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

(2)



# FINAL REPORT

# VOLUME 2
# RRA and PIE Results



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Hunting Technical Services Limited

in association with

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The present report is one of a series produced by Flood Action Plan components 12, the FCD/I Agricultural Study and 13, the Operation and Maintenance Study.

The full series comprises the following reports:

**FAP 12**

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

Project Impact Evaluation studies of:

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

Rapid Rural Appraisal Studies of:

Protappur Irrigation Project
Nagor River Project
Sonamukhi Bonmander Beel Drainage Project
Improvement of Sakunia Beel
Silimpur-Karatia Bridge cum Regulators
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Kahua Muhuri Embankment
Konapara Embankment [1]
Polder 17/2
BRE Kamarjani Reach [1]
BRE Kazipur Reach [1]

Draft Final Report (4 Volumes)
**Final Report (4 Volumes)**



**FAP 13**

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

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

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**Abbreviations, Glossary & Equivalents**

| | |
|---|---|
| AAM | Agricultural Assessment Matrix |
| AED | Agroecological Division |
| AEU | Agroecological Unit |
| BADC | Bangladesh Agricultural Development Corporation |
| BBS | Bangladesh Bureau of Statistics |
| BCR | Benefit Cost Ratio |
| beel | shallow water body |
| BETS | Bangladesh Engineering and Technical Services |
| BIDS | Bangladesh Institute of Development Studies |
| BNC | Bangladesh National Consultants |
| BRE | Brahmaputra Right Embankment |
| bund | Earthen embankment |
| BUP | Bangladesh Unnayan Parishad |
| BWDB | Bangladesh Water Development Board |
| C/S | Country Side |
| chhatak | 290 - 350 grammes |
| CIP | Chandpur Irrigation Project |
| CIRDAP | Centre for Integrated Rural Development in Asia and the Pacific |
| DSSTW | Deep Set Shallow Tubewell |
| DTW | Deep tube-well (with positive displacement pump) |
| DOF | Department of Fisheries |
| DAE | Directorate of Agricultural Extension |
| DAU | Draught Animal Units |
| dheki | wooden husking equipment |
| DU | University of Dhaka |
| EIP | Early Implementation Project(s) |
| EIRR | Economic Internal Rate of Return |
| ESL | Engineering Science Limited |
| FAP | Flood Action Plan |
| FAO | Food and Agriculture Organisation (of the United Nations) |
| FCD/I | FCD with or without Irrigation |
| ft | Feet |
| FCD | Flood Control and Drainage |
| FCDI | Flood Control Drainage and Irrigation |
| FPCO | Flood Plan Coordination Organisation |
| FFW | Food For Work |
| ha | Hectare (2.47 acre) |
| haor | saucer like depression |
| HTS | Hunting Technical Services Limited |
| HYV | High Yielding Variety |
| IBRD | International Bank for Reconstruction and Development (World Bank) |
| IDA | International Development Association (World Bank) |
| JICA | Japan International Cooperation Agency |
| KBK | Kolabashukhali Project |
| khal | Natural channel/minor river/ tidal creek |
| khalashi | 'Cleaner' (actually guard) of regulator/sluice |
| khana | persons who normally eat together (Food) |
| kharif | summer |
| khas | Government owned |

| | |
|---|---|
| km | Kilometer |
| LGEB | Local Government Engineering Bureau |
| LLP | Low Lift Pump |
| MPO | Master Plan Organisation |
| MDIP | Meghna-Dhonagoda Irrigation Project |
| mt | metric tonne (1,000 kg., 2,204 lb.) |
| NMIDP | National Minor Irrigation Development Project |
| NPV | Net Present Value |
| NGO | Non-governmental Organisation |
| O&M | Operation and Maintenance |
| ODA | United Kingdom Overseas Development Administration |
| PPS | Probability Proportional to Size |
| PEP | Production Employment Programme (of BRDB, q.v.) |
| PCR | Project Completion Report |
| PIE | Project Impact Evaluation |
| PP | Project Proforma |
| pucca | brick constructed |
| rabi | winter cropping season |
| RRA | Rapid Rural Appraisal |
| RHD | Roads and Highways Department |
| SCF | Shadow Conversion Factor |
| STW | Shallow tube-well (with suction pump) |
| SRS | Simple Random Sampling |
| SPSS | Statistical Package for Social Sciences |
| TOR | Terms of Reference |

# APPENDIX B

# SUMMARIES OF PROJECT IMPACT EVALUATION REPORTS

# APPENDIX B

## Summaries of Project Impact Evaluation Reports

**Contents**

## Chalan Beel Polder 'D'

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Chalan Beel Polder 'D' |
| **Project Type** | : Flood Control, Drainage and Irrigation |
| **Location** | |
| **FAP Region** | : North-West |
| **District** | : Rajshahi and Noagoan |
| **Area (ha.)** | : 53 000 ha. (gross)<br>37 235 ha. (cultivable) |
| **Funding Agency** | : IDA |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1981/82 |
| **Scheduled Completion** | : FY |
| **Actual Completion** | : FY 1988/89 |
| **Original Cost Estimate** | : Tk. |
| **Final Cost Estimate** | : Tk. 342.4 million (1991 prices) |
| **Major Flood Damage:** | : 1987, 1988 |
| **Repair/rehabilitation in** | : 1990 to present |

**Overview:**

A very large Project with primarily FCD objectives and subsidiary provision for irrigation, which has successfully reduced flood depth and duration in years when the embankment remains intact, but failure to consider external impacts at the planning stage has led to regular public cuts by disbenefited people outside, and the Project has produced far smaller agricultural benefits than expected. Fishery disbenefits have been large, and economic performance is poor, EIRR being below 12 per cent based on agricultural and fishery impacts, but excluding the substantial external disbenefits.

# CHALAN BEEL POLDER 'D'

## SUMMARY OF FINDINGS

### Location

Chalan Beel Polder D is located in Rajshahi and Naogaon Districts in the north west of Bangladesh, and falls within the FAP North-West region. The polder is enclosed by the River Atrai and its distributary, the River Fakirni on the east, by the Sib River on the west, and by the Barnai River on the south (see Figure B1.1). The Project covers an area of over 53000 ha. and is relatively flat. It has a complex relief, with undulating highlands, particularly in the northern part, saucer shaped low-lying areas and a number of beels and depressions. The control area is part of the incomplete Barnai Project (see Figure B1.2), since there are no unprotected areas in this part of the Atrai Basin which are not either impacted by completed projects or part of ongoing ones.

### Project Objectives

Prior to the Project more than half of the area used to be subject to annual flooding up to 1.5 m in depth. A further quarter of the area used to be flooded annually up to 0.9 m in depth. The Project as implemented was intended as a low-cost, quick-yielding and technically simple FCD project aimed particularly at reducing flooding problems in the shallow to medium flooded areas. The Project involved construction of a 132 km. ring embankment, 17 regulators, 77 dual purpose irrigation inlets/drainage outlets, 8 flushing sluices/drainage outlets, the excavation of 137 km. of drainage channels and construction of 102 km. of main and village roads.

### Project History

The Project was first conceived in 1964, as part of an EPWAPDA Master Plan for the Chalan Beel Area and all of what became Bangladesh. In 1970 a feasibility study for the entire area was prepared, and it was proposed to divide the area into four independent polders (A,B,C,D). Polders A,B and C were subsequently implemented and in 1979 a feasibility study was prepared for Chalan Beel Polder D. The World Bank agreed to support the Project under the Second Drainage and Flood Control Project (DFC-II, IDA credit 1184-BD). Construction started in 1981/82 and was completed in 1988/89.

The Project has been the subject of two previous evaluations, one at the time of Project completion (BETS, 1988) and the second two years later (MPO, 1991).

### Construction and Design

The Project went through a series of designs. The 1979 feasibility study proposed pumped drainage, but this was subsequently rejected. The number of structures proposed was increased during the construction period. However it appears that the capacity of many of the drainage structures remains inadequate. The quality of construction generally appears to have been good.

## Hydrological Impact

Based on the areas of plots cultivated by sample households, the FCD infrastructure has had a limited impact in transforming land to shallower normal flood levels (increase of 17 per cent of protected area); associated with this is a similar reduction in normal inundation period. However, in the unprotected impacted area the area of shallow flooded land has decreased and inundation periods have increased. Thus, there has been a negative off-site impact. The control area showed no significant changes in normal flooding, implying that changes in the impacted area are a Project effect. The adverse impacts are attributed in part to the inadequate drainage structures provided at both ends of the active channel (Kompo River) which passes through the middle of the Project, connecting the Sib and Fakirni Rivers. This has led to increased flood depths in adjacent unprotected areas and has exacerbated drainage congestion inside the Project. The Project has also increased flooding problems downstream.

Unfortunately the Project has also suffered from regular breaches and public cuts, sometimes due to embankment failure during high floods, but mainly due to the conflicting interests of insiders and outsiders, and of farmers and fishermen. These cuts have been followed by sudden rapid inundation of supposedly protected areas and have caused intense dissatisfaction. There have also been substantial drainage congestion problems in some areas of the Project, possibly due to inadequate capacity of drainage structures, and in some cases this has been the cause of the public cuts.

Although irrigation plays a vital role in the rabi season, particularly for HYV Boro cultivation, the incidence of 'modern' irrigation is less in the Project than in the control area. The main irrigation source in the Project is indigenous methods (47 per cent of irrigated area) while in the control area 64 per cent of irrigated land is covered by STWs. However, there is evidence that since the Project, irrigation facilities have been catching up with the control area.

## Operation and Maintenance

BWDB spends considerable sums on O&M at Chalan Beel Polder D, but in 1991 it was nevertheless judged that 40 per cent of the embankment length was damaged and in need of repair or rehabilitation. A large portion of the brick mattressing failed within one year, possibly due to poor toe construction. Irrigation inlets were generally in good condition, but some of the drainage structures were in need of repair. An O&M manual had been produced for the Project, but was not in use.

BWDB has not involved local people in operation of Project structures, and local committees have not been formed, but in practice local influential people often control the operation of structures.

There have been numerous disputes over operational procedures, leading on some occasions to the public cuts referred to. The greatest conflict of interest occurs during high floods on the Sib River in the west, when outsiders become desperate and cut the embankment to escape from inundation, causing an annual inflow of water which leads to a chain of cuts in main and village roads down the polder. This eventually leads to public cuts on the eastern side by insiders letting the water out to the Fakirni River, which in turn affects Chalan Beel Polder C.

### Agricultural Impact

The Project was expected to lead to a very substantial increase in cropping intensity (eventually to 235 per cent) and to reduce crop losses and increase yields. In practice much of the Project area, and the control area, is monocropped. The most important crop is HYV Boro, which is cultivated to a greater extent in the control area and has been stimulated by expansion in groundwater irrigation, and not by the FCD infrastructure.

Overall paddy yields were slightly higher in the Project area in the survey year, but there is reason to dobt that this is the usual situation. TL Aman and T Aus yields in particular were higher in the protected area, though in the peak flood years of 1987 and 1988 Aus and Aman yields were less than in the control area.

Overall there is a slight positive Project impact on agriculture, but it is far smaller than was anticipated by the Project Feasibility Study.

### Livestock Impact

A comparison between livestock holdings in the protected area and in the control area reveals little evidence of Project impact. There are however significantly larger holdings of bovine animals and poultry in the Project area, and incomes from livestock are slightly higher.

### Fisheries Impact

In Chalan Beel the polder has led to a reduction in the number of fishermen, a fall in the number of days a year the remaining fishermen spend fishing, and in a fall in their daily catch. As a result production of all capture fish species has dropped. This has been caused by the reduced area annually flooded, by the drying up of beels and the blockage to normal fish migration routes, although general overfishing, fish disease and illegal fishing (non-Project causes) have also contributed to the decline in output. A comparison of the Project and control areas noted that far fewer of the non-farm households in the Project area owned fishing nets, an independent confirmation of impact on capture fishing.

The area has the largest number and area of fishponds of any of the projects studied in detail, but a high proportion of these are still vulnerable to flooding, and their productivity is low - about half that normally expected. As a result increased fishpond output following protection is very limited, perhaps 430 mt. a year, compared to an annual loss of capture fisheries which is estimated to be between 1900 and 2500 mt..

### Infrastructure and Communications

The internal road network built by the Project, and the embankment itself, have had a very substantial impact on communications, which is only partly offset by the reduced use of boat transport. However, with the recent advent of powered boats using STW engines, boatmen in the Project area have largely been able to relocate to adjacent areas; the numbers of boatmen in the impacted but unprotected area have increased, while they have decreased in both the protected and control areas.

Few households in the control area appear to have suffered recent damaging flooding (since 1987) whereas 25 per cent of households in the Project area have been flooded in 1988 or later. The Project appears not to have reduced the risk of damaging floods (affecting

property) and in 1988 those properties affected in the control area suffered less damage than inside the polder. This may be because households and entrepreneurs felt safe in building inside the Project area on low lands which were considered risky outside.

**Socio-Economic Impact**

A comparison of social and economic conditions in the Project and control areas suggests that the FCD protection has had a modest positive impact. There has been no change in occupational structure, and agricultural labourers in the Project area report the same rate of employment and the same seasonal pattern (with a slack period in the late monsoon) as those in the control area. Wage rates are the same, and food availability appears to be the same in both areas; about 60 per cent of households reported 'partial starvation' in the lean period.

However, there is a higher level of rice milling and trading, of agricultural input trading and of blacksmithing in the impacted area. There has clearly been substantial employment generation in construction and maintenance of Project earthworks, and this has benefited women as well as men. Women have also benefited from increased work in processing crops as a result of higher production levels, though it is noticeable here, as in many other areas studied, that the growth in irrigation using STWs has been accompanied by use of the STW engines for rice husking, transferring part of the responsibility for this task from women to men. The change in cropping pattern from B Aman to T Aman has benefited women from ethnic minorities who are traditionally hired for transplanting. With the spread of STW engines as boat power units, boatbuilding has also flourished in and around the Project area, though the linkage with the Project in this case is rather tenuous.

