala khal, construction and re-construction of embankments along the Kahua River, and construction of ten irrigation flushing inlets along the Kahua River embankment and five such inlets along the Muhuri River embankment.

At present some re-sectioning works on the embankment along the Kahua and re-excavation of Chithalia Jala Khal have been completed. However, most of the re-excavated portion of the khal has been silted up after intrusion of flood water through the breach at Ratanpur in 1991. The construction of the 3-vent drainage-cum-flushing regulator at the outfall of the Chithalia Jala Khal has been progressing slowly; the construction work remained stopped for a long time apparently due to low bidding by the contractor coupled with increased material and transportation costs. The construction of 15 irrigation inlets along the embankments of the Muhuri and the Kahua Rivers could not be traced, and possibly these are yet to be constructed. More interesting, however, has been the failure of the RRA team to find any trace of a newly constructed embankment along the Kahua. In fact, the whole of the Project area is completely circumscribed by embankments and as such there is no scope for any completely new construction. There can be only resectioning or reconstruction of the embankment.

## **2.6 OPERATION AND MAINTENANCE**

The operation and maintenance of the Kahua-Muhuri Embankment suffers from a peculiar anomaly. Due to some rearrangement in organizational structure of the BWDB in that area the Project has been and will continue to remain under the Noakhali O & M Division even though there exists similar a official structure in Feni District where the Project is situated. As



a result, inadequate attention is given to operation and maintenance of the Project. At the same time it is also true that the Kahua-Muhuri embankment Project, has undergone many repairs, rehabilitation, re-construction and renovations in different periods. While some of these are due to initiatives taken by the people themselves, one particular reason is the initiatives taken by the local governments which clamour for funds at the Upazila headquarters and thus obtain allocations of wheat, however adequate or inadequate, for the earthwork. It may be that in the final analysis, the wheat may form a part of the broad allocation in favour of the BWDB, but the fact remains that the initiatives taken by the local governments, particularly the Union Parishads remain a major factor in the operation and maintenance of the Project.

## 2.7 CONCLUSIONS

Very little secondary material on the Project under study has been available. In the absence of any proper documentation it is difficult to hypothesise about the specific objectives of the Project and to check if these have been achieved. In such a situation it is only possible to make speculative statements on the possible objectives and their attainment. In the case of the Kahua-Muhuri Project, the problem becomes more complicated because there have been various infrastructural additions at different times by more than one agency including the local people.

The basic problem of the area is flash flooding during the pre- and peak monsoon periods. This is natural consequence of the area's situation close to the hills. The problem is compounded by the meandering nature of the Muhuri.

The embankment along the Muhuri River has been partially successful in realising its objectives. The achievement has been only partial because of failure of the left embankment of the Muhuri. The causes of failure are both natural and due to human actions. The energy of water during the flash floods flowing along a meandering river has often proved to be too much for the embankment to withstand, leading to serious erosion and breaches. On the other hand, the embankment has been cut in some places during the dry season for irrigation utilising river water. The cuts, prior to the next rainy season, have been only improperly filled up and often became the spots for the next season's breaches.

On the side of the Kahua, which is much less meandering than the Muhuri, the banks appear to be more stable although it is carrying more water than was expected. Still, here too there is evidence of breaches because of earlier public cuts and their improper filling.

The weir appears to be more successful than the other structures in that it has been serving the local community well in terms of providing irrigation water, although other problems of a social nature have cropped up (see Chapter 6 for details). The weir, however, also appears to be under threat due to erosion of the embankment on the upstream side.

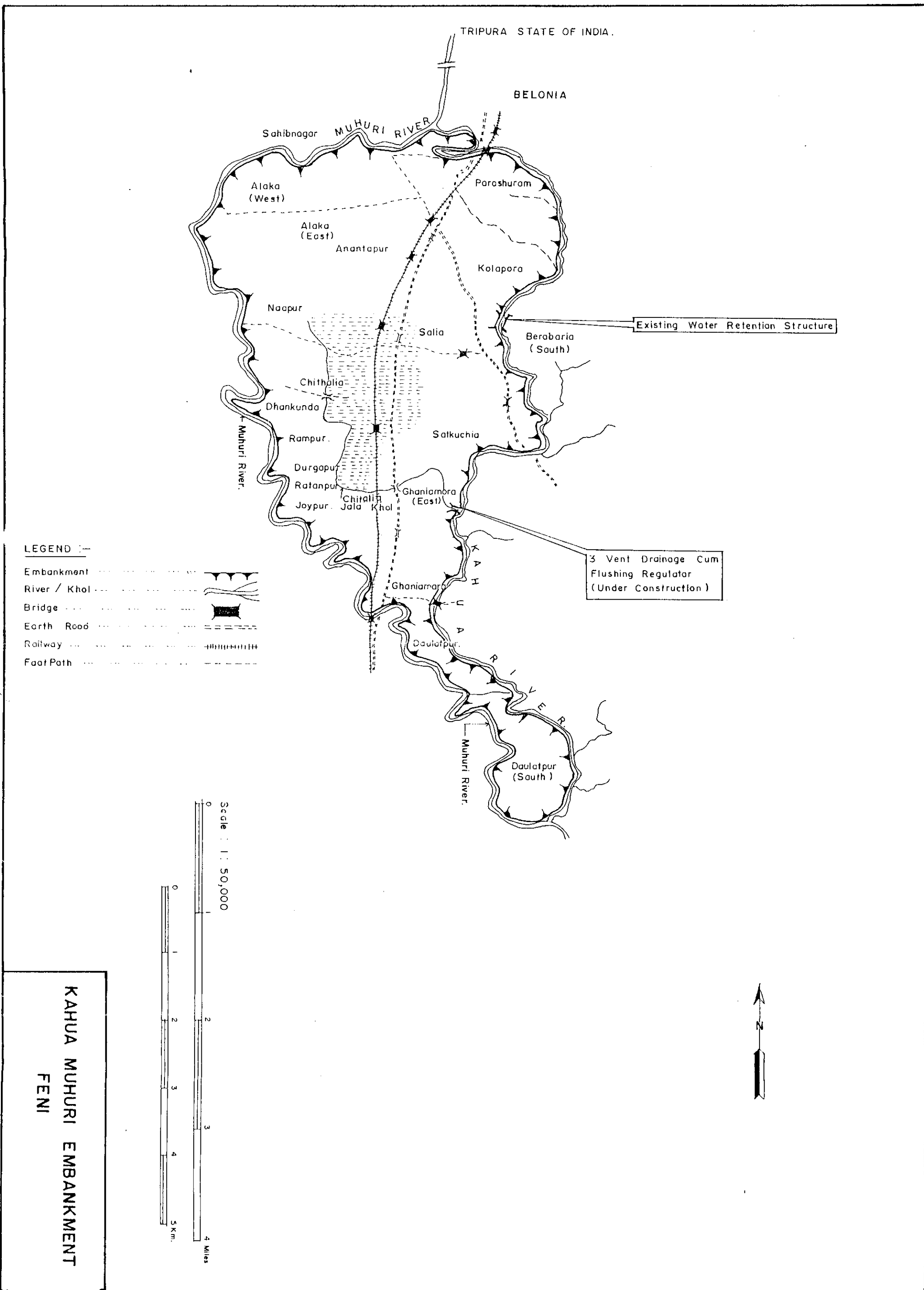
The construction of the irrigation flushing inlets along the Kahua and Muhuri River embankments has yet to be completed. The number of such inlets considered for the Muhuri River side would hardly fulfill their intended purpose compared to the large number of LLPs being used at present by the farmers for irrigation.

The Project area still suffers from various problems of a hydrological nature. To remove them several measures should be taken. One of these is to cut loops in certain

places along the course of the Muhuri. Such loop cuts will allow the water to flow in a more direct course and will help in protecting the embankments from severe erosion.

There remains a problem of stagnant monsoon and/or flood water in the Purba Ghoniamara, and a couple of embankment cuts in that area would certainly justify the construction of a sluice/regulator. The construction of a 3-vent regulator at the outfall of the Chithalia Jala Khal is still ongoing. As such, it is not possible to assess its actual performance, and whether or not this regulator would contribute to lessening the drainage congestion in and around Purba Ghoniamara.

Overall the Kahua - Muhuri Embankment Project, together with the add-on constructions at different times, would function well if quality of work for the embankments could be ensured at least by educating people about how to properly fill up the cuts they make during the dry period. Another way of ensuring this would be to construct the much needed irrigation inlets in time. The need for these inlets has been forcefully expressed by the people by constructing their own inlets in a cooperative fashion using their own money without waiting for the state authorities to provide them.





### 3 AGRICULTURE

#### 3.1 PRESENT PROJECT SITUATION

##### 3.1.1 Physiography

The Kahua - Muhuri Project area is part of a piedmont plain characterised by an uneven level and broad floodplain ridges, inter-ridge depressions and a small basin. It occupies a narrow belt gently sloping outward from the foot of the adjoining hills. The land elevation as stated earlier is between 21.5 ft to 36.5 ft PWD and slopes from north to south and from west to east, with irregular ridges. The north and north western part of the Project area falls in the category of high land on the basis of observed maximum flood depth. The south and southeastern part is in the low land category. Medium land falling in-between accounts for the rest of the Project area except the central and southeastern part which is a natural depression (Chitholia Jala).

##### 3.1.2 Soil

The soil of the Project area is mostly noncalcareous grey flood plain soil with a little admixture of grey piedmont soil. These types of soil have a grey or olive-grey, sandy loam or silty clay topsoil and the reaction is strongly acidic (pH 4.5 to 5.5, FAO, 1988). The proportion of organic matter in the topsoil is about one percent. The higher ridge soils are highly permeable and have a low moisture holding capacity. Much of the topsoil is in a puddled state leading to low permeability and high - moisture holding capacity. Lower layers generally are more permeable and have a moderate moisture - holding capacity.

##### 3.1.3 Land Level

As described in more detail in Chapter 2, the Project area can be divided into three categories depending on their height from the mean sea level. The respective proportions of the high, medium and low land in the Project area of nearly 2600 ha are 24 per cent, 38 per cent and 38 per cent. These heights have been determined on the basis of planimeter readings using the topographical maps which are about quarter of a century old. Thus, while these may depict the situation obtaining at the beginning of the Project (at the time of diversion of flow of the Muhuri partly along the Kahua), they may not necessarily hold any more because of very extensive sedimentation, sand deposition and raising of the level of land particularly in the low level category. As a result, at the margin, there may have occurred changes in the land levels from low to medium and from medium to high. As discussed below, this has created both problems and new opportunities in agriculture.

##### 3.1.4 Agroclimate

Compared to the average Bangladesh situation, this is a relatively wet region. The mean annual rainfall is high in the Project area (3416 mm). The pre-kharif transition period lasts about 40-45 days. The reference rainfed kharif growing period is short (230 days). The reference rabi growing period is 120-125 days. The mean annual temperature is 26°C. The mean date when the daily minimum temperature starts to fall below 20°C (the time limit within which Aman paddy plants should complete flowering) ranges between 10 to 16 November.