Overall, income per capita does not differ between impacted and control areas, but inside the Project incomes appear to be higher for large landowners and lower for landless households and marginal farmers (operating under 1 acre), implying that any distributional impact has been neutral or negative. No notable differences were found in the sources of household income, although crafts are relatively important for middle landholding categories.

Inequality in landholding categories is slightly higher in the Project sample households. Similar proportions of households have changed their holding size in the impacted and control areas, although within the Project the number making a significant shift of holding category (in either direction) is slightly greater. Land acquisition for the Project did not appear to be unusually contentious, but 9 per cent of impacted households lost land in the impacted area, and 5 per cent of acquired land was not compensated for. Since the Project land prices for irrigated and non-irrigated land have been increasing faster in the Project than in the control area, implying a perceived benefit to the Project.

The lack of apparent impacts is also reflected in the lack of difference in quality of life indicators: water and sanitation facilities show no difference between impacted and control area, and there is no difference in the type and quality of housing. More repairs had been carried out in the impacted area, but this reflects flood damage. There is, however, higher literacy amongst household heads in the Project area than in the control area.

**People in over half the impacted villages reported having doubts about the necessity for the Project and are dissatisfied with it.**

## Environmental Evaluation

The potential positive impacts of the Project on human and physical environmental issues, in increasing land availability, monsoon season cropping and harvested monsoon season yields, and in improving the communications network, were limited and have been further offset by a number of serious negative impacts, mainly associated within the impacted area with the annual public cuts and breaches. The main negative impacts are the decrease in wetlands leading to a decline in capture fisheries, the marked deterioration in social cohesion and equity, the failure to develop any public participation in Project operation and the threat to the cultural traditions of the largely Hindu capture fishermen. Outside the Project area the Project has had major negative impacts, on conditions in adjacent areas which suffer higher flood levels and downstream where the combination of the Chalan Beel D polder with other middle Atrai embankment systems leads to threats of catastrophic flooding. The retreat of the wetlands has caused more significant biotic impacts than in most projects studied by FAP 12, because of its magnitude. Fish ecology and aquatic micro-biota in particular have suffered.

## Economic Appraisal

The estimated economic returns to the Chalan Beel Project are disappointing. Assuming no fisheries losses, the agricultural benefits yield an EIRR of 26 per cent, but this a maximum estimate based on one of the probably rare years when the protected area showed a superiority over the control. With the lowest estimate of the actual fisheries losses, the Project is marginally viable (EIRR 14.5 per cent), while the higher estimate of fishery losses reduces EIRR to 8.5 per cent.

The Project was not particularly costly, with capital costs at Tk 9196 per benefited hectare (in 1991 financial prices), and O&M costs are not unusually high. The Project's poor performance stems from its very limited agricultural impact, due to the impossibility of proper operation due to offsite impacts, the substantial fisheries losses incurred, and to a lesser extent from the fairly long implementation period (eight years).

If any quantification of off-site impacts on non-Project areas could be made, these would further reduce the EIRR of the Project.

## Recommendations

Substantial changes would be needed to develop an approach to FCD in the Chalan Beel Polder D which corrected the present difficulties. These might require a substantial change in the flood control philosophy, and this is currently (1991) under review by the FAP North-West Regional Study (FAP 2). If, on the other hand, the polder is retained in its current form, a substantial review of operating practices, and their implications for outsiders and insiders is essential. This would probably lead to a move to some controlled flooding, and to structural changes in the internal drainage network and in many drainage structures. Any revised plan for Chalan Beel D will only be feasible if it is made in the context of a long-term integrated plan for coordination of development in the Atrai basin.

If the polder is retained in its present form, a programme for rehabilitation of the public cuts, drainage systems and structures will be required to allow the Project to function as planned. This rehabilitation will in turn be effective only if measures are taken to correct the fundamental inequity of Project impacts on insiders and outsiders.

**B1-7**

Monitoring programmes should be established for critical environmental parameters, including groundwater levels and quality, extent and quality of wetlands, wetland wildlife including fish, and micro-biota. If such a programme can be set up, and if the Project is successfully rehabilitated, a detailed environmental audit should be conducted about five years after the completion of rehabilitation.

Figure B1.1 Chalan Beel Project Area



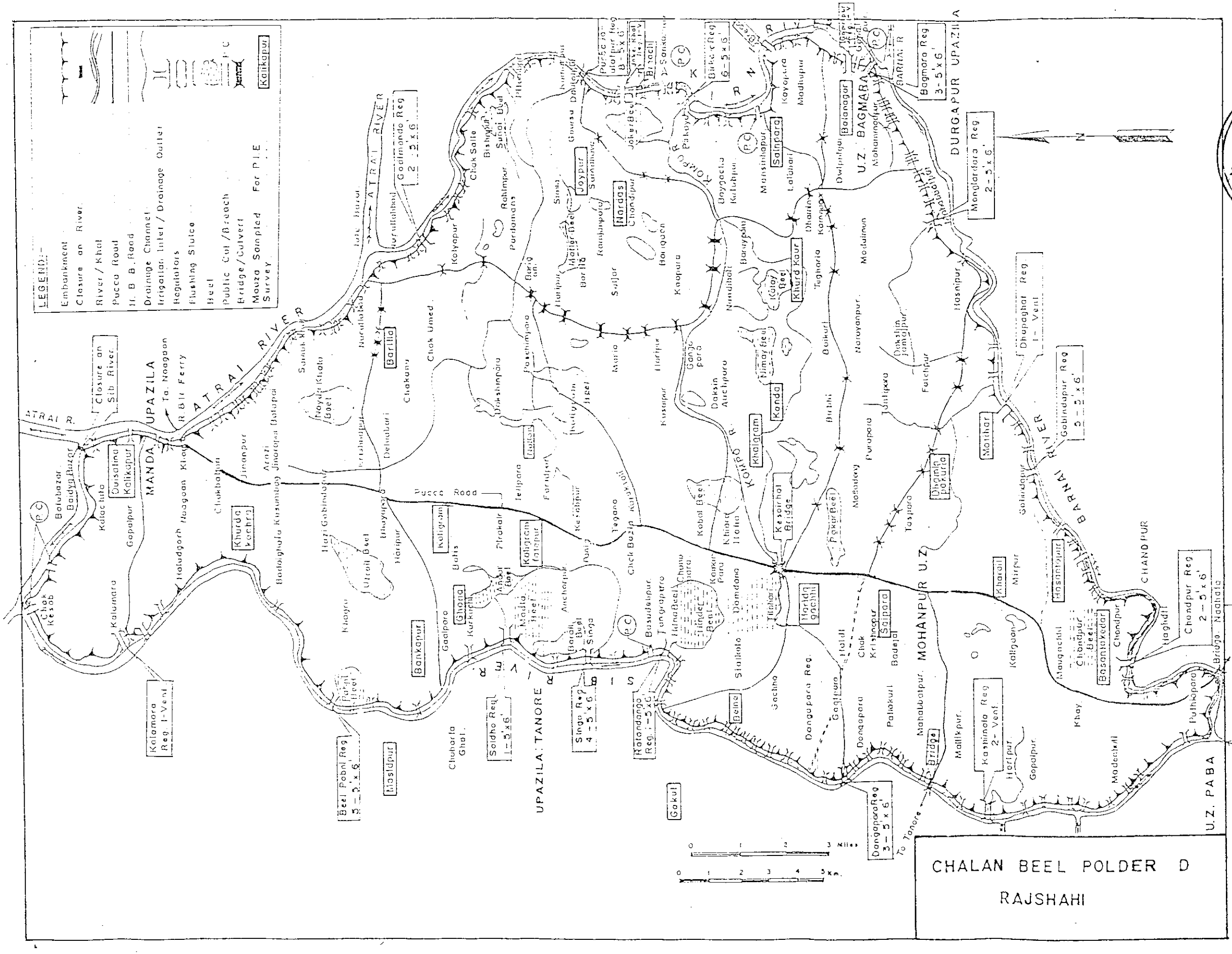
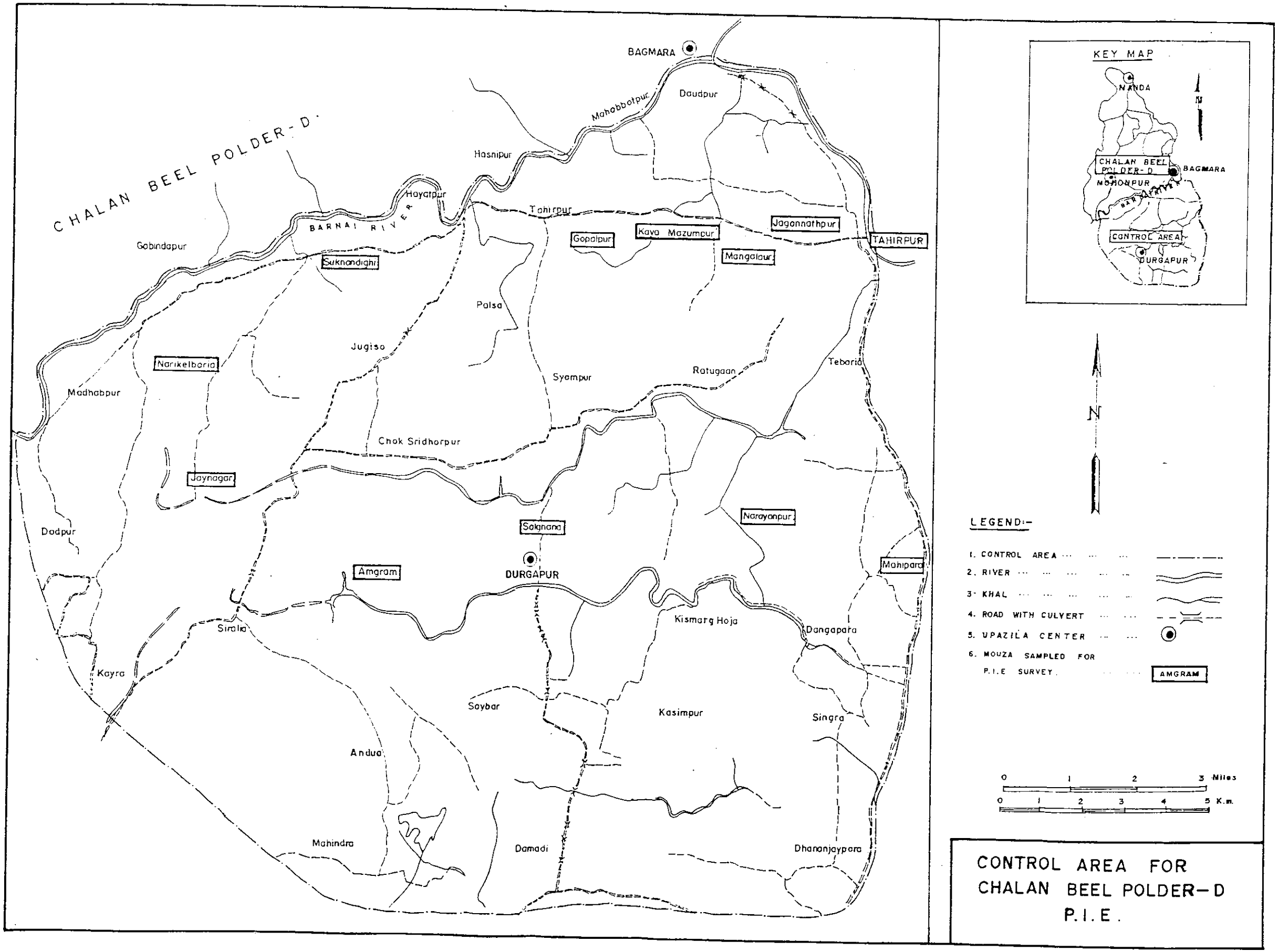


Figure B1.2 Chalan Beel PIE Control Area



## Kurigram South Unit

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Kurigram South Unit |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : North-West |
| **District** | : Kurigram and Lalmonirhat |
| **Area (ha.)** | : 63 000 ha. (gross)<br>50 000 ha. (cultivable) |
| **Funding Agency** | : Government of Bangladesh |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1975 |
| **Scheduled Completion** | : FY 1982 (eight year construction period) |
| **Actual Completion** | : FY 1984 (FCD component) |
| **Original Cost Estimate** | : Rs 232.46 million (1971 prices) |
| **Final Cost Estimate** | : Tk. 683.6 million (1991 prices) |
| **Major Flood Damage:** | : 1988, 1991 |
| **Repair/rehabilitation in** | : Ongoing from 1988 |

**Overview:**

A very large FCD project, implemented over a protracted period with Bangladesh internal resources. The Project does not benefit the very important HYV Boro crop in the area, but has resulted in some increase in the area of Aus and in increased adoption and yield of T Aman, both local and HYV. Drainage congestion persists, and sections of the embankment are under constant erosion threat, both due to poor planning. O&M has been very poor. There is still widespread poverty in the area. The Project is marginally viable; EIRR is estimated at 22 per cent, but this is highly sensitive to yield estimates, variations within the range of uncertainty of survey estimates reducing EIRR to 2 per cent.

# KURIGRAM SOUTH UNIT

## SUMMARY OF FINDINGS

### Location

The Kurigram South Project (correctly known as the South Unit of the Kurigram Flood Control and Irrigation Project) is located in the north-west of Bangladesh in the Kurigram and Lalmonirhat Districts, and falls within the FAP North-West Region. The Project area is over 63 000 ha. and is mainly bounded by three major rivers - by the Brahmaputra on the east, by the Teesta on the south and south-west, and by the Dharla on the north-east. The western boundary north of the Teesta is the Kaunia-Mogulhat railway line (see Figure B2.1).

The land is generally highest in the north. It slopes gently down from the north-west to the south-east, and the internal relief is irregular, due to low pockets, gulleys and channels, with low ridges formed by the levees of past river courses.

The control area studied is in the north-western part of the North Unit of the same Project (see Figure B2.2) - this area is open to floods from minor rivers flowing from India, and to some extent from the Dharla River. All other areas in this region have already been protected by embankment projects.