### 3.1.5 Problems of the Area

Flash floods, as described in the section on engineering, are the major problem in the area. These floods are becoming more severe and more frequent possibly because of the settlements in the hills surrounding the general Project area. Two types of problems arise due to the new settlements. Previously, as testified by people in the area who temporarily cross the international border, much of the rainfall used to accumulate in natural reservoirs formed by the hills. The spreading settlements in many places have demolished these hills, destroying the natural reservoirs and allowing the excess water to come down and flow through the Muhuri and other rivers in the area.

Secondly, because of the spreading settlements and population pressure, the hills are being stripped of trees, thus causing degradation and soil erosion. With the flash floods, therefore now comes large volumes of the sediment.

The inflow of water puts a heavy pressure on the carrying capacity of the river and as a result breaches occur frequently in the embankment. Through the breaches, water enters the Project area inundating farm land and sometimes homesteads, and causes damage to the Aus, Aman and Boro crops.

In the lower part of the area and towards the Kahua, water stands for a longer period of time. Public cuts are made in the Kahua River embankment to facilitate the drainage of stagnant flood and rain water. The area suffering from stagnant water is virtually a single crop area (HYV Boro).

Floods, as stated earlier, bring in huge quantities of sediment, mostly sand which lacks organic matter. When breaches occur, whether naturally or due to earlier public cuts, the flood water leaves behind vast areas of sandy deposits. This creates two types of problem for crop cultivation. In the first place, the land becomes less suitable for paddy cultivation due to lack of organic materials. Secondly, the land level is raised in many areas changing the natural moisture availability, possibly making them less suitable for transplanted Aman, HYV Boro and T. Aus cultivation.

Before the embankments along the Muhuri and the Kahua had been constructed, flood water could enter the Project area from the Muhuri River and recede through the Chithalia Khal. Water did not stand for a long period of time. Due to river erosion and the frequent breaches in the embankment, the land level has been raised along the river bank on the Project side, including that of the Kahua. This creates water congestion in the low lying areas of Chithalia and Ghaniamora as natural drainage is impeded. As a result, the land remains fallow during the Kharif season in this area (Table 4.4).

### 3.1.6 Land Level and Land Use Pattern

The Project area may be divided into three land levels, high, medium and low as defined in Chapter 2 and shown in Table 3.1. The land levels are typified by specific cropping patterns depending on other characteristics.

High land, defined here as land above 26.5 ft PWD and accounting for nearly a quarter of all land, is used mainly for homesteads, roads, market places and embankments, while a little is used to cultivate crops. The crops in such lands usually include winter vegetables,



some HYV Boro, and some rabi crops. These need irrigation in the dry season. Transplanted Aman is cultivated in the Kharif season.

The frequency of flood in the high land area is once in every five years. Low moisture content in the soil is a problem in this area from September to April. As a result cultivation without irrigation is difficult, if not impossible. The northern part of the Project area, particularly in and around the Purba Aloka, mouza, falls in this category.

Medium high land (constituting areas between 26.6 and 31.5 ft. PWD), accounts for nearly 38 per cent of the Project area. This type of land, while susceptible to moisture stress, also suffers from moderate levels of flooding when flood water enters the area through breaches and public cuts. Several cropping patterns are found in such lands. HYV Boro is cultivated quite extensively during the rabi season. During other seasons, depending on the drainage conditions, transplanted Aman and Aus are cultivated, but a part of the land remains fallow. This land level is highly prone to drought and moderately prone to normal flood.

The rest of the Project area is low and remains under water from July to October. Therefore during the kharif seasons there is little opportunity to grow any crop in this area. Only during the dry season, is there an opportunity to grow any crop. Nearly two-thirds of the area is cultivated during the Boro season with Boro HYVs. In the rest, transplanted Aman may be cultivated but the harvest is uncertain due to the possibility of breach in the embankment and consequent inundation.

## 3.2 PROJECT OBJECTIVE

As stated in earlier Chapters the explicit objectives of the Project remain unknown due to the non-availability of any Project document. However, given the problems of flash floods in the area and the problem of drainage, and the nature and extent of crop damage due to the floods, it is apparent that one major objective of the embankment has been to protect both Aus and Aman crops from such damage. Later on, a weir has been constructed with the explicit aim of providing irrigation water during the dry period. Except in case of the on-going Kahua sub-Project, drainage has not been included either as an explicit or an implicit objective.

## 3.3 PROJECT ACHIEVEMENTS

### 3.3.1 A Comparison with the Situation in 1983-84

There is a problem of methodology in describing and analysing the achievements of the Kahua-Muhuri Project. The basic reason is that the Project apparently had a beginning, even if the British period is excluded, in the mid-1960s. Since then there have been many repairs, reconstructions, resectioning and structural additions. During the last decade, 1983-84 was the year when the major changes in structures were planned. As a result, the old embankment was resectioned, a weir was constructed, and the construction of a sluice gate to improve the drainage congestion has been undertaken. As there is little secondary material to draw upon and the people's memory can stretch back only a couple of years, it has been decided to find out the situation in the early eighties and in many cases in the year 1983-84 as there are some agricultural and other related data available for that year and use that as the benchmark against which to measure the changes, whenever possible.



### 3.3.2 Crops and Cropping Pattern

The crop calendar and the cropping sequences are presented in Table 3.2. From the crop calendar it appears that although on the whole the calendar is similar to the timing of sowing and harvesting of Boro HYVs and T. Aman (both local improved and HYVs) have somewhat changed. This is important as it has implications for seasonal spread of employment and in-migration of labour from outside which, as discussed in Chapter 6, is a very important feature of the labour market in the area. A possible reason for the changes in the crop calendar appears to be the widespread cultivation of Boro HYVs (see below). It is quite possible that the facilities available for irrigation are inadequate leading to less than optimal water consumption by the plants which lengthens the growth periods (i.e. the interval between transplantation and harvest time). In about 85 per cent of the cultivated areas HYV Boro is cultivated during the rabi season. Other rabi crops are cultivated in 10 per cent of the area. In the rabi season fallow area is very small. Transplanted Aus area is negligible (10 per cent) in comparison to the transplanted Aman area (92 per cent). The dominant cropping pattern is Boro HYV - T. Aman (Table 3.2).

Boro HYV and T. Aman are cultivated a little later than the optimum time because of the standing water in the fields during the right time of sowing. This increases the risk of flood damage to Boro HYV.

Crops grown during 1983-84 are still cultivated in the area. Only B. Aus has been replaced by T. Aus and the total area under Aus has decreased. The area under other crops has increased (Table 3.3). HYV Boro area has increased many-fold. Local varieties have been replaced by high yielding varieties even to the extent of losing genetic diversity. There is now only one local T. Aman variety, *nagpechi*, which is still cultivated by some farmers in the low-lying areas.

### 3.3.3 Irrigation Management

During the dry rabi season, the rainfall in the Project area is very low. Irrigation, therefore, is necessary for crop cultivation. On the other hand, the availability of surface water is greatly reduced during the dry season. To solve the problem of water availability, local people used to construct earthen cross dams across the Kahua for retaining water. In 1987, BWDB constructed a weir for the purpose at Berabaria. The weir helps to raise the water level, commanding the fields through gravity flow through the cuts made into the embankment. From Satkuchia to Ghaniamora about 1200 acres of land get this facility. Farmers have to pay for the labour cost and a fee for this water.

There are 80 low lift pumps in the Project area through which land along the Muhuri and Kahua River are irrigated. The charge for water is Tk. 700 per acre.

The other method of irrigation is utilizing ground water through shallow and deep tubewells. At present there are 3 deep tubewells and 17 shallow tubewells in the Project area.

### 3.3.4 Input Use

The use of inputs including tillage, fertilizer, irrigation, seed, pesticides and labour used for different crop production are shown in Table 3.7. The use of fertilizer for high yielding varieties is near the recommended dose. The use of pesticides is limited only to high yielding varieties, as these are more susceptible to pest attacks.

The use of farm yard manure is limited as the number of cattle has decreased. Moreover, cow dung is used as fuel in the area. The reduced availability of draught cattle has encouraged farmers to use power tillers. In the Project area the number of power tillers is 24. About 50 per cent of the land is cultivated by power tillers in high and medium high land levels. However, the percentage is low (20 per cent) in the low-lying area. The cost of one tillage with power tiller is Tk. 100 - 120, whereas, it is Tk. 100 for animal draft power. As at least three ploughings are needed with bullocks, while the number is two in case of power tillers, the introduction of power tillers helps the farmers save cash. At the same time the tillage can be carried out much more quickly.

Labour wages are high in the area as there is a high demand for labour due to the increased cropping intensity and the substitution of local varieties by HYVs, while local labour is scarce.

The traditional use of bullocks for threshing paddy has now been replaced by the pedal thresher. About 80 percent of the paddy harvest is now threshed mechanically. Farmers have to pay Tk. 30 per day for the use of a thresher.

Generally the level of input use has increased with the introduction of HYV varieties. Farmers, for example, do not use fertilizer for cultivating local varieties while heavy doses are used in case of HYVs.

### 3.3.5 Yields, Production and Crop Damage

The yields per acre of different crops in the Project area are similar to the national average yields. The proper use of fertilizer, pesticides and mechanized cultivation have helped the yield to be stable, except for the years when flood damages standing crops. The average yield in those years is almost one half of the normal. Sometimes farmers can hardly harvest any crop (Table 3.6).

The total production of crops in the Project area has increased as HYV Boro, local improved varieties of T. Aman, and HYV Aman have been introduced and the area under each crop increased (Table 3.5). It is clear from the table that the growth in production is attributable mainly to HYV cultivation during the Boro and the Aman seasons.

### 3.3.6 Costs and Returns

The last column of Table 3.7 shows the costs of production per acre for various crops as estimated on the basis of information provided by the farmers. Table 3.9 shows the costs per unit of output. Net profit per unit of output is also presented in the same table. These indicate that among the various types of paddy, there does not appear to be much of a difference in terms of profitability particularly between the local and the HYVs. Clearly it is the yield differences which tilt the scale in favour of the HYVs.

## 3.4 CONCLUSION

The Project has been partially successful in achieving its objectives of flood control and irrigation for several years. As a result, there has been substantial improvements in cropping intensity and production of paddy. On the other hand the failure of the Project in providing full flood protection has also been responsible for the changes in land level and consequently



for the changes in cropping pattern in specific locations within the Project area and thus in the Project area as a whole. Thus again, during the last 3 to 4 years, repeated breaches have made the situation rather uncertain and unless appropriate measures are taken to protect and rehabilitate the embankment and improve the drainage within the Project area, the gains made so far may be lost again.

**Table 3.1: Area by Land Level in the Project Area**

Union	Total and % of area under each land level						Total
	High		Medium		Low		
	Area (ac.)	%	Area (ac.)	%	Area (ac.)	%	
Baksh Mohammad	-	-	92	42	128	58	220
Parsuram	764	34	966	43	516	23	2,246
Chithalia	557	20	863	31	1,364	49	2,784
Fulgazi	240	19	557	44	468	37	1,265
Total (ac.)	1,561		2,478		2,476		6,515

Source: Planimeter reading and consultants estimate.