### Project Objectives

About 40 per cent of the area used to be flooded annually before the Project, resulting in major damage to Aus and Aman crops, disruption of communication and damage to infrastructure. Large tracts of agricultural land were lost each year due to erosion by the major rivers. Kurigram town was itself threatened by the River Dharla. The Project as implemented aimed to protect the area from flooding by the three major rivers, while at the same time facilitating drainage into the rivers at low river stages.

### Project History

A feasibility study for the Kurigram Flood Control and Irrigation Project was carried out in 1971. This recommended a much larger project than the one implemented so far, including flood protection for both north and south units, pumped irrigation from the Dharla for about 30 000 ha. in the north, a diversion barrage on the Dharla River near Kurigram Town to command about 29 000 ha. in the south unit, and tubewell irrigation for a further 20 000 ha. in the south unit. The Project has been implemented over an extended period by BWDB, using local financial resources and FFW. Implementation has concentrated on the flood control and drainage components, and these were substantially complete in the South Unit by 1983/84. Since that date there have continued to be problems due to river erosion, and substantial expenditures have been needed on bank protection works to protect Kurigram town.

In September 1991 the area suffered from serious flooding. This came in from the north-west after the Teesta had overtopped its banks and cut through the Kaunia-Mogulhat railway line.

BWDB continue to plan and prepare for development of the north unit and for irrigation development in the south unit, and in 1991 a Feasibility Study for the latter component was commissioned by JICA.

### Construction and Design

The Project as constructed comprises 110 km. of embankment, along the three main rivers, eight main regulators and limited excavation of drainage channels. Standards of construction were acceptable, but the embankments have required frequent rehabilitation following river erosion, and substantial retirement may be necessary in the south following damage in 1991. The embankment in several places crosses sections of the active floodplains of the major rivers, where most of the problems occur, due to river erosion and the use of very sandy floodplain soil for embankments which are then vulnerable to raincuts.

The construction process was spread over a long period, and there appeared to be no procedure for design review in the light of changing river conditions. Moreover, in some places natural drainage channels were blocked by the embankment without any drainage provision, and in general there is inadequate capacity to quickly drain out water during the often short periods in the monsoon when river levels permit gravity drainage (especially from the lowlying south-eastern part of the Project). The Ratna River was never closed off, and hence it flows into the Project freely, but its outfall is a regulator which collapsed in 1988 when flood water in the Ratna breached the embankment. Construction of bank protection works has continued, but these continue to suffer from erosion.

### Hydrological Impact

Over the Project as a whole there has been a small reduction in the proportion of lower land categories. Local people reported increased depths and durations of monsoon inundation in the waterlogged south-eastern part of the Project, but the problem was not reflected in PIE data. However, the flashy nature of flooding in the area is not necessarily reflected in normal monsoon water levels.

Irrigation by STW is widespread in both Project and control areas. A slightly higher proportion of Boro is under mechanised irrigation in the Project, possibly reflecting increased security from flooding, since there has been a greater expansion of STW irrigation inside the Project than in the control area in the last 10 years.

### Operation and Maintenance

Maintenance of Project infrastructure has been highly inadequate. This is due partly to planning defects and the diversion of scarce resources to expensive protection works for embankments in the active floodplains, and also to high establishment and running costs relative to the amount of active routine O&M undertaken. Funds have been spent on new regulators but not on restoring the intended level of flood protection following the various damages. Cuts and breaches have remained in a state of disrepair for long periods, seriously limiting the potential benefits from the Project. All the drainage channels have now silted up, to a greater or lesser extent, and require re-excavation. Additionally, about two-thirds of the embankment length has homesteads cut into the slopes, further weakening erosion prone reaches of the embankment.

There are conflicts between BWDB and local people over breaches and cuts in the embankment, and over the design and maintenance of regulators. No committees involving local people in O&M have been set up.

### Agricultural Impact

The main crops in both the Project area and the control area are TL Aman and HYV Boro, with HYV Aman also important in the northern half of the Project area. The Boro is mainly irrigated by shallow tubewells (STWs). The Project area has a slightly larger area under Boro than the control area, but this is unlikely to be related to the FCD infrastructure as the three main rivers flood after the Boro season.

Cropping intensity is higher in the Project (190 per cent) than the control (174 per cent), largely because of a greater area under jute. There has been a greater move from B Aman to TL Aman, and TL Aman yields are 15 per cent higher in the Project area than in the control. Expenditures on crop inputs are also a little higher in the impacted than in the control area (for both TL Aman and HYV Boro). Reduced flood depths and duration do appear to have had a significant, though not a dramatic impact, on Aus and Aman crops; for example, in 1987 and 1988, yields of the main monsoon crops were substantially higher in the Project than for the same crops in the control area.

### Livestock Impact

The impact of the Project on livestock appears to have been minor. The Kurigram area is distinguished by the large holdings of goats and sheep, but these are larger in the control area than in the Project area, as are holdings of bovine animals and of poultry.

### Fisheries Impact

Although the Project has had a negative impact on fisheries, this is not as marked as in other FCD project areas. A comparison of Project and control areas indicates that fish catches have fallen in both, but that the declines are greater in the protected area. Fishing effort has been diverted from beels to the less productive rivers, and the blocking of past fish access routes has reduced fishery productivity.

The area is distinguished by a successful fisheries extension effort. The New Fisheries Management Policy is being implemented in the area, NGOs are involved in management of some of the lesser water bodies, deliberate efforts have been made to assist disadvantaged capture fishermen in developing fishponds, and fishpond productivity is exceptionally high - particularly in the protected area. In the Project area, half of the sample fishponds that had been vulnerable to flooding before the Project are still often flooded, but nevertheless the FCD intervention has assisted in promoting culture fisheries.

### Infrastructure and Communications

The Project area already had a good road communications network, and while construction of the embankment has further improved this, the impact is not great. The number of boatmen is reported to have fallen in the protected area, but not in the unprotected riverside areas.

The Project infrastructure has complemented the Kurigram town protection works, and has probably reduced flood losses there. But in general it has not increased security from flood damages in rural areas. It was found that in rural areas flooded households in 1988 suffered similar losses in the Project and control areas, although more were affected in the control area. Businesses reported higher damages in the Project, which could have been associated with the timing of the evaluation (which coincided with the exceptional 1991 flood in Kurigram south) or with a tendency for people to invest more at lower land elevations under the impression that these were better protected than they were. It is also a result of the unwise inclusion in the Project of often low-lying tracts of active meander floodplains under constant and fierce erosional attack by the rivers.

**Socio-Economic Impact**

There appear to be no major differences in occupations or sources of income between Project and control areas, although secondary occupations are more common in the Project. There is no difference in agricultural employment at household level. Although the survey data suggest that the cropping pattern inside the Project implies about one-third more days per hectare are required than in the control area, wage rates in the Project area are slightly lower than in the control area.

There appear to have been negligible Project impacts on secondary economic activities. There has been hardly any growth in numbers of rice mills, input and grain trading enterprises, and light engineering workshops, while the number of oil mills has decreased. The latter, however, is primarily due to the replacement of rabi oilseeds by Boro, and is not a Project effect. It was noted that in the Project area household heads were very likely to have a secondary occupation - far more likely than in the control area. This is usually an indicator of a relatively poor area.

It was also reported that the amount of women's work in farm related activities was declining in this area. A decline in paddy husking, associated with expanded use by men of STW engines for this purpose, is a common phenomenon, but a general decline is not expected and again is an indicator of increasing poverty. Caution must be exercised here, however, since responses may have been coloured by the loss of paddy in the 1991 floods.

Despite these indications, reported incomes were slightly higher (11 per cent) on a per capita basis, but lower on a household basis, in the Project area. However, this may be unreliable, since housing quality, sources of water, sanitary facilities, and food availability all show negligible differences with the control area. Kurigram South was the poorest area surveyed in detail by FAP 12, and the Project has not prevented 80 per cent of households 'partially starving' in the lean period.

Inequality is still extreme (per capita incomes of large landholders are 5.8 times those of the landless) and landholding patterns have not changed relative to the control area.

Local people noted disbenefits to fishermen, boatmen, and the inhabitants of neighbouring areas, and are concerned about declining soil fertility and soil moisture, loss of fisheries and drainage congestion. Land acquisition was a serious problem. Although only 4 per cent of households lost land, in 56 per cent of cases there was no compensation, and compensation was paid only slowly and after payment of bribes.

## Environmental Evaluation

Environmental impacts of the Project itself have not been great, but they vary significantly between different agroecological divisions within the Project area. The higher lands in the north and west are barely affected or unaffected by the Project. The land that used to be moderately flooded in the past has benefited significantly, and there has been a change in cropping patterns as a result. Low lying lands may well be worse off than in pre-Project periods, as drainage congestion has been exacerbated by the embankments. Where tracts of active river floodplain have been included within the embankment, the environmental risk factor is high. Off-site impacts are only minor, as the volumes of water excluded are small compared to the scale of the rivers, and of the Brahmaputra in particular.

Although a number of major environmental changes have taken place in the Project area, these are mainly the result of trends occurring irrespective of the Project and which generally receive only minor and/or localised additional impetus from it. These include the more obvious negative ecological impacts such as retreat of wetlands and the decline of birds, fish and other wildlife; hence, the biotic impact of the Project is almost negligible. Similarly, marked changes in human issues which have been only partially influenced by the Project include the modest increase in agricultural productivity, the decline of capture fisheries and the growing inequity between rich and poor.

## Economic Appraisal

Despite the mediocre agricultural performance and prolonged construction period of the Project, it yields an EIRR of about 22 per cent. This is partly due to the absence of large fisheries net disbenefits, since the impact on capture fisheries was small and culture fisheries were benefited and are highly productive. However, the EIRR should be interpreted with great caution. Sensitivity analysis shows that a reduction of 10 per cent in impacted area paddy yield would be sufficient to reduce EIRR below 12 per cent, the assumed opportunity cost of capital, while the PIE survey design was not expected to measure yields to an accuracy of greater than +/- 10 per cent. The Project should therefore be assessed as only marginally viable.

## Recommendations

The strategy of trying to protect the low-lying areas from flooding, especially where they are active meander floodplain lands, appears to be very expensive, and not very effective. It may be necessary to revise the approach to FCD infrastructure in the area, maintaining protection to land at medium elevations, where TL Aman and HYV T Aman can be grown, and removing or abandoning the protection attempted for the low-lying areas which at present often suffer from acute drainage congestion or are open to flooding.

Two particular weak spots are currently threatening catastrophic flooding: at Kishorpur Regulator on the Teesta; and at the mouth of the Sanyashil Khal on the Dharla. These require urgent attention.

The proposals to develop a surface irrigation system do not appear justifiable, given the rapid recent expansion of irrigation using groundwater, and should be appraised in comparison with the alternative costs of further promoting STWs, MOSTI and DTWs. Given the poor O&M record it is very unlikely that a major irrigation system would be able to recover even O&M costs, whereas the private irrigation systems cover both O&M and capital costs.

More concentrated effort by DOF and NGOs is justified to capitalise on the gains already made in fish farming and culture based capture fishing in some of the jalmahals, in order to accelerate the process of fisheries expansion.

Given the generally limited environmental impact of the Project as a whole, the need for a future more detailed environmental evaluation (i.e. a Project environmental audit) is less than in many other projects. It would become important if either large-scale surface irrigation were implemented, or large-scale catastrophic flooding took place, since both would have major environmental impacts.

Figure B2.1 Kurigram South Unit Project Area

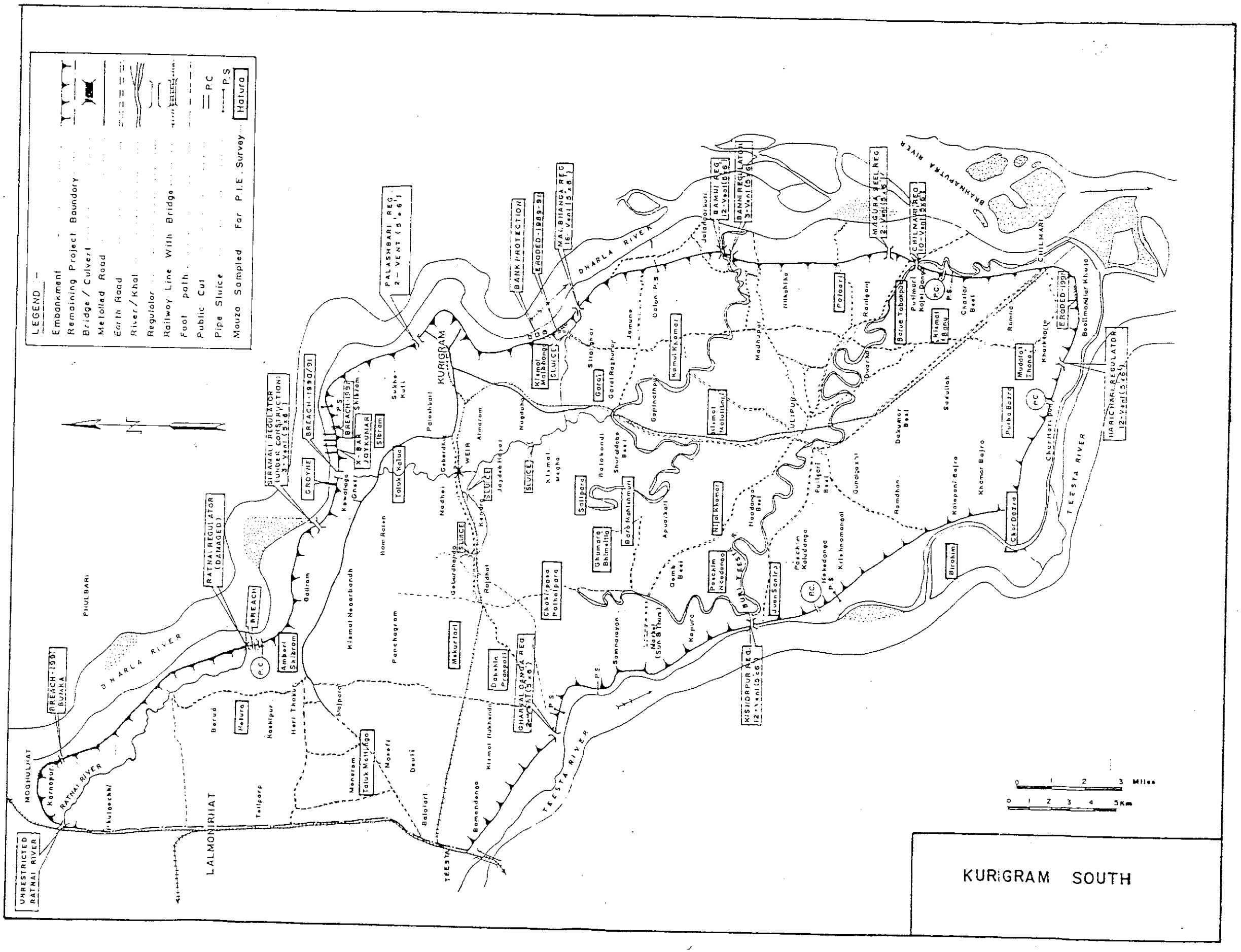
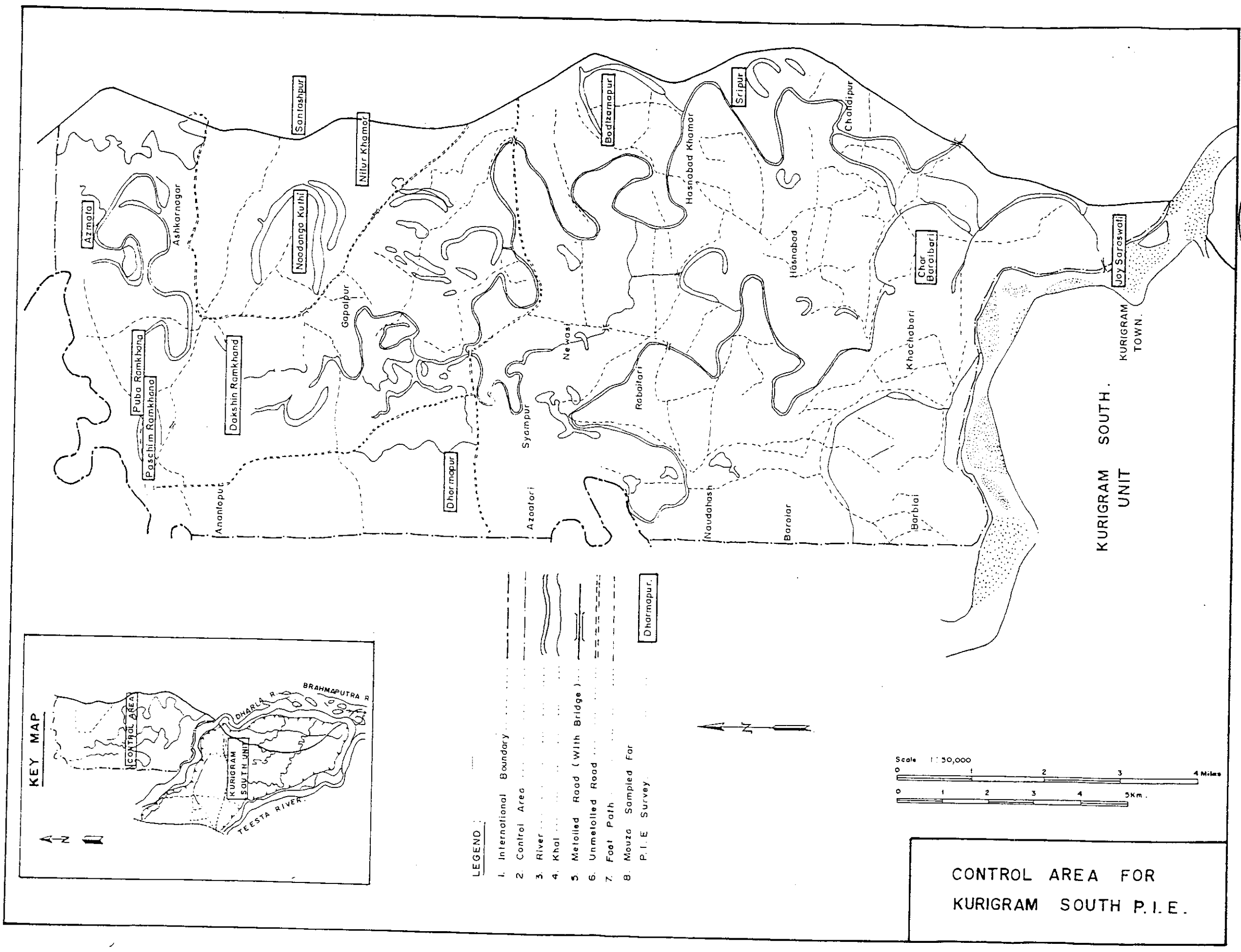


Figure B2.2 Kurigram South Unit PIE Control Area



## Meghna-Dhonagoda Irrigation Project

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Meghna-Dhonagoda Irrigation Project |
| **Project Type** | : Flood Control, Drainage and Irrigation |
| **Location** | |
| **FAP Region** | : South-East |
| **District** | : Chandpur |
| **Area (ha.)** | : 17 584 ha. (gross)<br>14 367 ha. (cultivable) |
| **Funding Agency** | : ADB |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1977/78 |
| **Scheduled Completion** | : FY 1983/84 |
| **Actual Completion** | : FY 1987/88 |
| **Original Cost Estimate** | : Tk. |
| **Final Cost Estimate** | : Tk. 2418.8 million (1991 prices) |
| **Major Flood Damage:** | : 1987, 1988 |
| **Repair/rehabilitation in** | : 1989 to present |

**Overview:**

A very high cost Project (even as appraised, and much more so as built) incorporating pumped drainage and canal irrigation as well as flood control. Construction was protracted due to poor planning and site investigation, and the embankment failed twice in the first two years after completion due to poor investigation and reduction of design standards. Hydrological impact and agricultural performance subsequently have been very good, and there are clear indications of increased wellbeing in the Project population, but EIRR is only 6.7 per cent (including fishery losses, but assuming no further failures). Economic performance has been worsened by the long delay in completion, cost overruns and breaches, but is fundamentally due to unrealistic estimates of agricultural benefits based on inaccurate assessment of without-project yields.

# MEGHNA-DHONAGODA IRRIGATION PROJECT

## SUMMARY OF FINDINGS

### Location

The Meghna-Dhonagoda Irrigation Project (MDIP) is situated in Chandpur District in the south-east of Bangladesh. and is located in the FAP South-East Region. The Project has a gross area of 17 584 ha. and is located on an island, surrounded by the Meghna River on the north and west, and by the Dhonagoda (also called the Gumti in some reaches), a distributary of the Meghna, on the east and south (see Figure B3.1). The topography is a variable pattern of ridge-and-trough throughout the Project area, so that the typical saucer-shaped relief of many FCD projects does not occur. The peripheral rivers have not yet had time to establish commanding levees which would define a central depression, although the process has begun. As a result, there are no large beels, but the Project area intersected by a network of khals which pre-Project were fresh water, but tidal.

The control area is situated to the south-east of the Project, in an unprotected and unimpacted area of similar topography, but without the direct influence of the main rivers, such as the Meghna, on erosion (see Figure B3.2).

### Project Objectives

MDIP is a combined Flood Control, Drainage and Irrigation Project. Before the Project large areas flooded to a depth of 2 to 3 metres every year, and almost all areas experienced some flooding, while soil moisture was deficient for agriculture in the rabi and early kharif seasons. The Project objective was to protect the interior of the island from river flooding and drainage congestion, in order to encourage agriculture, and especially cultivation of HYV Aman, during the monsoon, to increase the security of the population, crops and livestock during the monsoon, and to promote rabi cropping, and especially HYV Boro, by providing an irrigation system.

### Project History

The Project was identified in the 1964 Master Plan and a feasibility study was conducted in 1967. It was shelved until a second feasibility was conducted in 1976-77, and the Project was appraised by ADB in 1977. Construction commenced in 1978, but part of the embankment was eroded during construction and it was not closed until 1987, four years after the scheduled completion date. Breaches of the embankment occurred on the eastern (Dhonagoda) side in both 1987 and 1988, causing deep and rapid flooding, sand deposition and substantial damage to the irrigation system. A rehabilitation programme is being implemented by BWDB, but in 1991 over 3000 ha. of the irrigable area remained without canal irrigation supply due to unrepaired flood damage.

### Construction and Design

The main engineering features are a 60 km. ring embankment around the perimeter of the island, internal networks of irrigation canals (218 km) and drainage channels (126 km), 62 drainage structures, 72 bridges and two pumping stations, one in the north and one in the south, which pump drainage water out of the area in the monsoon season, and lift water into

the irrigation canals for dry season irrigation. Within the Project area irrigation water distribution is mainly by gravity flow, but there are also two internal booster pump stations to lift water to higher areas. The canal system commands a total of 14 367 ha., the remainder being excluded as it was considered to be too high to be irrigated economically.

Various features of Project design were changed at the detailed design and construction stages. The reasons are not well documented, but it is clear that serious cost and time overruns were an important factor.

BWDB's own Project Completion Report (1988) recognised some of the survey and design problems associated with the Project. The foundation designs of both pumping stations were inadequate, probably due to inadequate research into sub-soil conditions. One gave many problems during construction, the other's foundation cracked and has had to be rehabilitated.

There have been two major embankment failures since Project construction, stemming from two causes. The design standards of the embankment were reduced during detailed design and there seems to have been inadequate understanding of sub-soil conditions. During embankment construction labour intensive methods and manual compaction techniques were used. These have resulted in inadequate compaction, which cannot be justified in such a major structure. Further failures are threatened by continuing erosion hazard on the Meghna side, the extent of which appears to have been inadequately assessed in the feasibility studies.

**Hydrological Impact**

Since 1988 the Project has had a very major impact on flood conditions in the area, with great reductions in annual flood depths on medium low, low and very low land. 65 per cent of land operated by surveyed households is no longer flooded in a normal monsoon season, whereas all land had experienced annual flooding before the Project. Likewise, prior to the Project 70 per cent of land was under water for four months or more, while now only 14 per cent is still similarly affected. There has been no change in control area flood depth and duration over the same period. The irrigation system by 1991 was very successful, and is used almost entirely to irrigate Boro and Aus. All irrigation water in the Project ultimately comes from the main pumping stations, but 65 per cent of irrigated land is supplied direct by gravity turnouts from BWDB canals, while 30 per cent is supplied by low-lift pumps from khals and borrowpit canals filled from the BWDB system. The balance is supplied by traditional methods.

In 1987 and 1988 the embankment breaches resulted in greater damage to crops than would have occurred without the Project, due to the sudden rise in water level and the change to less flood tolerant but higher yielding paddy varieties in anticipation of stable water levels. This has not only reduced the flow of benefits in those two years, but also the future potential, due to sand deposition over some areas, and damage to the irrigation system which delayed the spread of irrigation. The risk of future failures is unknown, but there has been no testing flood since 1988, while erosion continues and the embankment south of Durgapur (near the previous breaches) remains in a dangerous condition; hence the risk may be quite high.

## Operation and Maintenance

Considerable thought went into the O&M arrangements for MDIP, and a detailed O&M manual was prepared. The latter has not been used, partly because it was in English and was not geared to the requirements of those who would actually be involved in O&M. A detailed network of committees and associations was also proposed, but again has not been implemented. It was intended that farmers would contribute to irrigation costs by paying water charges, commencing with the first season in which they received irrigation water. The level of water charges has not yet been fixed and no charges have been levied. While it might be argued that flood damage has prevented the move to permanent O&M arrangements, it is also clear that inadequate attention was paid to establishing the required institutional framework during the implementation and rehabilitation periods.

BWDB spends a great deal on O&M of MDIP (about Tk 2400 per hectare, or 3 to 5 times the cost of most other FCD/I projects). The high costs relate particularly to the pumping requirements, but there are also other O&M costs, and the costs of repair and rehabilitation of the damaged irrigation canals, which is not being carried out to a high standard. It seems very unlikely that even O&M costs will be recovered by BWDB, although private LLP contractors recover similar amounts of money for irrigation services.

## Agricultural Impact

MDIP has resulted in a very large growth in paddy output, estimated at some 74 000 mt. annually, which has transformed the area from grain deficit to grain surplus. Mean yield over all types of paddy is about 4.4 mt./ha., compared with 2.5 mt./ha. in the control area, and cropping intensity for paddy is also over 60 per cent higher than in the control. The yield increase is associated with the replacement of B Aman and Aus/Aman by HYV Aman, and of L Boro by HYV Boro. The gains in intensity have taken place largely in the Aus season, with introduction of an HYV Aus crop; in an interesting indigenous farming system development, some farmers are sowing HYV Aus broadcast to minimise time and cost requirements. The Project area is at present almost a paddy monoculture, which accurately reflects the financial returns to production of paddy and non-paddy crops when water is free, as it is to the majority of MDIP farmers.

Impressive though the agricultural impact is, it is considerably less than was estimated during the feasibility study and appraisal. While planning estimates of with-project yields match closely the actual performance, without-project yield estimates (as assessed both by FAP 12 and by the 1987 CIRDAP study) appear to have been grossly underestimated, producing a spuriously high estimate of potential benefits.

## Livestock Impact

A comparison of the MDIP with the control area shows substantial differences in the livestock sector. At MDIP the proportion of households owning bovine animals is higher, the average holding size is substantially higher, and as a result the availability of draught power per household is much greater. Nevertheless there is probably still a seasonal shortage of draught power for medium and large farmers in both the Aman and Boro seasons.

The populations of sheep and goats, and of chickens and ducks, are slightly lower in the MDIP than in the control area. Despite this, gross and net incomes from livestock overall are higher in the Project area, possibly reflecting greater purchasing power being used for

protein foods, and it would appear that the livestock sector has benefited from the flood protection provided.

### Fisheries Impact

The success of the Project in reducing flood levels and the inundated area has, inevitably, had a devastating effect on the floodplain subsistence and capture fisheries. Blockage of the khals has prevented fish migration, halted the annual natural restocking of internal water bodies, and also reduced the residual stocks in the rivers.