**Table 3.2: a) Crop Calendar and Cropping Patterns**

Crops	1983 - 84			1989 - 90		
	Sowing	Transplanting	Harvest	Sowing	Transplanting	Harvest
Boro HYV	Nov-Dec	Jan-Feb	Apr-May	Dec-Jan	Jan-Feb	May-Jun
Boro LV	Dec-Jan	Jan-Feb	Mar-Apr	-----		
T. Aman LV	Jun-Jul	Aug-Sept	Nov-Dec	-----		
T. Aman LIV	May-Jun	Jul-Aug	Nov-Dec	July	Sept	Dec
T. Aman HYV	May-Jun	Jul-Aug	Nov-Dec	July	Sept	Dec
B. Aus	Mar-Apr	-----	May-Jun	-----		
T. Aus	-----			Mar-Apr	May	July
Potato	Nov-Dec	-----	Feb-Mar	Nov-Dec	-----	Feb-Mar
S. Potato	Oct-Nov	-----	Feb-Mar	Oct-Nov	-----	Feb-Mar
Chili	Oct-Nov	-----	Mar-Apr	Oct-Nov	-----	Mar-Apr
Groundnut	Dec-Jan	-----	Mar-Apr	Dec-Jan	-----	Mar-Apr

Source: Farmers' interview.



Table 3.2: b) Cropping Pattern

Year	Highland	Medium land	Lowland
1983-84	Boro HYV - T. Aman	Boro HYV - T. Aman	Boro LV-Fallow
	W.Vegetable-T. Aman	W.Vegetable-B.Aus	
		Boro HYV - Fallow	
		B. Aus - T. Aman	
1990-91	Boro HYV - T. Aman	Boro HYV - Fallow	Boro HYV-Fallow
		Boro HYV - T. Aman	Boro HYV-Fallow
		W.Vegetable-T. Aman	

Source: Farmers' interview.

Table 3.3: Crop Areas 1983 - 1991

Crops	Cropped area (ac.)			
	1983-84	1985-86	1989-90	1990-91
Boro LV	719.0	720	110	80
Boro HYV	900.0	1,670	4,090	4,250
Wheat	2.8	-	38	36
Pulses	6.8	-	29	36
Winter Vegetable	183.0	240	290	210
B. Aus	1,637.0	1,350	-	-
T. Aus	-	-	706	504
T. Aman LV	730.0	1,860	367	-
T. Aman LIV	1,358.0	2,451	2,577	2,390
T. Aman HYV	1,000.0	1,778	2,066	2,243
Potato	50.0	55	70	94
Sweet Potato	10.0	12	20	75
Groundnut	4.4	-	50	12
Chili	74.0	-	-	42

Source: Upazila Agricultural Office, Parsuram, Feni.

Table 3.4: Crops Grown by Land Level in Mouzas Sampled for RRA

Mouzas	% Area under each land level	1983 - 84 Crop Seasons						1990 - 91 Crop Seasons					
		Rabi			Kharif I			Rabi			Kharif I		
		Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area
Purba Aloka	H=100	Boro HYV	50					Boro HYV	100			T.Aman	75
		W.Veget. Fallow	10 40							T.Aus Fallow	25 75		25
Ratanpur	H=31.25	Fallow	50					Boro HYV	100			T.Aman	100
		W.Veget.	50	B.Aus	100	T.Aman	100	Boro HYV	100				
	M=31.25	Fallow	100	B.Aus	100	T.Aman	100	Boro HYV	100				
	L=37.5	Fallow	100	B.Aus	100	Fallow	100	Boro HYV	100			T.Aman	100
Durgapur	H=5 L=95	G.nut	25					Boro HYV				T.Aman	
		S.Potato	25										
		Fallow	50					Boro HYV	100			T.Aman	100
Kolapara	H=50	W.Veget. Fallow	20 80			T.Aman	100	Boro HYV	100			T.Aman	100
	M=10	Boro HYV	100			T.Aman	100	Boro HYV	85			T.Aman	100
								Potato Chilli Brinjal	10 3 2				
East Salla	L=40	Boro HYV	100			T.Aman	100	Boro HYV	100			T.Aman	100
	L=100	Fallow	100			T.Aman	100	Boro HYV	100			T.Aman	100
Chithalla	H=10	Fallow	100			B.Aus Fallow	25 75	Boro HYV	70			T.Aman	100
								Potato W.Veget.	10 20				
	M=20	Fallow	100					Boro HYV	100			T.Aman	100
	L=70	Fallow	100					Boro HYV	80			T.Aman	75
Paschim Ghanimora	M=25	Fallow	25					Boro LV	20			Fallow	25
		Boro HYV	75										
	L=75	Boro LV	50			Fallow	100	Boro HYV	100			T.Aman	100
		Fallow	50			Fallow	100	Boro HYV	100			T.Aman	50
Ghaniamora	M=15	Fallow	100					Boro HYV	100			Fallow	100
	L=85	Fallow	100					Boro HYV	100			Fallow	100
Satkucha	L=100	Fallow	100					Boro HYV	100			Fallow	100

Note: H = High, M = Medium, L = Low  
Source: Farmers interview.



**Table 3.5: Crop Yields and Production in the Project Area.**

Crop	Yield (mds./acre)			Production (mt.)		
	1983-84	1990-91	Change	1983-84	1990-91	Change
Boro LV	20	22	+2	536.77	65.70	-471.07
Boro HYV	55	60	+5	1,847.70	9,518.48	7670.78
T. Aman LV	30	N/A	-	817.47	0	-817.47
T. Aman LIV	40	40	0	2,027.62	3,568.49	1,540.87
T. Aman HYV	50	50	0	1,866.37	4,186.26	2,319.89
B. Aus	20	N/A	-	1,222.09	0	-1,222.09
T. Aus	N/A	30	-	0	564.39	564.39
Potato	80	147	+67	149.31	515.79	366.48
S. Potato	150	220	+70	55.99	615.90	559.91
W. Veget.	130	135	+5	888.01	1,058.23	170.22
Gr. Nut	10	12	+2	1.64	5.37	3.73
Chilies (dry)	18	20	+2	49.72	31.35	-18.37
Wheat	16	18	+2	1.67	24.19	22.52
Pulse	12	12	0	3.04	16.12	13.08

Source: Consultant's estimates.

Note : Yield and production figures for rice are in terms of unhusked paddy.

### 3.6 Crop Damage Due to Flood in Different Areas of the Project (Percentage loss)

Mouzas	Season		
	Boro (1989)	T. Aman (1990)	Boro (1991)
Purba Alka	50		50.0
Durgapur			62.5
Ratanpur			50.0
West Ghanimora			50.0
Kolapara			15.0
Chitalia		80	55.0

Source: Farmers' interview and consultant's estimation.

Table 3.7: Input Use per Acre for Crops Grown in the Project Area

Crops	No of tillage	Fertilizer (Kg./ac.)				Seed kg./ac.	Irrigation Tk./ac.	Pesticide kg./ac.	Labour Man-days No./ac.	Prod. cost Tk./ac.
		Urea	TSP	MP	Zinc/others					
Boro LV	4	25	12	12	-	25	-	-	40	3460
Boro HYV	4	60	30	15	1.5	20	1750	1.5	50	6797
T. Aman LV	4	20	9	6	-	25	-	-	32	2869
T. Aman LIV	4	50	20	-	-	25	-	-	40	3787
T. Aman HYV	4	50	20	-	-	25	-	1.0	40	3887
B. Aus	4	-	-	-	-	25	-	-	24	2125
T. Aus	4	30	20	10	-	20	-	-	45	3815
Potato	6	75	20	10	1.0	500	300	-	50	11007
S. Potato	6	70	15	10	-	300	200	-	45	7277
W. Veget.	5	80	15	10	FYM 120 md.	2	200	-	75	6183
Gr.nut	6	20	50	15	-	40	-	-	50	5622
Chili (dry)	8	80	15	10	-	Tk. 100	100	-	50	4758
Wheat	3	50	20	7	0.5	50	1750	-	50	6156
Pulse	3	10	30	7	-	15	100	-	40	3891

Table 3.8: Unit Cost of Inputs

Inputs		Unit	Cost(Tk.)/unit
Tillage	Power tiller	1 till	120.00
	Bullock	2 round	100.00
Fertilizer	Urea	kg.	5.50
	TSP	kg.	5.50
	MP	kg.	4.50
	Zinc	kg.	10.00
Seed	Paddy	kg.	6.50
	Wheat	kg.	8.00
	Potato	kg.	12.50
	Gr.nut	kg.	32.00
	Pulse	kg.	40.00
	Chili	Seedling	0.50
	Vegetables	Seedlings/seed	0.50
	S. Potato	kg.	10.00
Irrigation	STW/DTW	Acre	1750.00
	LLP	Acre	1000.00
Pesticide		kg.	80.00-130.00
Labour		Man-day	60.00-80.00

Source: Farmers' interview.



Table 3.9: Costs and Returns in Crop Cultivation (in 1991 prices)

(Tk./mt.)

Crops	Cost	Price	Profit (+), Loss (-)
Boro LV	4213	6697	2484
Boro HYV	3035	6697	3662
T. Aman LV	2562	4822	2260
T. Aman LIV	2537	7501	4964
T. Aman HYV	2083	6965	4882
B. Aus	2846	4018	1172
T. Aus	3408	6430	3023
Potato	2006	3215	1209
Sweet Potato	886	3215	2329
Ground Nut	12552	17145	4593
Chilies	6373	32148	25774
Wheat	9163	7501	-1662
Pulse	8688	13395	4707

Source: Consultants' estimates.

Note + indicates profit  
- indicates loss

## 4 LIVESTOCK

### 4.1 PRE-PROJECT SITUATION

As noted in earlier Chapters, there is hardly any documentary evidence which can shed light on the situation in the Project area before the flood protection interventions were made. This section, is therefore, based on individual and group interviews of the farmers and knowledgeable persons in the area including officials as well as personal observations during the RRA field visit.

In the pre-Project period, agriculture was the main occupation of the people in the Project area and livestock played an important role in the farming system. It was kept as the source of draught power and as a secondary source of income to the household. In general each household had a small number of livestock. Important animals in the area were cattle, goats, chickens and ducks. A few sheep were also seen in the area. However, buffaloes were very rare. According to the Census of Agriculture and Livestock 1983/84 about 70 - 75 per cent of all farm households had cattle in the early 1980s (Table 4.1). However, Fulgazi Thana had a lower percentage of livestock than Parshuram Thana in which much of the area falls. Thus, much of the Project area had a higher density of livestock compared to areas outside the Project.

Cattle were the most important livestock in the area. Bullocks were kept mainly for draft power and cows for milk and calves. Except under special circumstances cows were not used for draught purposes.

Grasses and paddy straw were the main feedstuffs for cattle. However, small quantities of oilcake, rice bran and salt were fed with the straw. Wild grass growing on the road side and weeds from the crop fields and fallow land were the main sources of green feedstuff. A part of the pulses grown as relay crops was also fed to the cattle as a green feedstuff.

There were some goats in the area but not many sheep. Because of frequent flash flood farmers had difficulty in keeping goats and sheep. About 35 - 40 per cent of farm households kept goats (Table 4.2). Chickens and ducks were quite common in the area. According to the Census of Agriculture and Livestock 1983/84, more than 90 per cent of all farm household kept poultry which numbered on average 10 - 11 birds per household. These were kept mostly as scavenging birds. Diseases like Ranikhet (Newcastle Disease) and Fowl Cholera were quite common and took a heavy toll of poultry every year.

### 4.2 OBJECTIVES

The lack of documentary sources on the Project precludes any definitive statement about the objective of the Project in terms of livestock. However, in view of the general lack of livestock objectives, whether explicit or implicit, in FCD/I projects, it would not be far from the truth if it is assumed that the Project did not have any livestock-related objective.



#### 4.3 SOURCES OF DATA

The data during the RRA were collected from the following sources:

- available general documents and reports on the Project area;
- individual and group interviews of farmers and knowledgeable persons in the area;
- Upazila Livestock and other officials; and
- personal experience gained from physical observation of livestock, their management practices and performance in the Project area.

#### 4.4 PRESENT SITUATION IN THE AREA

During the field visit, the RRA team was informed of regular breaches in the embankment almost every year during the last 3 to 4 years causing inundation of the area and damage to standing crops, property and livestock. Apparently, therefore, the conditions for livestock have not changed much since before the Project. However, there have been other changes, particularly in the cropping pattern and cropping practices, which would impinge upon the situation related to livestock, and also there would be autonomous changes, which would also directly affect livestock. The changes which have been observed are given below:

##### a) Cattle population

It was reported by the farmers all over the Project area that the cattle population has decreased by 50 per cent over the last decade or so. The number of cattle held has decreased for all types of farmers. However, the reduction in number is more noticeable for the small and marginal farmers than for others. This decrease in cattle number may be due to the following reasons:

- i. as explained in Chapter 3, the Project area has experienced a change in cropping intensity, in that a basically single-cropped area has been turned into a double cropped area. This has led to less fallow land which used to grow green fodder. On the other hand, although there has been a compensating change in the quantity of available feed due to higher straw production, the shortage of quality feed persisted as the change has led to very widespread cultivation of HYVs, the straw of which is generally considered to be less palatable to cattle than that of the local varieties like B. Aus;
- ii. traditionally the people in the Project area had the practice of allowing their livestock to be maintained part of the year on the other side of the border and to graze them in the pastureland in the hills. Due to various reasons, this has stopped and this denial of a very important source of highly nutritious feed has led to decrease in the number of cattle;

- iii. whenever there is any financial difficulty due to crop failure or other reasons, farmers sell off their cattle to overcome the crisis. However, many of those farmers could not replace their animals again;
- iv. cattle in the area are very poor in health and suffer from parasitic infestation. They have a low calving rate and thereby a low rate of herd replacement; and
- v. farmers are now increasingly reluctant to maintain bullocks for draught power because of high maintenance costs. Moreover, power tillers are easily available on rental basis which as has been argued in Chapter 3 is the cheaper alternative.

b) Goats

There are the second most important ruminant in the area and about 35-40 per cent of all farm households have goats. The number of goats has decreased by 15 - 20 per cent in the last 10 years. This is mainly due to scarcity of feed and reduced availability of dry land during floods.

c) Poultry

Chickens are quite common in the Project area. More than 90 per cent of households possess chickens. Crossbred chickens were observed in most of the houses, which might be due to the DANIDA programme on poultry improvement.

Ducks are quite common in the Project area. It is more common in the low lying areas due to availability of natural duck feed in there.

d) Livestock Feeds

Availability of green feedstuffs for ruminants has significantly decreased due to reduction of fallow land as a consequence of the change in cropping pattern and cropping intensity.

Production of paddy straw in the area has increased but the quality has deteriorated as explained earlier. Then again, the straw produced could not be preserved long due to the flood and rain. In 1991 almost all Boro straw was spoiled due to rain and early flood.

e) Animal Health

In general, the physical condition of cattle in the area is very poor. Direct observation in cattle hats showed how pathetic the condition is. Even the best one among the lot would be rated only as an average animal in most other places in Bangladesh. Moreover, the animals were also reported to be suffering from parasitic diseases.

f) Available information indicates that the incidence of parasitic diseases, particularly round worm infestation of calves and fluke infestation of adult cattle, have increased. This may be due to shallow water levels in the low lying areas and in beels, which act as breeding grounds for snails, the intermediate host of flukes. The occurrence of Foot and Mouth disease in cattle is common in winter season as well as in the monsoon season, particularly in July-August when draft power requirement for ploughing is high.



## g) Milk Production

This has been reduced significantly due to decrease in the cattle population, shortage of green feeds and increased parasitic diseases.

## h) Draught Power

Cattle were the main source of draught power in the Project area. According to the Census of Agriculture and Livestock 1983/84 there were about 1.9 - 2.0 heads of cattle per farm household with a cultivable land of 1.5 acres. So there was no shortage of draft power in the area. However, with the decrease in cattle number and increase in cropping intensity and draught power requirement there appears to be some shortage of draught animals in the area. This shortage is more noticeable with the small and marginal farmers. But the introduction of power tiller in the area has overcome the draft power shortage.

## i) 1987/1988 Flood Damage

There are no reliable statistics on the extent of damage to livestock caused by the 1987 and 1988 floods. According to farmers and officials there were no dry places in the Project area except the embankment and a few homesteads. People took temporary shelter on the embankment with their livestock and movable property. There were substantial losses of poultry, which were swept away by the flood water. After the flood, many farmers had to sell off their cattle and goats due to acute shortage of livestock feed as well as scarcity of human food.

#### 4.5 RECOMMENDATIONS

FCD/I Projects, in general have an adverse effect on livestock feed resources through reducing fallow and grazing land and by changing cropping patterns. This has led to deterioration of livestock health and productivity. The following measures could be taken to overcome the adverse impacts and improve livestock production in the area.

- i. a programme could be undertaken to cultivate high yielding forage crops like Napier, Para grass, etc., on the embankment slopes and roadsides, which will not only produce green feedstuffs but also reduce soil erosion. Para grass which grows well on wet land may be planted on the lower part of the embankment slopes;
- ii. some cultivable fallow land could be used for food and forage crop (khesari, cowpea, maize, sorghum etc.) cultivation in order to minimize feed shortage. An extensive extension and motivational drive would be required for this purpose;
- iii. pulse and oilseed cultivation could be encouraged through introduction of a crop diversification programme which would help in improving nutritional status of the people, providing cattle feeds and increasing soil fertility;
- iv. during selection of HYV paddy some consideration should be given to straw quality because the straw of some HYV has higher digestibility than that of

others. This will help to improve straw quality along with increased rice production;

- v. 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. Thus an extension programme could be undertaken under the Project to popularize urea treatment of straw for improving cattle nutrition in the Project area;
- vi. a programme on introduction of urea-molasses blocks for feeding cattle with straw ration could be undertaken. 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 block as supplemental feed for cattle on straw based rations will not only improve digestibility and palatability of straw but also improve total nutrient intake of the cattle; and
- vii. the extension programme of the Department of Livestock Services should be extended and strengthened in the area under FCD/I Projects. 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.



Table 4.1: Cattle and Buffalo Population in Selected Upazilas by Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Fulgazi Thana					
No. of Households	10,241.00	2,811.00	221.00	13,273.00	4,163.00
% of Households	58.70	16.10	1.30	76.10	23.90
Households with Cattle and Buffalo	6,570.00	2,692.00	212.00	9,474.00	885.00
% of Household with Cattle and Buffalo	64.20	95.80	95.90	71.40	21.30
No. of Cattle + Buffalo	14,590.00	8,987.00	1,207.00	24,784.00	1,371.00
No. of cattle and Buffalo per household	1.42	3.20	5.46	1.87	0.33
Net cultivable area (ac) per household	0.83	3.40	8.03	1.49	-
Parshuram Thana					
No. of Households	5,199.00	1,525.00	109.00	6,833.00	2,011.00
% of Households	58.80	17.20	1.20	77.30	22.70
Household with Cattle and Buffalo	3,537.00	1,488.00	106.00	5,131.00	497.00
% of Households with cattle and Buffalo	68.00	97.60	97.20	75.10	24.70
No. of Cattle and Buffalo	8,269.00	5,472.00	557.00	14,298.00	814.00
No. of cattle and Buffalo per household	1.59	3.59	5.11	2.09	0.40
Net cultivable area (ac) per household	0.86	3.40	7.99	1.54	-

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

Table 4.2: Goats, Sheep and Poultry Population in Selected Upazilas by Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Fulgazi Thana					
No. of households	10,241.00	2,811.00	221.00	13,273.00	4,163.00
Households with goat and sheep	3,293.00	1,254.00	102.00	4,649.00	922.00
% of Households with goats and sheep	32.20	44.60	46.20	35.00	22.10
No. of goats and sheep	6,984.00	3,516.00	357.00	10,857.00	1,587.00
No. of goats+sheep per household	0.68	1.25	1.62	0.82	0.38
Households with poultry	9,232.00	2,726.00	214.00	12,172.00	3,106.00
% of households with poultry	90.10	97.00	96.80	91.70	74.60
No. of poultry	82,102.00	35,680.00	4,186.00	1,21,968.00	20,736.00
No. of poultry per household	8.00	12.70	18.90	9.20	5.00
Parshuram Thana					
No. of households	5,199.00	1,525.00	109.00	6,833.00	2,011.00
Households with goat and sheep	2,067.00	835.00	63.00	2,965.00	436.00
% of Households with goats and sheep	39.80	54.80	57.80	43.40	21.70
No. of goats and sheep	4,870.00	2,608.00	309.00	7,787.00	864.00
No. of goats+sheep per household	0.94	1.71	2.83	1.20	0.43
Household with poultry	4,844.00	1,495.00	108.00	6,447.00	1,500.00
% of households with poultry	93.20	98.00	99.10	94.40	74.60
No. of poultry	48,807.00	24,282.00	2,343.00	75,432.00	10,361.00
No. of poultry per household	9.40	15.90	21.50	11.00	5.20

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



## 5 FISHERIES

### 5.1 INTRODUCTION

The problem of lack of information on the past activities related to the Project and more particularly on the situation existing at the time of recent major investments during the early 1980s is probably the most daunting in case of the fisheries. For this reason, the RRA team relied mainly on interviews with people in the area to reconstruct the situation obtaining during the pre-Project period. As the information is rather sketchy and intertwined with descriptions obtained regarding the present situation, the section below on the present situation is actually a blend of the past, the present and the processes which may have given rise to the present situation.

### 5.2 PRESENT SITUATION

#### 5.2.1 Open Water Fisheries

Apart from the two rivers defining the boundary of the Project area, the only other major natural ground for open water fisheries is the Chithalia Jala or what remains of it now. The Jala formally accounts for about one-half of the Project area, but the actual fishing ground is almost certainly confined to the deeper parts during the dry season and this must be much smaller than the area of the Jala. During the monsoon and when water from the Muhuri or the Kahua enters the Project area through the breaches and/or cuts, the whole flood plain turns into a fishing ground, as was observed first hand by the RRA team. Apart from the Jala itself, there are also rather small natural depressions within the Project area which also serve as fishing grounds. Quite naturally they all because linked together with one another during the monsoon.