Many fishermen have been forced to seek other work, and even for the remainder average daily catches have fallen by 40 per cent in the Project area; this compares with a 34 per cent decline in the control area. The decline has affected all the major fish species groups.

Fish farmers have benefited from flood protection and production from Project area ponds now averages 1400 kg./ha. compared with 1200 kg./ha. in the control area; in both cases pre=Project yields would have been under 1000 kg./ha.. Increased fishpond output is estimated to be now about 160 mt. per year and is still growing, but is insufficient to offset the annual loss of capture fisheries which is estimated to be close to 400 mt..

### Infrastructure and Communications

The embankment has provided an improved road transport route, but the internal road network originally intended as part of the Project was dropped during construction, and internal road transport is seriously deficient. The Project has severely impeded boat transport, and the number of boatmen inside the Project has fallen substantially. Original feasibility study proposals included navigation locks to provide access to the interior khals, but these were eliminated from the final design. Overall, the Project has facilitated transport around the periphery, but has made access to the interior of the Project area much more difficult at the same time that movement of paddy cultivation inputs and outputs has increased greatly.

### Socio-Economic Impact

Despite only having been 'completed' for a short period, the Project does appear to have had important socio-economic impacts because of sharp changes in the local economy - for the worse when the embankment failed, and for the better in the years since 1988.

The majority of labourers found work building or repairing Project infrastructure, and there has been growth in secondary economic activities such as rickshaw pulling, trading (paddy and agricultural inputs) and paddy milling. However, there have been important adverse impacts on minority occupations and employment. Fishermen and boatmen are generally regarded as having lost income or been displaced.

Agricultural labourers obtain about 12 per cent more work than in the control area, though agricultural changes have generated some 25 per cent more work per hectare, and now a much higher proportion of work is done by hired labour than in the control area. Wage rates, however, are the same as in the control area, implying in-migration at peak periods. Overall, incomes are substantially higher in the Project than in the control area for virtually all landholding categories.

More households reported changes in holding size in the Project area than in the control, reflecting a high incidence of land acquisition (affecting 29 per cent of households) and transactions (mostly in 1988 and 1989) which may reflect flood losses and/or landowners realising increased land values. Compensation for 77 per cent of land acquired for the Project was paid only after a bribe. The acquisition process was strongly contested, even though there was reportedly widespread support for the Project, partly because erosion and embankment retirement led to potential beneficiaries losing land to the embankment and the river.

The Project appears to have increased the food security of cultivating households, which on average produce 9 months' grain supply in the Project area compared with 7.5 months' in the control. Houses inside the Project are also in better condition and there are more houses built of durable materials (mostly corrugated iron) than in the control area. However, most households were flooded in 1988, when flood depths were greater than in the control area, and damages per household were considerably higher. The main problems created by the Project were reportedly embankment failures and some waterlogging, along with the fishery and water transport impacts.

Women's workloads were reported to have increased significantly due to the Project, particularly in the post-harvest processing of paddy. Unusually, there has been no diversion of rice-husking to men, presumably because STW/LLP engines are not required for irrigation in the areas where the canal system is functioning properly, and are therefore not available to power husking mills.

### Environmental Evaluation

As in most of Bangladesh, negative ecological changes in the last few decades have been substantial, and would have continued regardless of whether the Project was built. It is difficult to assess the additional impact of the Project, which is superimposed on these trends, but it seems certain that the Project area already had a predominantly anthropic landscape by 1978, and that additional negative biotic impacts have therefore been very limited.

Both the physical and human environmental impacts frequently conflict with one another. Even the overall assessment of individual environmental issues is often a net value derived from both positive and negative significant impacts. This reflects the marked contrast between the largely negative impacts arising during construction and especially in the 1987-88 embankment failures, and the very positive agricultural and socio-economic impacts (albeit still subject to a significant risk factor) since then.

There is an immediate high risk of catastrophic flooding through failure of the embankment south of Durgapur, and a long-term risk in the south-west, near the Meghna-Dhonagoda confluence, and in the west, where rapid erosion seems likely to continue.

There is cause for concern in the apparent decline in soil physical characteristics, and possibly also in fertility.

### Economic Appraisal

MDIP has given substantial financial benefits to the farmers in the area, particularly as they are not yet contributing to the irrigation costs. However the Project is extremely costly. Capital costs at Tk 160 000 per benefited hectare are almost ten times the cost of the

next most expensive project studied by FAP 12. O&M costs, at over Tk 2400 a hectare, are 3 to 5 times those found elsewhere. These high costs mean that even the high level of agricultural benefits achieved (the greatest of any project studied by FAP 12) cannot justify the expenditure. The Project has an estimated EIRR of 6.7 per cent and a Benefit:Cost Ratio of 0.56, including a conservative estimate of fisheries losses. Even these estimates assume that there will be no further breaches comparable with 1987-88, which is unlikely in view of the rapid erosion taking place.

The poor economic performance of MDIP is therefore fundamental. The long implementation period, the cost overruns, and the further loss of and delay in benefits and increase in costs caused by the failures of 1987 and 1988, have worsened the Project's economic performance, but even if these factors are discounted the Project is non-viable. The implication is that pumped drainage is not an acceptable option for future FCD projects.

**Recommendations**

The pumped drainage/irrigation FCD/I project concept represented by MDIP should not be replicated. Even if the construction and operating costs can be substantially reduced below those actually incurred, they are unlikely to approach the levels of simpler concepts which have far better economic performance.

The capital and rehabilitation costs of MDIP itself are now sunk, and the infrastructure permits a highly successful agricultural system to continue. In order to ensure the Project's sustainability it is essential that a system of cost recovery from irrigation be introduced. Farmers often pay considerably more than Tk. 2000 per hectare for irrigation elsewhere, so it should be possible for an irrigation fee to be levied which would cover BWDB's irrigation and drainage O&M costs and contribute to recovery of the FCD related expenditures.

Even so, a careful reassessment of the erosion and failure risks is needed, since expensive bank protection may be difficult to justify economically. Urgent attention should be given to the Nandalapur-Durgapur stretch of the embankment, where the greatest immediate risk of breach occurs.

MDIP offers excellent opportunities for monitoring two major aspects of FCD projects for which little or no data now exist:

- water quality in ponds, khals, drainage effluent, rivers and (especially) groundwater, to establish baseline values and then to assess the impacts of agrochemicals and sewage; and

- soil physical characteristics and fertility under the paddy monoculture created by the Project.

In view of the past problems and continued high risk to physical and human environmental issues, there appears to be a need for a full project environmental audit at a time after the rehabilitation of the eastern and south-western stretches of the embankment has been completed.

**Figure B3.1 Meghna-Dhonagoda Irrigation Project Area**

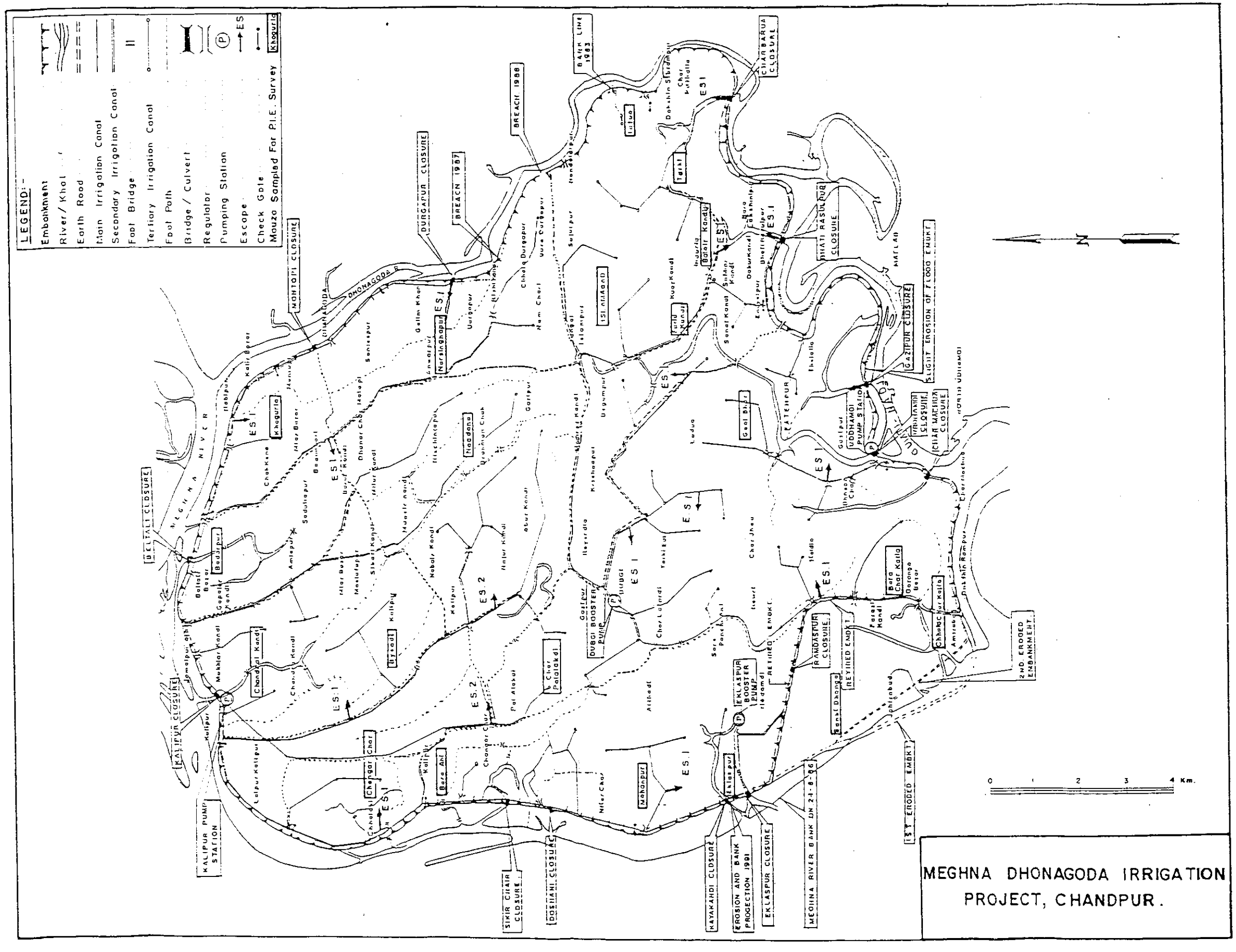
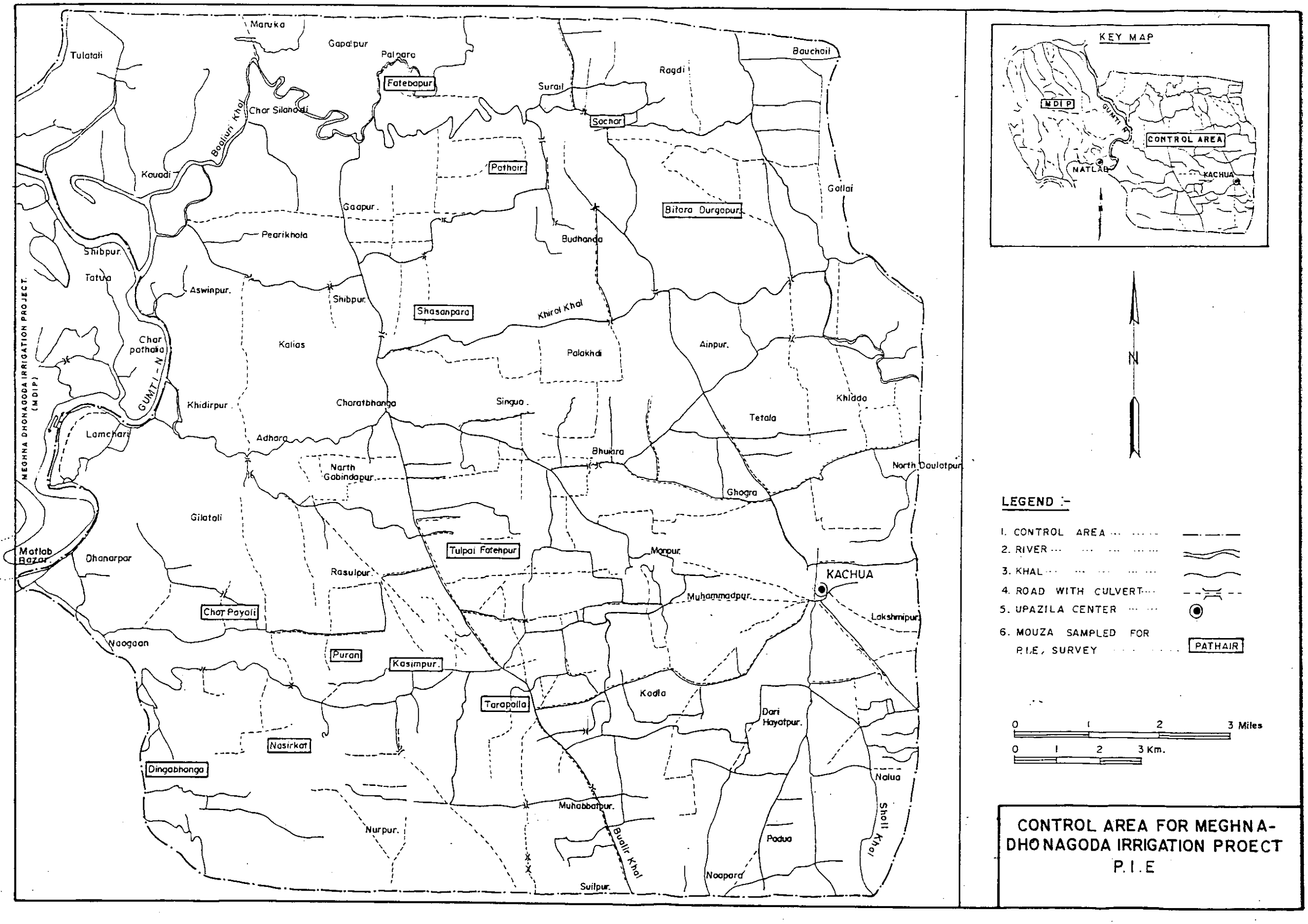


**Figure B3.2 Meghna-Dhonagoda PIE Control Area**



# Zilkar Haor Project

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Zilkar Haor Project |
| **Project Type** | : Flood Control, Drainage and Irrigation |
| **Location** | |
| **FAP Region** | : North-East |
| **District** | : Sylhet |
| **Area (ha.)** | : 5263 ha. (gross)<br>4238 ha. (cultivable) |
| **Funding Agency** | : EIP (Netherlands and Sweden) |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1983/84 |
| **Scheduled Completion** | : FY |
| **Actual Completion** | : FY 1987/88 |
| **Original Cost Estimate** | : Tk. |
| **Final Cost Estimate** | : Tk. 75.5 million (1991 prices) |
| **Major Flood Damage:** | : 1988 |
| **Repair/rehabilitation in** | : |

**Overview:**

A relatively small FCD project comprising both submersible embankment (Zilkar Haor) and full flood protection (Haparu Haor) sections, which was a development of existing water management systems and planned with local consultation. The Project has operational problems relating to sluice design and management, and Haparu Haor is subject to rainwater congestion when early rains coincide with high river stages. Nevertheless, agricultural impact has been strongly positive, through the greater security provided for Local Boro (Zilkar Haor) and HYV Boro and both Local and HYV Aman (Haparu Haor). Paddy yields are double those of the control area. Fishery disbenefits are small, and EIRR is estimated at 40 per cent.