The problem of deposition of silt and the raising of land levels in various parts of the Project area, but more particularly in the low-lying areas and near the areas where breaches occur, has been discussed in Chapter 2. These repeated siltations have caused gradual reduction in the water volume both in terms of area and depth by raising the land level of the water bodies in the low-lying areas. It has been reported by the fishermen and local villagers that the areas of Chithalia Jala and Paschim Ghoniamara Jala have been reduced to 50 per cent of their size compared to what they were about a decade back. The use of surface water from these water bodies for irrigation has also contributed to their early drying-up.

The reduction in the area and depth of water bodies has adversely affected fish production. The fishermen and local villagers reported that fish production in Chithalia Jala and other water bodies has declined by more than 50 per cent from what it was 8-10 years ago. This decline of fish production may also be associated with the gradual raising of the height of the embankment by re-sectioning, which is now controlling the early flood more effectively than before and therefore may have lessened the problem of sand and sediment deposition during the more recent periods. Paradoxically, this also hinders the entry of fish into the Project area from the rivers.

The Project area may be suffering also due to another very large project, the Muhuri Irrigation Project, under which the natural channel of the Muhuri near the Bay of Bengal has been diverted and sluice gates have been constructed at the mouth of the diverted channel.

There are reasons to believe that such a diversion may have disturbed the path of the migratory fishes and shrimps. It has been reported by the fishermen and the farmers that before this enclosure they used to catch large quantities of big shrimp and hilsa along with other fishes. Sometimes stray hilsa could be even caught in the Chithalia Jala, but now shrimps are rarely available and hilsa is not found at all.

The length of the fishing season has shortened. Previously (8-10 years ago) the fishermen used to catch fish almost year round from the Chithalia Jala. Now the fishing period has been shortened to mid-April to mid-November due to reduction in area and depth of the water bodies.

### 5.2.2 Pond Fishery

The Project area is known to have had a considerable number of ponds. The early flash floods and also those during the peak monsoon periods often caused problems, however, as flood water passed through them and the ponds overspilled allowing the fish to get away. This discouraged investment in pond fishery. Of late, however, the high price of fish and the somewhat improved flood protection have encouraged such investments. Not only are the old ponds being used for the purpose, but also new ponds are being excavated. About 80-90 per cent of ponds are now stocked with fish by the pond owners. The stocking is helped by the availability of fish fry and of the major carps.

Apparently the practice of culture fishery is still rather new, as apart from stocking very few other improved fish culture methods are followed. Very few fish farmers use fertilizers and even the feed provided appears to be insufficient in quantity. Only one organised group, the Char Gram Samabaya Samity Ltd. of Durgapur, follows relatively improved methods of fish culture.

The breaches and public cuts mentioned in earlier Chapters may also be responsible for the still lukewarm response of the fish farms towards intensive method of culture. It has been alleged by local people that frequent breaches of the embankment are discouraging some of the pond owners from stocking fish in their ponds. Sudden inflow of flood water from the river due to breaches in the embankment overflows almost all the low-lying ponds in the villages. As a result the farmers are incurring considerable economic losses.

### 5.2.3 Management of the Fisheries

The open fishing grounds are leased out by the Upazila Parishad. Chithalia Jala is leased out on an annual basis every year by the Upazila Parishad of Parsuram Upazila. The lease holder hires the fishermen for catching fish at different rates depending upon the type of net and method of catching. The Muhuri River has been brought under the New Fisheries Management Policy under which only the genuine fishermen are supposed to be issued fishing licences to catch fish from the river. The Kahua River is also leased out by the Upazila Parishad annually for a year.

The pond owners catch fish by hiring fishermen at the rate of TK.100/netting, but for small fishes, the fishermen get half of the total catch.

Now, major carps, lobsters, air and pabda are very rarely available. It has been reported by the fishermen that sometimes major carps are found in the natural water bodies when the ponds are inundated by the on-rush of flood water. The relatively more available



species at present are tengra, shol, gajar, magur, shing, baim, koi, gulum, puti, dhela, boal, fali, darkina, kholisa and small shrimps.

#### 5.2.4 Income from Fisheries

The Upazila Fisheries Officer provide some information on estimated fish catch in the years 1986 and 1990. Assuming that the decline in fish catch from open fisheries had been at a rate observed between these two years and that the output from pond fishing remained unchanged before 1986 for a few years, the total catch in 1983/84 is estimated as 62.19 mt.. By 1990, it fell by more than a quarter. The catch from open water capture fisheries fell more than half which lends support to the claims made by local people. In contrast, there has been a compensating change in pond output which increased by 20 per cent.

The loss in production has obviously led to a decline in income (see Chapter 10). As a result many fishermen engaged in subsidiary occupations in addition to fishing.

The income of fish traders has also decreased by about 50-60 per cent due to lower availability of fish, especially the commercially important fishes.

### 5.3 CONCLUSION

Lack of pre-Project information makes it difficult to estimate the changes in fisheries. However, the general direction of the trend appears to be definitely downwards. The question, however, remains of whether the changes can be attributed to the Project. The reduction in the area in the Jala is rather due to the siltation and raising of land level caused by intrusion of sediment-laden flood water. On the other hand the production change in pond fisheries is due to the protection provided by the embankment. Thus while the negative changes cannot be solely due to the Project, the positive changes can be so related.

**Table 5.1: Fish Catch in the Project Area  
(metric tons)**

Type of fishery	1983	1986	1990
Capture	39.42 (63)	28.74 (56)	18.89 (41)
Pond	22.77 (37)	22.77 (44)	27.43 (59)
Total	62.19	51.51	46.32

Source: 1983: Consultant's estimate  
Other years: Upazila Fisheries Officer

Note: Figures in parantheses are percentages of total catch

**Table 5.2: Prices of Fish (1990)  
(Tk. per kg.)**

Type of fish	Price
Rui, Katla, Mrigel	55 - 65
Silver Carp, Capio	40 - 50
Magur	60 - 70
Shing and Koi	50 - 60
Tengra	30 - 35
Small Fish	25 - 30
Small Shrimp	20 - 25
Big Shrimp	200 - 250





## 6 SOCIAL AND INSTITUTIONAL CHANGES

### 6.1. PRESENT SITUATION

The social situation at present appears to be little different from that before the Project. During the Project period, changes took place with respect to demographic characteristics, occupation, land ownership and farm size distribution and tenurial relationship. However, there appears little evidence, if any, to suggest that these changes are different from what would have been expected from a reading of the general national trend.

#### 6.1.1 Demographic Change

As described in an earlier Chapter, the Project area falls largely within the Upazila of Parshuram. In 1983-84, the Upazila had a total population of only 50,495 with a density of 1803 per sq. mile, which was much lower than the average for the Feni District (2365 per sq. mile). It is quite likely that the Project area itself may have had a lower density than Parshuram Upazila itself as there is a large low-lying area in the central part of the Project area.

In 1991, the District of Feni has an unadjusted population of 1.095 million. Applying the proportion of Parshuram population to that of Feni District in 1983-84, gives an estimated population of 61,545 in 1991. This indicates an annual rate of growth of 2.8 per cent which is much higher than the estimated national average of about 2.2 per cent. This is however, consistent with the RRA evidence for increased foodgrain output (Chapter 3).

#### 6.1.2 Occupation

Most of the households in the Project area in 1983-84 depended on farming for their livelihood. An earlier report puts the percentage of households dependent primarily on agriculture at 57 per cent. However, the figure reported by the Agricultural Census is 77 per cent for all those engaged in agriculture. This suggests that about 20 per cent or at least a substantial minority of the households depend on agriculture as a secondary source of income.

#### 6.1.3 Land Ownership and Tenancy

There is some disagreement regarding the proportion of households which are landless. In 1983-84, the Agricultural Census reported the proportion to be 14 per cent. If the functionally landless (i.e. those owning no more than 5 decimals of cultivable land) are included, the proportion goes up to about 18 per cent. Another report for the same year states it to be about one-third. However, the village people during the RRA stated it to be about 25 - 30 per cent at present with the claim that it has been rising over time. The figure cited in the Census thus becomes more credible.

#### 6.1.4 Migration and Labour Situation

Landlessness has resulted in widespread share-tenancy and also outmigration, the latter also giving the former some impetus. In 1983-84, nearly 50 per cent of all farm households rented in some land. The proportion remains still very high. On the other hand

from group interviews it appears that about 20 per cent of the native male labour force has left the area for non-farm jobs in the urban areas.

The literacy rate in the Project area is almost certainly as high as the national average of 25 per cent (for 1991), if not higher which may well be as the rate for Feni District is 30 per cent. This high rate may have been facilitated by outmigration in search of non-farm jobs which demands a certain minimum level of literacy.

While people from Parshuram are going out in search of non-farm jobs, agricultural labourers flock to the area in search of jobs during the transplanting and harvesting stages of both Aman and Boro paddy. The agricultural labourers come to the Project area from neighbouring labour surplus areas of Langolkote, Hashenpur etc and also from other Districts like Mymensingh, Jamalpur and even Rangpur and Dinajpur. Some of the farmers claim that of the hired labour, nearly 80 per cent are migrant labourers.

The members of the RRA team spoke to a number of migrant labourers and found that while some of them have been coming to the area for work for quite a few years, others are new to the area. They opined that the prospects for jobs have increased in the area over the last few years due to the expansion of HYV cultivation particularly during the Boro season. The farmers when asked about the use of hired migrant labour often expressed the view that without them farming would be well-nigh impossible.

The market for hired labour is organised exactly like that of commodities sold in a market place. On hat days as the RRA team has found those wishing to be hired congregate in specific spots. Farmers come and bargain and take them away. Once the contract period is over, the labourer again comes and stands in the hat to be hired.

The wage rates vary by season but not by much as only the cash component changes. The cash wage rate varies from Tk. 25 in the lean period to Tk. 30-35 during transplantation (Aman and Boro HYVs) and shoots up to Tk. 50 during Boro harvest. Three meals per day are provided irrespective of the reason. The modal wage rate would be Tk. 70-80 per day.

### 6.1.5 Physical and Social Infrastructure

Both physical and social infrastructure are poorly developed in the Project area. Although there is an all-weather road between Feni and Parshuram, the condition of the road is not good. There is a rail link between the border town of Belonia and Feni but the frequency of service is very low. The educational facilities are very few. There are only one college and three high schools in the Project area.

### 6.1.6 Group Activities

A number of types of co-operative societies are functioning inside the Project area under the supervision of BRDB. These co-operatives were organized during the early 1980s. Only a few were reported to be functioning properly.

The most interesting finding regarding group activity is the formation of apparently well-functioning informal societies. Some involved group action for cutting irrigation inlets while others are much more comprehensive in their views and activities. One of these societies has, with some outside assistance, constructed roads, leased in ponds for pisciculture, and organised the landless for earthwork for repair of the eroded embankment under Food for



Work. Another society mobilised resources to construct pucca irrigation inlets so that the embankment is not threatened due to public cuts.

Most importantly, these societies have also set examples of how people, when threatened with the prospect of the loss of their property and livelihood, can band together. In quite a few places the RRA team came across spurs and porcupines made of bamboo, thatching and other materials to protect the embankment, constructed by local people on their own without any help from the BWDB engineers.

## 6.2. O&M OF THE PROJECT

There is no O&M manual for this Project, nor has any such manual ever been prepared for the Project. No local institutional arrangement for the operation and maintenance of the Project exists, particularly regarding the protection of the embankment. There is in theory a weir operation committee. In practice, the weir is operated by a coterie of influential people who also charge irrigation fees to the farmers. Thus, a valuable resource provided by the state has become the tool for extraction of rent by locally powerful people.

The institutional mechanism in operation at the local level is that the maintenance of the embankment is carried out under the Food for Works (FFW) programme through BWDB by the the local Union Parishad, more specifically, through specific Union Parishad members who organise and enroll labourers for the earth work. Nominal supervision is provided by Work Assistants and Section Officers.

For guarding against possible breaches in the embankment the people are mostly left to themselves as described above. Only on one occasion did the RRA team find some labourers being engaged in making concrete blocks for use against river erosion. They were employed by the BWDB.

## 6.3 SUMMARY OF FINDINGS

Several positive and negative social and institutional developments have taken place in the Project area. Some are specifically linked to the Project but some others are not. A summary of these developments is given below.

### 6.3.1 Positive Findings

- i. local people have mobilised themselves and put in their own money for protection of the embankment. They have also understood the need for more organised irrigation activity and the conflicts that may arise between irrigation and protection from flood and have taken some appropriate steps on their own;
- ii. there has been an increase in agricultural employment which has benefited the hired and migrant labour to a considerable extent; and
- iii. increased opportunities now exist for employment under the Food-For-Work programme in Project area.

### 6.3.2 Negative Findings

- i. there is no formal institutional arrangement for public participation in O & M of the Project. Project committees for O & M have not been formed. In the case of the weir, the committee serves the interest of the local influential people who use the weir for their private gain.
- ii. effective consultation between BWDB, the Upazila and the local people concerning O&M of the Project is virtually nonexistent.
- iii. the literacy rate in the Project Upazila is high compared to the national average. On the other hand the actual facilities for education is rather very limited.





## 7 IMPACT ON WOMEN

### 7.1 PRE PROJECT SITUATION

A system of strict 'purdah' was followed by Muslim women in the Project area. Women were secluded in their houses, and was not allowed even to see some of their near relatives of the opposite sex. In that situation the activities of the women were restricted to home production and post-harvest processing of agricultural produce. They were not even involved in homestead gardening. Only poor and destitute women were found to be working outside their own homes, but again only in other people's homes.

In contrast to the Muslim women, those from the Hindu community were much less inhibited, but they too were involved mainly in home-based activities.

### 7.2 PROJECT OBJECTIVES

In the absence of any project document, it is not possible to make any statement about Project objectives regarding women. It would be quite safe to assume, however, that the Project did not have any explicit objective related to its impact on women.

### 7.3 POST PROJECT SITUATION

Women still are found to observe a strict 'pardah' in presence of men. Only the poor and destitute are working outside the house for earning their livelihood.

#### 7.3.1 Road Maintenance Work

Some of these poor and destitute women are working as labourers in the road maintenance programme. Funded by DANIDA, teams of women workers are employed through the Union Parishads in the Project area. In each ward where there is a team, 15 women form a group. Each woman is in charge of repair of an 8 ft. long stretch of the road and earns Tk. 24 per day.

#### 7.3.2 Handicrafts

Some women in Hindu families have been found to make mats from a kind of locally available reed. Men help them in the initial stage of mat making. The craft is common in Anantapur, Kaukhali and Kolapara villages. Women in fifteen families are now engaged in making of mats in village Anantapur.

One small mat needs six to seven hours work per day for several days. The cost of production of a mat varies from Tk. 40 to 80 depending on size while the sale price ranges from Tk. 125 to Tk. 300 depending on size and quality. The price and cost figures indicate that productivity and return to labour are both very low (Tk. 10-15 a day) and compare poorly with the wage rate received by the women in road maintenance work.

Women in the Project area are also involved in the making bamboo baskets and bamboo head covers (jhongra), particularly in the villages of Ratanpur, Durgapur and Rampur.

About 30 - 35 women are so employed. They make the jhongras during June-July and baskets all throughout the year. Each basket costs Tk. 5 and each jhongra Tk. 8 in terms of the raw materials whereas they sell respectively for Tk. 10 and Tk. 20 each.

Women also make fish nets during the month of September-October. It takes about a month to make one net. While it costs Tk. 80 - 150 to make a net depending on its size and the type, the sale price varies from Tk. 250 to 500.

### **7.3.3 Homestead Gardening**

Compared to the situation before and with a reduced risk of flood, women are now showing interest in homestead gardening. They are growing vegetables and spices which they can eat as well as sell in the market. In Ratanpur area some women are earning about Tk. 3000 annually from homestead gardening. They buy chickens, ducks, cattle and goats with the proceeds.

### **7.3.4 Post Harvest Activities**

Compared to the earlier situation, the demand for post-harvest processing of crops has increased. During the last few years, however, such activities have again decreased as farmers are losing their crops due to flooding through breaches in the embankment.

### **7.3.5 Education**

Only about 10 per cent of the total female population is educated in the Project area. In some villages like Ratanpur and Durgapur the percentage of educated women is somewhat higher.

## **7.4 OTHER FINDINGS**

The situation outlined above seems dark, but it has been found that where there are opportunities, women utilise them. The case of the Chargram Samiti is a case in point. The Samiti encourages women to be involved in various income-earning activities. Women members of this Samiti appeared to be more full of hope than those elsewhere within the Project area.

## **7.5 CONCLUSION**

The changes in women's activities are not primarily due to the Project implementation but to the overall change in the country and the new opportunities that are coming up. However, the pace of change is rather slow. This is surprising, given the high rate of outmigration and the generally higher level of literacy in the area (see Chapter 6).



## 8 IMPACT ON NUTRITION AND HEALTH

### 8.1 PRE PROJECT NUTRITIONAL STATUS

From informal interviews with men and women in the Project area, it is obvious that, pre-Project, most of the Project area was flood prone and every year some of the crop was lost. Additionally, HYVs were less common than at present, while the over-all cropping intensity was also lower than that at present. Most of the people at that time were eating two meals a day. Also, the uncertainty in crop production meant a fluctuation in the nutritional status between years and between seasons within a year.

Rice was a common food item but rather expensive compared to others like sweet potatoes, wheat and other food. Many people therefore used to eat those foods once in a day. On the other hand fish was available much more easily as anybody could go to the beels to fish. Thus, the people could eat fish in quantity. The availability of game birds during the winter also allowed people to have access to protein food and add variety to the diet.

### 8.2 PROJECT OBJECTIVES

Almost certainly, the Project was conceived without any explicit nutritional objective. However, the Project sought to stabilise yields of crops and also to raise cropping intensity by providing irrigation facilities and thereby increased total production. As increased food production provided better food security, an implied nutritional objective has almost certainly been to increase the availability of food to the residents in the Project area.

### 8.3 PRESENT NUTRITIONAL STATUS

#### 8.3.1 Food Consumption

The Project area has experienced a higher level of production as a result of protection to the crops as described in detail in Chapter 3. It has also been pointed out there that a part of the increase can definitely be ascribed to the operation of the Project. As a result, food availability has improved in the Project area. On an average, about 80 per cent of the people now eat three meals a day. As rice production has increased, rice consumption has gone up. Most of the people now consume rice in all the three meals they eat.

The increased production of rice has been partly offset by the decline in pulse and fish production. However, it appears that the decline in pulses production has not lowered the consumption of pulse as higher income compared to the previous situation has allowed people to buy them from the market. The drastic fall in fish production coupled with its high price, however, may have lowered the protein intake in the Project area, particularly among the less well-off who no longer have easy access to the beels, and who cannot buy the more expensive carp produced in the ponds.

The livestock situation has considerably worsened in the Project area. This has also led to a decline in the production of dairy and meat products, increasing their prices and adversely affecting their consumption. The redeeming feature is that the production of poultry

and eggs have increased thus offsetting somewhat the nutritional consequences of a decline in large livestock production.

Homestead gardening has become more common in the Project area. Similarly new fruit trees are also being planted. There has been, therefore, an increase in the consumption of vegetables and fruits supplying the essential vitamins and minerals.

On the whole, despite some decrease in the availability of fish and its consumption, overall food consumption has increased in the Project area. The incidence of malnutrition has declined.

Despite an upward trend in nutritional well-being some of the groups in society may not have fared well. Possibly the professional fishermen, have become worse-off in terms of their level of income and hence in terms of their nutrition.

### **8.3.2 Drinking Water Supply and Health**

In the Project area hand tubewells are the source of safe drinking water. The local societies and NGOs are sinking the tubewells and thus decreasing the incidence of water borne diseases. However, the ground water is high in iron content which causes stomach ailments. Also, apart from drinking other household water needs are met with water from open sources which offsets the positive effects of use of tubewell water for drinking. Villagers have reported that during April-May water quality falls and during that period the incidence of diarrhoeal diseases increases. The incidence of other diseases is low.

## **8.4 CONCLUSION**

The residents within the Project area seem to be happy with the Project as food production has gone up and they are eating better than before. Except for the years with breaches in the embankment, good crop harvests provide enough food. The farmers are better off both in the sense that they are getting enough food as well as gaining better purchasing capacity.



## 9 ENVIRONMENTAL EVALUATION

### 9.1 INTRODUCTION

Many of the Project details in relation to the characteristics of the area it serves have already been elaborated upon in the previous Chapter. The purpose of this section is to recapitulate these from the specific angle of an assessment of the environmental impact of the Project. Accordingly, a general Project background, rather briefly, will be presented. Then the physical, biological and human dimensions of the environmental change in the Project area will be discussed in detail.

### 9.2 AGROECOLOGICAL LOCATION

The Kahua-Muhuri Project is located within the Piedmont Plains and River Floodplain Sub region (Agro-ecological Sub region 23a) of the Chittagong Coastal Plain Agro-ecological Region (FAO, 1988). As stated earlier the flood plain is wedged between the hills of the State of Tripura, India.

The level of land within the Project area is rather uneven. The central and the south eastern part differ markedly from the north west. A large part of the latter is low lying and often suffers from waterlogging and drainage congestion occurs in these areas.

The soil is generally of the non-calcareous grey flood plain category in which silty loams and silty clay loams predominate. The top soils are poor in organic matter (2.2 to 2.7 per cent). The top soil is strongly acidic (with pH between 4.5 and 5.5). The soil in the high ridges is highly permeable and has a low moisture holding capacity. Much of the soil in this Sub-region, however, has a puddled top soil which leads to slow permeability and a low moisture-holding capacity (FAO 1988).

The Project Area is surrounded by the Muhuri River on the north-west and the south-west; and the Kahua River on the north-east and south-east. Flooding occurs mainly due to the overflow of the Muhuri River which cannot drain the high volume of water quickly because of its highly meandering nature and causes inundation of vast areas within the Project. In addition, erosion and sand deposition also occur. Deposition of sediments between embankments raises the river bed causing the channel to shift and erode its bank, so that eventually the embankments are breached.

Old people in the Project area reported that a few decades ago, wildlife and especially birdlife, was much more common. However, rapid population growth and reduction of wetland habitat have created pressure on natural fauna and flora, which were reduced to a low base level by the time the Project started.