# ZILKAR HAOR PROJECT

## SUMMARY OF FINDINGS

### Location

The Zilkar Haor Project is located in Sylhet District in the FAP North-East Region, immediately north west of Sylhet town. The Project covers a gross area of 5263 ha. and comprises two separate haors, Haparu Haor to the east and Zilkar Haor to the west (see Figure B4.1). The Project is bounded on the south and west by the Surma river, on the north by the Singar Khal and on the east by the Sadi Khal which links the Surma river and the Singar Khal.

The control area is to the east of Sylhet town, upstream on the Surma and located between the Surma and the Bara Haor, a large unembanked haor area with similar topography to the Project and which is subject to flash floods.

### Project Objectives

The Project aimed to provide different levels of flood protection to the two haors. It aimed to provide full flood protection to Haparu haor, protecting the Boro crop from early floods (April-May) and the Aus and Aman crops from monsoon season floods. However it only aimed to protect the Zilkar Haor from early floods, by means of a submersible embankment. The approach was expected to facilitate the existing irrigation system, which involved transferring water stored in Haparu Haor to Zilkar Haor during the rabi season.

### Project History

The Project was financed under EIP. The technical proposal was prepared by the Sylhet Division of BWDB and this was followed by a socio-economic feasibility study in 1983 and a baseline study in 1984. The Project was reviewed and endorsed by the 1983 EIP Advisory Mission.

During Project preparation BWDB approached the local people and despite some early confusion the local people became involved with and identified with the Project. There was consultation at the planning stage with respect to land acquisition, alignment of the embankment, construction of sluice gates and provision of irrigation pipe inlets.

Construction started in 1983/84 and was substantially complete by 1987/88. The entire area was severely affected by floods in 1988 and the area used as a control in the PIE survey was badly affected by an early flash flood in 1990.

### Construction and Design

The Project involved construction of a 15.8 km. full flood embankment around Haparu haor and an 8.9 km. submersible embankment around part of Zilkar Haor. In addition 3 regulators, 5 pipe sluices, and 25 pipe inlets were constructed, and 3.5 km. of drainage channels were excavated. In general the engineering infrastructure works as planned, although the road that acts as the embankment on the south tends to overtop, and the

structures leak and are in need of repair and maintenance. The existing regulators are inadequate to cope with the drainage problems that emerge in the monsoon season.

### Hydrological Impact

The Project has generally succeeded in its objective of protecting Zilkar Haor from early flash floods, and this has been reflected in a substantial expansion in irrigation and production of both LV and HYV Boro. The full flood protection of Haparu Haor has had more limited impact as the lower part of the haor still suffers from serious drainage congestion, but there has been a modest conversion of low land to medium low land. A greater proportion of the Project area is irrigated compared with the control area, and more mechanised irrigation is used, probably reflecting increased security from early floods.

### Operation and Maintenance

The RRA found that 60 to 70 per cent of the embankment length was in poor condition, that fall-board grooves were damaged at most structures and that culverts on the Sylhet-Sunamganj road had been converted to control structures and were in need of repair and modification. There is no routine maintenance and operation procedures are inadequate - for example irrigation pipe inlets are not closed at the right time, and as a result pre-monsoon flood waters enter the Project area.

Operation of the regulators on the Singer Khal seems satisfactory but there is a great deal of dissatisfaction over the operation of the road sluices, which seem often to be under the control of locally influential individuals and are a source of conflicts between farmers and fishermen.

### Agricultural Impact

The Project has had a substantial positive impact on agriculture. This was particularly evident in 1990, when the Boro crop was effectively protected in the Project area, and severely damaged in the control area outside the Project, but the differential is expected to be significant even in normal years. The Project has resulted in a very substantial increase in the cultivation of HYV Boro (quite important in the Project area, very little grown outside it) and a substantial increase in production of LV Boro. HYV Boro in Haparu Haor is, however, still at risk from rainwater congestion when, as observed in 1991, early heavy rains coincide with high river stages which prevent drainage.

Yields of all crop varieties appear to be higher in the Project area than in the unprotected area, presumably reflecting reduced flood losses, and very much higher use of fertiliser in the protected area. Overall the weighted average paddy yield in the protected area is double that in the unprotected control area.

### Livestock Impact

There appears to have been a slight negative impact on the bovine livestock population, compared to the position outside the Project area, as numbers are lower, feed quality is poorer, feed costs are higher and net incomes from livestock are lower. The differences however are not great. Despite the decline in draught power availability in the Project area there is no absolute draught power constraint.

Comparison with the control area suggests that the Project area has seen an increase in goat and duck numbers, but a decline in the chicken population.

**Fisheries Impact**

There appears to have been a negative impact on capture fisheries in the haor areas, although this is not as marked as in other FCD projects. Even in the Zilkar Haor area, where flooding is delayed rather than prevented, there have been some reductions in the capture fishery. In Haparu Haor the full flood protection has promoted limited development of some of the beels by restocking with hatchery produced fish to compensate for the loss of natural stocks. There are very few fish ponds, due to the continuing danger of overtopping (especially in Zilkar Haor proper) and little prospect of any substantial development of pond culture. Fishermen ascribe the fall in fish yields to the embankments, which block fish migration, to the increased use of agrochemicals on crops, and to fish disease.

**Infrastructure and Communications**

The Project appears to have had a marginally positive impact on road communications, but a significant negative impact on navigation - boatmen were identified as the second most seriously disbenefited group, after fishermen, and have declined considerably in number.

The Project has provided some protection to housing and commercial infrastructure, but perhaps paradoxically the 1988 floods caused more damage to this infrastructure inside the protected area than outside. This may be because those inside the protected area had established buildings in areas that they believed were not at risk, whereas people outside the protected area tended to build on higher ground.

**Socio-Economic Impact**

The clear positive impact of the Project on paddy production appears to have had a significant impact on other economic activities. The protected area has a substantially higher level of employment in non-farm enterprises, particularly in rice milling and marketing and in vegetable trading, though there is little difference between Project and control areas in the incidence of non-farm secondary occupations.

Housing conditions are generally better in the protected area and there have been more land transactions. Notably, within the Project area some people have been able to substantially increase their holding sizes, whereas no-one interviewed in the control area has achieved this. It also appears that average loan sizes are higher within the protected area, and that those interviewed in the control area have significantly less access to credit. Adult literacy is much higher in the Project than in the control area, which is unlikely to be a Project effect but may explain some of the relative advances in the Project area.

The benefits of the Project clearly went to landowners, and in particular to larger landowners. This was confirmed both by RRA interviewees and by survey data, which showed that only those with over 1 acre of land (0.4 ha.) in the protected area had significantly higher per capita incomes than those outside the protected area. It was also noted that both inside and outside the Project households with relatively large holdings (particularly over 2.5 acres - 1.0 ha.) tended to receive a substantial proportion of their income from "salaries" - often remittances from overseas. This is likely to be a common phenomenon in the Sylhet District.

The Project's impact on women was difficult to identify, but women had more work in paddy processing and reduced work in net repair, thus being affected by the trade pursued by their husbands.

In five out of fourteen impacted mouzas doubts were expressed about the necessity of the Project. Three of these five expressed such doubts in terms of general dissatisfaction while in the other two there were feuds between rival factions.

The Project has clearly resulted in social tensions, particularly between farmers and fishermen, and between farmers and boatmen who used to earn their incomes from transport of boulders across the haors. It has also caused some dissatisfaction amongst those whose land was acquired for the embankments, as they were paid less than the prevailing land price. However, these were few in number, compared with other FCD projects studied by FAP 12.

### Environmental Evaluation

Flood control has no direct impact on the relatively high south-western part of the Project area, but has significantly changed the physical environment elsewhere, especially in Haparu Haor. As a result, the Project has had a substantial positive impact on crop production, and hence on the economy as a whole. This has been offset to a limited extent by a reduction in capture fisheries and in navigation, and possibly in the bovine population. The hydrological data, and local opinion, suggests that there have been negative impacts on the immediately adjacent population, as there appears to have been a slight increase in flood depths outside the protected area.

Assessment of biotic impacts is difficult, given the complete lack of quantified baseline data. However, all ecological impacts in Bangladesh must be viewed in the context of the extreme pressure exerted by human population growth, and which would have continued regardless of Project intervention. The biotic impact of Zilkar Haor is therefore assessed as slight.

### Economic Appraisal

Zilkar Haor is a fairly high cost Project (capital costs of Tk 15 000 per net benefited hectare), but has provided substantial economic benefits from increased agricultural production, without any significant quantifiable disbenefits. As a result it has a high Economic Internal Rate of Return (40 per cent) and a very satisfactory Benefit:Cost Ratio (3.4).

### Recommendations

Operation and maintenance procedures need significant improvement at Zilkar Haor and a number of structures require repair or redesign. In particular regulator gates need to be sealed, the use of culverts on the main road as FCD structures needs to be reviewed and an additional drainage regulator is probably needed on Singhar Khal.

Tubewell development is negligible, although the Project location suggests that groundwater potential should be considerable. Given the large increase in land available for irrigation due to the Project, this potential, and the reasons for it remaining untapped, require investigation.

Ways of upgrading livestock production systems to compensate for the reduced grazing area should be examined.

The development of fish culture in ponds in the higher areas should be encouraged.

Given the generally beneficial physical and human environmental impacts of this small Project and the very limited biotic impacts, there appears to be no justification for detailed environmental audit.