### 9.3 PROJECT OBJECTIVES

As has been emphasised several times in this report, neither the Project proforma nor any feasibility report were available. Only two reports on the Project area have been found. None of these reports, however, dealt with environmental issues. It can be safely assumed in such a situation that the Project did not have any explicitly environmental objective.



## 9.4 SOURCES OF INFORMATION

Information was collected from farmers and other knowledgeable persons in the area through individual and group interviews. Information was also obtained from various Upazila level officials including the Upazila Chairman, UNO, Agricultural Officer, and the Fisheries Officer. Personal observations on the physical condition of the area were also recorded.

## 9.5 PHYSICAL ENVIRONMENTAL IMPACTS

Physical impacts have been sub divided into two types, viz., those which are related mainly to hydrology and those which are basically terrestrial (Table 9.1). Other physical changes such as those in climate and atmosphere have not been investigated.

### 9.5.1. Physical Impacts (Water)

#### a) River Flow

The relevant parameters here include several like the discharge, velocity, timing and duration of river flows. The Project has had some adverse impacts on the river flow and flooding in the area. Due to the joining of the Muhuri and the Kahua through a canal, a significant volume of water from the Muhuri passes through the Kahua because of its lower elevation. As a result the flow and velocity of water in the Muhuri have reduced and the river bed has been raised due to siltation. The construction of embankments on both sides of the Muhuri as well as the raised river bed have reduced the water holding capacity of the latter.

#### b) River Water Quality

Key factors in the determination of river water quality in the Project area include the presence and level of sewage, agro-chemicals and sediment load (reflected by turbidity). Sewage does not appear to be a problem while any pollution of the river water by agro-chemicals is likely to be diluted by the strong monsoon flow. The increased bedload due to the denudation of hills in the upstream areas and any scouring (see subsection (c) below) may have a negative impact on turbidity of the water particularly in the Muhuri River.

#### c) River Morphology

The changes in the flow of the Muhuri that have resulted from the Project, have affected river morphology. The highly meandering nature of the Muhuri River coupled with occasional flash floods causes severe scouring in many places, badly damaging the embankment. Severe bank erosion has been observed at Rampur, Durgapur, Ratanpur and some other areas. Side by side with the bank erosion the river bed has risen due to the reduced flow of the water in the Muhuri.

#### d) Flooding and Drainage

The incidence of floods has probably increased, not due to the Project as such, but possibly due to the human activities upstream in the hills of the Tripura. As a result of population pressure new settlements have come up in areas where there had been none before, deforestation has probably become faster and some of the natural reservoirs formed by the hills have been destroyed. All these have combined to increase both the incidence of



floods and the volumes of water these carry. Both of these have tended to aggravate the problem of drainage in the Project area.

Impediments to drainage along the Muhuri have been caused by the reduced flow in that river along with the heavier sediment load it has to carry, raising the river bed. Along the Kahua, the problem seems to be less serious as the river, as described in Chapter 2, has a lower width to length ratio and is also much less meandering than the Muhuri.

The drainage inside the Project area has worsened over time due to the siltation and sedimentation caused by the intrusion of flood water inside the area. The intrusion of flood water inside the Project area, is in turn caused by to the breaches and public cuts and improper repairs i.e. improper operation and maintenance.

e) Ground Water Levels

Dry period irrigation in the Project area takes place mainly with the help of low-lift pumps utilising surface water lifted from the rivers. Moreover, the repeated intrusion of flood water inside the Project area and the heavy rainfall that it experiences allow recharging to take place more or less regularly.

In such a situation it is not expected that there will be any problem with ground water levels and the RRA team did not hear any such complaint.

f) Ground Water Quality

As with the level of ground water, there appears to be no reason to suspect any deterioration in the quality of ground water.

g) Area of Wetland

The most important wetland inside the Project area is the Chithalia Jala accounting for half the area of the Project. Repeated breaches and public cuts allow flood water to intrude and deposit huge volumes of silt and sand raising the land level in and around the Jala. As a result, the actual area of the Jala which holds water perennially has fallen over time. Local people estimate that the Jala and other smaller water bodies inside the Project area are now only about one-half of their total size about a decade back.

h) Surface Water Quality in the Wetlands

The Chithalia Jala, the major wetland, occupies the central part of the Project area and thus accumulates agro-chemicals, sewage and other pollutants from the homesteads and the surrounding fields. On the other hand the average depth of water and the total volume both are falling. Thus, the water quality in the Jala is deteriorating. People have complained that the water has become darker and on contact, itching developes on the skin. However, the almost regular flushing that takes place due to the breaches and the public cuts has kept the problem within tolerable limits.

### 9.5.2 Physical Impacts (Land)

#### a) Physical Characteristics of Soil

The most important change which has taken place is the deposition of sandy sediments inside the Project area due to the breaches and public cuts in the embankment, particularly along the Muhuri. Therefore, the top soil is sandy in many places.

#### b) Soil Fertility

The decrease in the area under the wetland and the raising of land level inside the Project area have resulted in less aquatic vegetation than before. As aquatic weeds decompose and add organic matter to the soil increasing its fertility, the problem may be quite serious particularly in the aftermath of floods which sometime leave huge deposits of sandy sediments practically devoid of any organic matter.

#### c) Soil Moisture Status

High rainfall in the area should not allow any reduction in the soil moisture even if inundation is reduced, which it is not. However, the raising of the land level and the nature of the sediment mean that there may be localised negative impacts on the available soil moisture.

#### d) Soil Erosion

The erosion of soil due to the increased incidence of floods and the larger volume of water carried by the Muhuri along a highly meandering course is a major problem in the area. The problem has been aggravated due to the improper repairs of the cuts made for irrigation inlets either because of the loose filling, or the sandy soil used for the purpose, or both. In any case, the improperly filled-up cuts later develop into full-fledged breaches and lead to heavy soil erosion.

#### e) Land Availability

Breaches in every year deposit silt in the lowlying areas which has significantly reduced the wet land area but increased the area available for crop cultivation. Whether such lands can actually be used for cultivation depends on other factors, however.

#### f) Land Capability

A host of factors determine the capability of land. The information and analyses in Chapter 3 indicate that on the whole during the last decade or so there has been a significant increase in the cropping intensity and a switch to HYVs, raising the productivity of land. Land capability, therefore, has definitely increased to sustain the growing population. The changes in the cropping intensity and the increased reliance on HYVs, it has been argued before, is at least partly a result of the facilities for irrigation and flood protection created by the Project. The increased capability of land, by the same argument, can therefore be traced partially to the operation of the Project.



## 9.6 BIOLOGICAL ENVIRONMENTAL IMPACTS

Biological environmental impacts can be subdivided into those on fauna and flora (Table 9.2). Most have suffered no significant impacts. Hence only a few will be discussed.

### 9.6.1 Biological Impacts (Fauna)

#### a) Fish Communities/Habitats

There has been a significant negative impact on fish ecology due to the reduction of wetland area and depth, resulting from siltation and sand deposition. The enclosure on the mouth of the Muhuri River downstream has changed the natural course which may have affected the movement of hilsa and big shrimp. At present hilsa has disappeared completely in the surrounding rivers and shrimps are rarely found.

The declining open water fishery has been compensated somewhat by the better prospects for pond fishery. However, the species composition will be affected greatly as only a few of the available large number of species are cultured.

#### b) Bird Communities/Habitats.

People in the Project area claim that, 10-15 years ago, a substantial number of migratory water birds used to come in the late winter to the Chithalia Jala. The number has now significantly fallen. The change can be attributed both to the decline in the actual area under water and to the increased level of human activity during that time of the year which coincides with the beginning of the Boro period.

#### c) Parasites

The mosquito population has greatly increased in the area due to formation of increased number of shallow stagnant water bodies as well as continued growth of water hyacinth in the area. Snail population has also increased in the beels and khals due to low water level.

## 9.7 HUMAN ENVIRONMENTAL IMPACTS

Some of the most important impacts of the Kahua Muhuri embankment are those affecting the human environment. Most of these have already been described in detail in various other sections. Here, only the most important ones are reiterated briefly. These are grouped into five sub-categories: human use, social, economic, institutional and cultural.

### 9.7.1 Human Use Impacts

#### a) Crop Cultivation

The operation of the Project and sometime its lack of effectiveness due to breaches and public cuts in the embankment have led to several changes in the crop cultivation practices in the Project area. These include an encouragement to cultivation of Boro HYVs due to the surface water irrigation facilities provided by the weir, the increased availability of land in low-lying areas through the raising of land level and an increased opportunity to

cultivate T. Aman HYVs for similar reasons. The production effects of all these are, however, moderated due to the breaches and public cuts which almost every year damage crops in one place or the other.

b) Livestock

The cattle population has decreased substantially and cattle also suffer from poor health. This may be related to the shortage of animal feeds and decrease in grazing land. The increased incidence of liver fluke may have been caused by the expanding snail population in the shallow beel areas. The impact therefore, is moderately negative.

c) Fisheries

Chapter 5 shows that initially there was a marked decrease in capture fishery and corresponding increase in culture fishery. Later on bund failures affected the latter adversely. The effect therefore is moderately negative.

d) Domestic Water Supply

In the pre-Project period there was a limited number of hand tubewells in the area. Most of the people used water from ponds and khals for cooking, bathing, washing and drinking purposes. There was, therefore, a lack of pure drinking water. But over the last one decade or so, the number of hand tubewells has significantly increased and thereby the supply of safe drinking water has increased. The limited growth in the number of shallow and deep tubewells has also helped. Now, practically all households in the area drink water from the tubewells. However, this change cannot be attributed directly to the Project.

e) Sanitation

Sanitation did not appear to be a major problem in the Project area. The regular flushing away of the accumulated filth has not stopped due to the Project because of the breaches and public cuts. In fact, as described earlier, had flood water been stopped totally from entering the Project area, this could turn out to be a major health hazard in the area.

### 9.7.2 Social Impacts

a) Human Carrying Capacity

A significant increase in crop production was noted. On the other hand, there had been negative changes in production from fishery and livestock. On balance there is a moderate positive impact.

b) Demography

The Project has probably influenced demographic structures and trends only very little if at all.

c) Gender

No significant impact.



## d) Age

No significant impact.

## e) Health and Nutrition

Minor positive impact due to supply of safe water from the hand and shallow tubewells.

## f) Disruption, Safety and Survival

Although the Project has offered some protection from flood, it is only partial. Hence only a minor positive impact is expected regarding safety and survival.

## g) Land Ownership

No clear picture emerges regarding land ownership changes.

## h) Equity

Farmers have gained while fishermen are on the losing side. But the farmers are much more numerous. Also, among the farmers there appears to be little systematic pattern in terms of access to the incremental gains. Thus, on the whole there appears to be little change in terms of equity.

## i) Social Cohesion

No clear pattern could be discerned, but there is much resentment amongst the losers, particularly the traditional fishermen.

## j) Social Attitudes

There is public discontent due to the Project's failure i.e. breaches, but the adverse situation has also increased group activities. On the whole, it can be assumed that the impact on social attitudes in the Project area is negligible.

### 9.7.3 Economic Impacts

The three main potential impacts on the people are incomes, employment and land values. There have been positive changes in all the three areas. But due to fluctuations in the level of production, the impacts have been moderate.

### 9.7.4 Institutional Impacts

Informal institutional activity has changed for the better but public participation in the O&M of the Project is lacking. On the whole, a minor positive change may be assumed.

### 9.7.5 Cultural Impacts

Cultural continuity is somewhat threatened as the traditional fishermen who used to catch fish in the open water bodies no longer find adequate employment and have to look for

other occupations and jobs. As they are generally low-caste Hindus with their distinct sub-culture, the decline of capture fisheries is likely to threaten the diversity in the culture of the people in the Project area.

## 9.8 A SUMMING UP

The description above in sections 9.5 to 9.7 has been summed up in Tables 9.1 to 9.3. It appears that while there have been some losses in the physical and biological aspects of the environment, there have been quite a few gains in the human environment. The question therefore is whether the positive gains are sustainable. This remains a matter of investigation for the future.





**Table 9.1: Physical Environmental Impacts.**

Physical Issues	Degree of Environmental Impact	
	Project Area Impacts	External Impacts
<b>I. WATER</b>		
a. River Flow	0	+1
b. River Water Quality	0	-1
c. River Morphology	0	-2
d. Flooding	-1	-1
e. Groundwater Levels/Recharge	0	0
f. Groundwater Quality	0	0
g. Wetland Area	-2	0
h. Wetland Water Quality	0	0
<b>LAND</b>		
a. Physical Characteristics of Soil	-1	0
b. Soil Fertility	-2	0
c. Soil Moisture Status	-1	0
d. Soil Erosion	-1	-1
e. Land Capability	+1	0
f. Land Availability	+1	0

Note: +1: moderately positive, +2: strongly positive,  
 -1: moderately negative, -2: strongly negative,  
 0: no change

**Table 9.2: Biological Environmental Impacts**

Biological Issues	Degree of Environmental Impact	
	Project Area Impacts	External Impacts
<b>FAUNA</b>		
a. Bird Communities/Habitats	-1	0
b. Fish Communities/Habitats	-1	0
c. Other Macro-Fauna Communities/Habitats	0	0
d. Micro-Fauna Communities/Habitats	-1	0
<b>FLORA</b>		
a. Trees	0	0
b. Other Terrestrial Vegetation	0	0
c. Aquatic Vegetation	-1	0

Table 9.3: Human Environmental Impacts

Human Issues	Degree of Environmental Impact	
	Project Area Impacts	External Impacts
<b>HUMAN USE</b>		
a. Crop Cultivation	+1	0
b. Livestock	-2	0
c. Fisheries	-1	0
d. Afforestation	0	0
e. Agroindustrial	0	0
f. Transport Communications	+1	0
g. Infrastructure	+1	0
h. Domestic Water Supply	+2	0
i. Sanitation	0	0
j. Recreation	0	0
<b>SOCIAL</b>		
a. Human Carrying Capacity	+2	0
b. Demography	0	0
c. Gender	0	0
d. Age	0	0
e. Health and Nutrition	+1	0
f. Disruption, Safety and Survival	+1	0
g. Land Ownership	0	0
h. Equity	0	0
i. Social Cohesion	-1	0
j. Social Attitudes	0	0
<b>ECONOMIC</b>		
a. Incomes	+1	0
b. Employment	+1	0
c. Land Values	+1	0
<b>INSTITUTIONAL</b>		
a. Institutional Activity/Effectiveness	+1	0
b. Public Participation	+1	0
<b>CULTURAL</b>		
a. Historical/Archaeological Sites	0	0
b. Cultural Continuity	-1	0
c. Aesthetics	0	0
d. Lifestyle (Quality of life)	0	0



## 10 ECONOMIC IMPACTS

### 10.1 TYPES OF IMPACT

The economic impacts of the Project include those on production, income, consumption and employment. Apart from income all the others have been discussed in various degrees of detail in previous sections. That on income and the part that may be attributed to the Project are described below. An attempt is made here on the basis of these data to estimate the return to the Project.

### 10.2 CHANGE IN AGRICULTURAL INCOME

The increase in annual production in 1991 over that in 1983-84 and the net returns therefrom have been described in the section on agriculture. These imply a net incremental value of crops to the tune of Tk. 195.4 million over 1983/84 - 1990/91 (at 1991 prices). As Table 10.1 indicates the contribution of Boro and Aman paddies are of similar magnitude. Then again the table clearly shows the dominance of HYVs to be the major factor behind the growth.

All of the increment in value cannot be attributed to the Project. As discussed in the section on agriculture, some 1200 acres of the total of 4200 acres of Boro HYV land is irrigated with surface water available due to the weir. At most, 30 per cent of the net incremental value of Boro HYVs therefore can be estimated as the impact of the Project. Of the increase in production in T. Aman, all of it may be assigned to the Project. Further the advent of Boro HYVs is often at the cost of B. Aus. In the present case, B. Aus area has fallen drastically. Some of it has been shifted to the cultivation of T. Aus. Making adjustment for the net decrease in production of Aus paddy, the contribution of the Project to the net incremental value of crop production comes to Tk. 131 million or just about two-thirds of the total incremental value over the eighties.

### 10.3 FISHERIES INCOME

The section on fisheries indicated a fall in the catch of fish to the extent of 15.87 mt per year as estimated between 1983 and 1990. The value of this fish loss is Tk. 0.63 million or at most Tk. 1 million.

### 10.4 AGGREGATE INCOME CHANGE

The aggregate of the income changes from crop production and fisheries together is estimated at Tk. 18.82 million (Tk. 19.82 from crops adjusted for Tk. 1 million of loss of fisheries income) per year. It must be understood that this is the maximum level that has been reached so far and previously particularly before 1985-86 has been much less.

### 10.5 LAND VALUES

One beneficial impact of the Project can be on the value of land which may increase due to the changes in productivity. One observes a major change in land values in the Project area, sometimes to the extent of 400 per cent or more (Table 10.2). Note that the change has been most pronounced in case of low lying land because those are the areas which have been benefited most due to the cultivation of Boro HYVs and sometimes also the Aman HYVs.

**Table 10.1: Incremental Value of Production (1983/84-1990-91)**

(Tk. million)

Season	Crop	Value	Percent
Boro	Boro LV	- 4.8	
	Boro HYV	96.7	
	Boro Total	91.9	47
Aman	Aman LV	0.7	
	Aman LIV	49.8	
	Aman HYV	53.1	
	Aman Total	103.6	53
Aus	B. Aus	- 4.6	
	T. Aus	4.1	
	Aus Total	- 0.5	-
All	All	195.0	100
Due to Project	All	131.0	67

- Note: 1. All values are at 1991 prices.  
 2. The percentages are estimated using the total incremental value as the base.

Source : Field observations and Consultant's estimates.



Table 10.2: Change in Land Prices (Tk. per acre)

Mouzas	Land Level	Land Price		Percent Change
		1983 - 84	1990 - 91	
Purba Aloka	High	125,000	150,000	20
Durgapur	Low	87,500	175,000	100
Ratanpur	High	100,000	275,000	215
	Low	50,000	100,000	100
Paschim Ghaniamora	High	162,500	200,000	123
	Low	37,500	87,500	233
Chithalia	High	125,000	250,000	200
	Medium	37,500	175,000	467
	Low	25,000	100,000	400
Purba Salia	Low	87,000	187,000	215
Kolapara	High	200,000	250,000	125
	Medium	75,000	300,000	400
	Low	62,500	187,500	460

Source: Field observations

## 10.6 PROJECT APPRAISAL

### 10.6.1 Project Costs

The actual cost figures for the Project are unknown. However, the Project has basically two structural components, the earthen embankment and the weir. Given the dimensions of the structures, it is possible to evaluate the cost of construction and under plausible assumptions, to make estimates of O&M costs given the observed problems of erosion and breaches. The estimated costs are shown in Tables 10. 3 and 10. 4. The first of these indicates that more than 85 per cent of the costs may have been incurred for employing unskilled labour mainly for moving earth.

Table 10.4 shows the estimated O&M and rehabilitations costs. Whenever available, actual costs have been used. It is assumed that the weir will need some repair every fifth year or so.

**Table 10.3 Structure of Estimated Project Cost (1983/84 - 2002/03)**

Type of cost	Cost (Tk. '000)	Percent
Labour	27,184	87.6
Skilled	429	1.4
Unskilled	26,755	86.2
Materials	3,861	12.4
Steel	1,848	6.0
Cement	1,353	4.3
Bricks	660	2.1
All	31,045	100.0

### 10.6.2 Project Benefits.

Project benefits are shown alongside Project costs in Table 10.4. For the years 1983/84-1990/91 the agricultural benefits due to the Project as estimated earlier have been used. In 1990/91, the net incremental benefit due to the Project has been Tk.25.2 million. For subsequent years, it has been taken to be Tk.25 million. No adjustments have been made for fisheries loss. Similarly by-products have not been considered.

### 10.6.3 Project Returns.

The Project returns have been estimated using a 12 per cent rate of discount, and SCFs as calculated by FPCO. The results are shown in Table 10.5. The table clearly indicates the Project to be economically viable on the basis of all the usual project appraisal criteria. As there are no other major losses or adverse externalities detected by the RRA team, it appears that the results would remain basically unaffected even if these could be integrated into the analyses.



Table 10.4 Financial Cost and Benefit of Project

(Tk. '000)

Year ~	Construction	O&M incl.rehabilitation	Total cost	Total benefit
1	20,000	-	20,000	0
2	-	205	205	7,046
3	1,650	205	1,855	19,713
4	1,650	205	1,855	18,291
5	-	205	205	17,494
6	-	205	205	17,332
7	-	410	410	25,533
8	-	410	410	25,206
9	-	740	740	25,000
10	-	410	410	25,000
11	-	410	410	25,000
12	-	410	410	25,000
13	-	410	410	25,000
14	-	740	740	25,000
15	-	410	410	25,000
16	-	410	410	25,000
17	-	410	410	25,000
18	-	410	410	25,000
19	-	740	740	25,000
20	-	410	410	25,000

- Note:
1. All figures are at 1990-91 price.
  2. The year to year fluctuations in benefit during the early years reflect the impact of breaches and erosion and the adjustments in crop acreages made by farmers.
  3. The cost of construction has been estimated at Tk.980,000 per km of embankment. Another Tk.10 million is added for the 15 km Kahua link canal and other re-excavations. For rehabilitation/reconstruction the cost per km has been estimated to be Tk.820,000. The cost of weir is arbitrarily taken to be the equivalent to that for a 3-vent regulator which is estimated as Tk.3.3 million which is rather on the high side.
  4. The rehabilitation work witnessed by the RRA team has a budget of Tk.820 thousand over two years. The annual O&M cost for initial years has been assumed to be one-half of this rehabilitation cost incurred on the average in one year. For later years, the O&M cost for earthwork has been taken to be equal to this average yearly rehabilitation cost. The O&M for the weir has been assumed to be 10 per cent of sunk cost once every five years.

Source: Consultant's estimates.

Table 10.5 Project Appraisal of Kahua-Muhuri Embankment

Indicators	Financial	Economic
IRR (%)	68	96
B-C ratio	6:1	9:1
NPV (Tk. million)	110	130

Note : The estimates do not include fisheries loss as this is miniscule. Also the value of by-products has not been included.

Source: Consultant's estimate.





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