**Figure B4.1 Zilkar Haor Project Area**

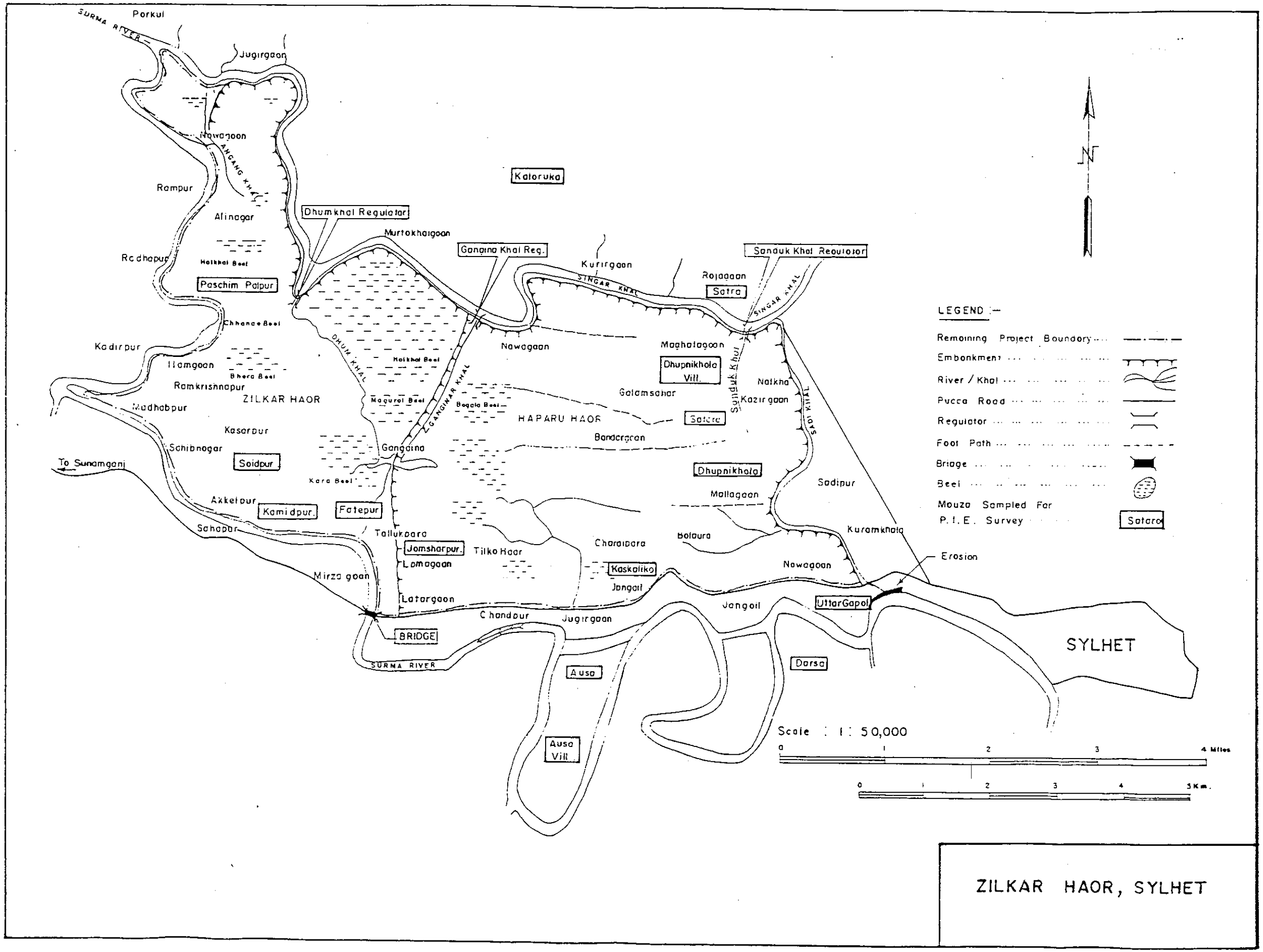
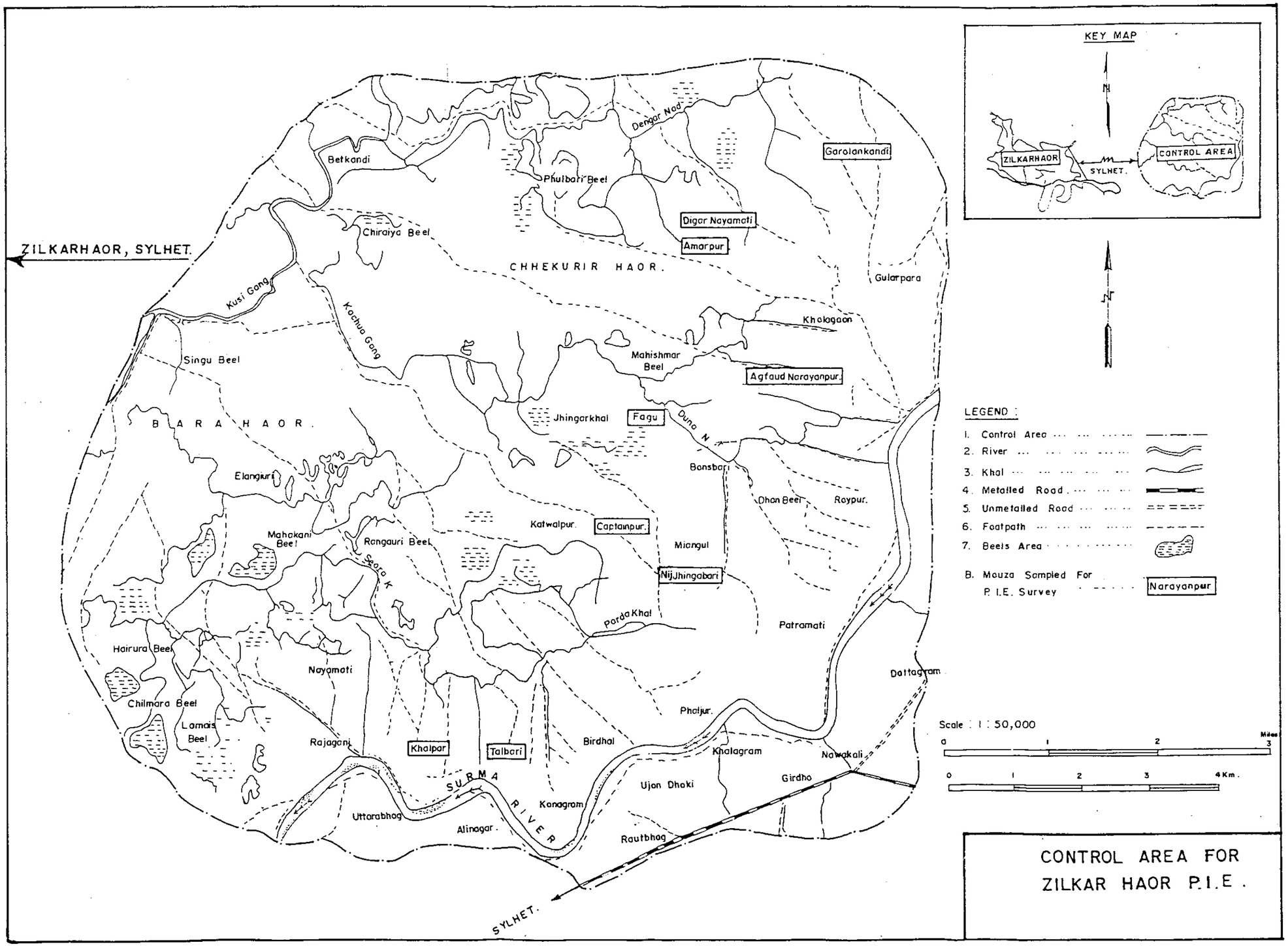


Figure B4.2 Zilkar Haor PIE Control Area



## Kolabashukhali Project

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Barnal-Salimpur-Kolabashukhali Project |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : South-West |
| **District** | : Khulna and Jessore |
| **Area (ha.)** | : 25 500 ha. (gross)<br>18 623 ha. (protected cultivable) |
| **Funding Agency** | : IDA |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1979/80 |
| **Scheduled Completion** | : FY 1983/84 |
| **Actual Completion** | : FY 1983/84 |
| **Original Cost Estimate** | : Tk. |
| **Final Cost Estimate** | : Tk. 224.25 million (1991 prices) |
| **Major Flood Damage:** | : |
| **Repair/rehabilitation in** | : 1989 to 1991 |

**Overview:**

A large but technically simple FCD project aimed at excluding both daily saline tidal inundation and seasonal river flooding. The Project has resulted in major reductions in depth of inundation and has reclaimed several thousand hectares of previously uncultivable land. There has been some movement into Local T Aman, but the main agricultural benefits are from increased area and greater security of the existing cropping pattern based on B Aus/Aman; there has been little uptake of HYVs. There is little irrigation, and the Project has had negligible impact on Boro paddy. There have been considerable capture fishery losses, but EIRR is estimated to be 24 per cent including such losses, the good performance being in large part due to the completion of the Project on time and to cost. Drainage congestion remains a problem, and rehabilitation and replanning of the drainage structures is required.

# KOLABASHUKHALI PROJECT

## SUMMARY OF FINDINGS

### Location

The Kolabashukhali Project, more accurately known as the Barnal-Silimpur-Kolabashukhali Project, is located on the borders of Jessore and Khulna Districts in south-west Bangladesh, and is within the FAP South-West region.

The Project area is a tidal river island, approximately 25 500 ha. in gross area, surrounded by the Atai River in the west, the Nabaganga to the north and north-west, the Chitra to the east, the Atharabanki to the south-east and the Bhairab to the south (see Figure B5.1)

All the nearby areas with a similar agro-ecology are within, or being incorporated in, polders. The Bhuter Beel Project, immediately east of Kolabashukhali, is not yet completed, so the unprotected north-central portion of the Project was used as the PIE control area (see Figure B5.2).

### Project Objectives

The rivers around the Project area have a tidal range of up to 2.44 m. and, in the absence of flood control infrastructure, the low lying parts of the area were inundated twice daily. In the low water season saline water advanced northwards, rendering irrigation using river water impossible except at the northern extremity of the Project area. Prior to the Project much of the low-lying area was occupied by extensive beels, a large area was uncultivated and much of the rest could only grow a single B Aman or Aus/Aman LV crop.

The Project had three main objectives: control of seasonal and daily flooding by closing the outfalls from khals into the main rivers with regulators that would permit drainage at low tide and low river stages; protection against high river stages and exceptional floods by construction of a ring flood embankment around the island; and facilitation of irrigation, again by means of the regulators in those areas where water salinity levels permitted irrigation. In addition the Project was intended to improve the internal drainage network and to upgrade internal communications through construction of an internal road network.

### Project History

The Project was the subject of a feasibility study by the BWDB Special Projects Division in 1977 and was adopted for funding with assistance from the World Bank under IDA credit 864-BD. It was built between 1979 and 1984. The Project was the subject of an evaluation study in 1986 and information from that evaluation was used by FAO in preparation of a Project Completion Report (1989) and by the World Bank in their Project Performance Audit Report (1990).

### Construction and Design

The main engineering features of the Project are an 85.5 km. ring flood embankment, 16 drainage and/or flushing sluices, 8.9 km. of drainage channel improvement, 18.9 km. of

access roads and 9 culverts on these roads. The Project appears to have been well conceived and implemented, although the provision of drainage facilities appears to have been inadequate.

However, most of the structures are now in poor condition, the network of drainage channels has almost disappeared and some of the access roads are severely damaged.

### Hydrological Impact

The Project has generally achieved its intended hydrological impact. It has succeeded in protecting the area from high tides and monsoon floods, in reducing soil salinity by preventing saline intrusion, in increasing security against tidal river level fluctuations and in facilitating irrigation from the rivers in the northern part of the Project area.

The area of previously very low land (24 per cent of Project area) has been converted to effectively 'higher' land with reduced monsoon season water levels; land at MPO levels F4 has been converted to F3, and F2 has been converted to F1 and F0. A similar but much smaller change was found in the control area, but the latter is itself a partly completed Project. Hence KBK has functioned effectively as a land reclamation project and reductions in monsoon season flooding have permitted a substantial increase in the cropped area during the kharif season, estimated at between 2000 ha. and 5000 ha. Flood durations have also been reduced somewhat, though there is still a substantial area under water for 5 or more months.

Because much of the Project is a series of basins, monsoon season drainage is limited. Coupled with the inadequacy of the drainage system this results in acute drainage congestion at the height of the monsoon season, and at other times of heavy rainfall.

There is relatively little irrigation in the Project area (only 6 per cent of land operated by sample households) but this is more than in the control area. Since the Project there appears to have been a small expansion of STW irrigation in both areas, but this is probably only part of the national trend, and the largest area of irrigation is managed by a traditional surface water system based on a tidal khal and predating the Project.

### Operation and Maintenance

Standards of maintenance at Kolabashukhali are poor, and have resulted in serious degradation in the Project infrastructure. About 30 per cent of the embankment length needs repair and resectioning; two of the sluices were inoperable and three quarters were leaking profusely at the time of the RRA; and the drainage channels had not been desilted. Problems with the sluices are partly due to poor construction and site investigations.

Khalashis are employed for all the sluices and appear to be active in operating them. There are sluice committees at almost every sluice, but they do not function effectively in conflict resolution, they do not reflect the interests of all those who are affected by sluice operation, and there have been disputes over their operation, particularly due to the conflicting interests of influential shrimp farmers and Boro paddy growers in part of the Project.

## Agricultural Impact

The Project has had a substantial agricultural impact. It has permitted the reclamation of between 2000 and 5000 ha. of land for cultivation of Aus and Aman paddy. There has been a shift in the cropping pattern due to reduced flooding,from B Aman and jute to mixed Aus/Aman around the beels and from uncultivated peat wetlands to B Aman within much of the beel centres. Cultivation of the peat soils, however, is not as successful as on the alluvium, and may face problems in the longer term. In the higher lands in the north and south there have been changes from B Aus/Aman to TL Aman, and to a very small extent, to HYV T Aman. Sugar cane has expanded in these areas and along the narrow strips of settled land in the beels. The extent and importance of jute have diminished. The Project was successful in 1987 and 1988 in protecting monsoon paddy crops, which suffered less damage than the same types of paddy in the control area.

The cropping intensity seems not to have changed on the lands that were already cultivated, although reduced kharif season flood depths and duration appear to have led to a move from rabi crops to more profitable Boro paddy, where irrigation is feasible.

Surface water irrigation development has been very limited because of the continued upstream penetration of saline tidal water in the adjacent rivers, which prevents irrigation in the latter part of the rabi season except in the north around Kalia. Groundwater irrigation potential is likewise limited to a small area in the north, since the southern part of the Project lies near the boundary of coastal saline groundwater intrusion. However, there has been some interest in LLPs in the Project area, and retention of surface water inside the Project might promote further expansion of irrigation.

The net result of these changes is an estimated annual incremental output of about 16 500 mt. of paddy over the without project estimate, including a decline in Local Boro, which is adversely affected by the drier with-Project conditions. There have also been small declines in output of other dry season crops, probably for the same reason. In general, land prices have increased more in the Project area than in the control, reflecting these benefits.

## Livestock Impact

The Project appears to have had no impact on the bovine population in the Project area. Cattle populations in the area are generally inadequate to meet Aman season draught power requirements and although there are increasing numbers of power tillers in the area there is likely to be a draught power constraint on kharif season cropping. The Project area has a significantly higher ovine population than the control area, but total numbers of sheep and goats are relatively small. Within the Project area livestock owners have to spend substantially more on purchased feed than in the control area, and as a result net household incomes from livestock are some Tk 700 a year lower.

## Fisheries Impact

The Project has had a severe impact on capture fisheries, but has benefitted culture fisheries of both shrimp and carp. The number of full-time fishermen has fallen, and reduced opportunities for capture fisheries within the Project area because of beel drainage have led to increased intensity of river fishing. Blockage of migration routes between rivers and beels has probably reduced river yields, a process exacerbated by the increased fishing pressure.

The farming of fresh-water shrimps has been facilitated by embankment protection and the tidal water control possibilities offered by the sluices, although there is often a conflict of interest over sluice operation between the shrimp farmers and rice cultivators. There is evidence of more new development of cultured fishponds for carp in the protected area than in the control area, presumably because of reduced flood risk.

Overall the capture fisheries and river fisheries losses are estimated at between 322 and 456 mt. a year, and are as yet only slightly offset by an increase in output of about 39 mt of (more valuable) cultured species.

**Infrastructure and Communications**

The embankment and the access road constructed under the Project have permitted an improvement in communications within the Project, bringing consequent social and economic benefits. The area still suffers, however, from lack of vehicle access in the southern half, and of a vehicle ferry to Khulna. The land transport benefits are also offset to some extent by a substantial decline in boat transport and the number of boatmen.

More than three-quarters of the enterprises engaged in non-farm activities within the Project area stated that they have benefited from the Project. Businessmen reported that the 1988 floods caused more damage inside the Project than in the control area, but this is not confirmed by household flood losses; the former sample is small, and entrepreneurs may have miscalculated drainage risks.

**Socio-Economic Impact**

There appear to be no differences in occupational pattern between Project and control areas, although in the Project area a small number of non-agricultural labourers have moved into agriculture. Similarly, a comparison between the Project and control areas suggested that slightly more non-farm economic activity, particularly in rice milling and trading and input marketing, was evident in the Project area.

Kolabashukhali does not show the usual pattern of declining workload for women in rice husking, because there is little irrigation by STW and thus STW engines are not available to power the mills. Although the city of Khulna is not far away, poor communications prevent use of urban rice mills by the Project population. On the other hand, workload in other agricultural activities has increased in the Project area, in most cases due to higher output, while in the control area a few cases of actual decline were noted, due to problems of waterlogging and pest attack.

Incomes in the Project area appear to be slightly higher, but notably both landholding and landless households appear to be better off in the Project area, suggesting a less inequitable impact on incomes than in other projects studied by FAP 12. However, this would obscure two important distributional impacts with the effect of a higher contribution from salaries (perhaps due to relative proximity to Khulna and two Upazila towns). Capture fishermen, as usual, have suffered disproportionately from the reduction of flood depth and duration and reclamation of low areas for agriculture, except in the (unusual) case of those who had a right to land that was occupied by beels and who now cultivate that land. Some dissatisfaction and even intra-village violence over the implications of the Project were reported, despite there having been local committees during implementation.

Landholding changes have affected more households in the Project than in the control area, partly reflecting land acquisition which had affected 20 per cent of Project area households. Reportedly 21 per cent of acquisitions were not compensated, while in 39 per cent of cases compensation was only obtained after payment of a bribe. However, more households have increased their holding, and this may reflect the conversion of beels into agricultural land (although this was probably not detected in full by the survey). Despite the existence of National legislation governing the distribution of reclaimed khas lands, and knowledge of the relevant provisions by Upazila officials, few or no landless households appear to have benefited from the increase in cultivable area.

Respondents confirmed many of the observed impacts, reporting that the main benefits were from flood protection, agriculture and improved communications, and the main disbenefits from waterlogging, loss of fisheries, and declining soil fertility. The benefits are reflected in households building extra rooms for their houses in the Project area, and also more houses in the Project area are of earth walled construction, suggesting reduced flood risk. Since 1987, more households in the control area have suffered flood damage, and the value of damages have also been slightly higher than in the Project area.

### Environmental Evaluation

The major changes in the flooding regime have led to significant ecological changes, as several thousand hectares of land which were perennially flooded are now largely under cultivation. These included large areas of peat soils, which were previously covered with reed beds providing rich habitats for waterbirds, fish and other aquatic biota. These are now largely destroyed. There is some danger that the peat soils will shrink and acidify as cultivation proceeds. The positive impacts on the human environment from the Project are substantial, although many capture fishermen are worse off as a result.

### Economic Appraisal

As the agricultural analyses resulted in a range of estimated benefits and disbenefits, the economic analysis examined a range of possible outcomes. However even the least "optimistic" analysis, based on benefits derived from cropping pattern and yield changes only, without the reclamation effect, gives an EIRR of 24.4 per cent. With the lowest estimate of reclaimed area the EIRR is 25.5 per cent. It is therefore clear that the Project has been a substantial success.

### Recommendations

Following several years of inadequate maintenance a substantial rehabilitation of the Project infrastructure is required. This should be accompanied by a redesign of the drainage infrastructure. Consideration should be given to installing the previously planned system of motorable roads, accompanied by a vehicle ferry to Khulna.

Systems of impounding water in the beel areas should be investigated, to preserve wetlands for fishery development and to retain water for irrigation. The development of fishponds should be facilitated, especially for groups of displaced fishermen.

Special advice is needed for farmers on the cultivation of peat soils.

The potential for groundwater development deserves more detailed attention. Given the large amount of land now available for dry-season irrigation, attention to the quality and cost aspects of tubewell development might be amply rewarded.

Detailed monitoring of river salinities could also allow more irrigation than was thought possible in the past, since farmers' long-established knowledge of river salinity may have been superseded by the containment effects of recent years. Certainly the fears expressed in the Feasibility Study, based on a salinity limit of 500 μmhos/cm for paddy irrigation, were unnecessarily alarmist, since this is the limit for perfect irrigation water, while usable water can be up to 2250 μmhos/cm..

The potential for embankment protection and production using trees, shrubs and/or forage grasses should be explored.

A project environmental audit is recommended, to provide more environmental data and analysis, especially of the ecological and long-term physical environmental impacts.

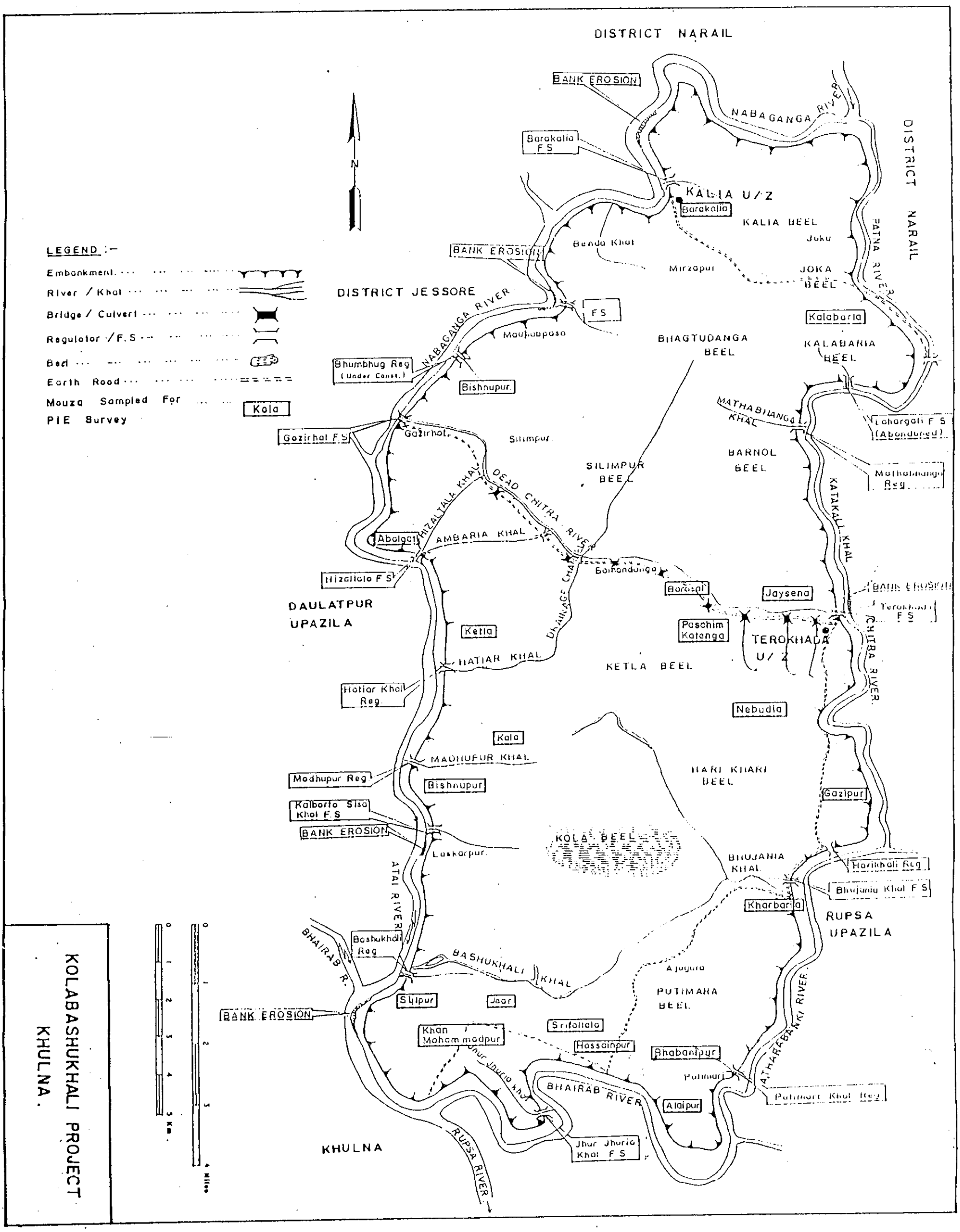
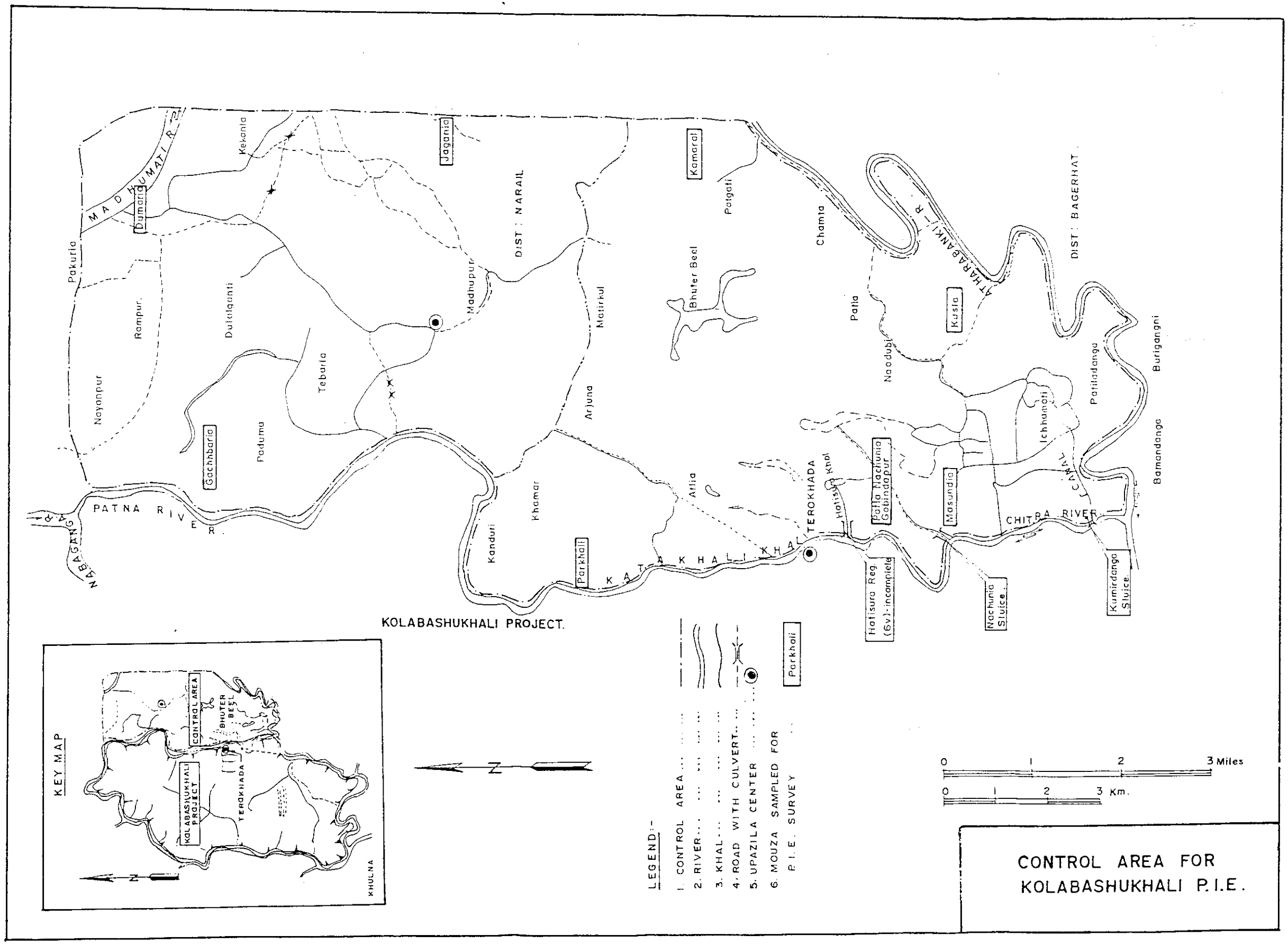



Figure B5.1 Kolabashukhali Project Area

Figure B5.2 Kolabashukhali PIE Control Area



# APPENDIX C

# SUMMARIES OF RAPID RURAL APPRAISAL REPORTS

# APPENDIX C

## Summaries of Rapid Rural Appraisal Reports

**Contents**

## Protappur Irrigation Project

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Protappur Irrigation Project |
| **Project Type** | : Flood Control, Drainage & Monsoon Inundation Irrigation |
| **Location** | |
| **FAP Region** | : North-West |
| **District** | : Bogra |
| **Area (ha.)** | : 5,200 ha.(gross)<br>4,000 ha.(cultivable) |
| **Funding Agency** | : Government of Bangladesh |
| **Implementing Agency** | : BWDB |
| **Construction started** | : FY 1974/75 |
| **Scheduled Completion** | : FY 1977/78 |
| **Actual Completion** | : FY 1977/78 |
| **Original Cost Estimate** | : Tk. 0.670 million |
| **Final Cost Estimate** | : Tk. 4.340 million |
| **Major Flood Damage:** | : |
| **Repair/rehabilitation in** | : 1990 to present |

**Overview:**

A small low cost FCDI project which provided protection against flash floods improved monsoon drainage and retained water at the end of the monsoon to facilitate irrigation. The project has an estimated EIRR of over 50 per cent, and no major disbenefits

# PROTAPPUR IRRIGATION PROJECT

## SUMMARY OF FINDINGS

### General Features of the Project

Protappur Irrigation Project is a small (4,000 ha. net area) FCDI (combined flood control, drainage and irrigation) project located near Bogra in the Barind Tract of north-west Bangladesh, a relatively elevated and free-draining area. The main water management problems of the area, pre-Project, were flash floods in the early monsoon from the Nagor River which forms one side of the Project area, and moisture deficit for the maturing Aman paddy crop in the post-monsoon period due to rapid drainage of monsoon rainfall.

The Project was implemented in the mid-1970s in response to demands from the local community, articulated through the Pally Mangal Samity, or village cooperative society. The Project works consisted of a flood control embankment to give protection from the flash floods, a series of regulators on the internal drainage channels intended to retain water at the end of the monsoon, and deepening of the channels themselves so as to more efficiently evacuate excess water during the monsoon. The regulators were intended to be a more durable replacement for an existing system of earth cross-dams erected annually by communal effort. This, together with the communal initiative for implementing the Project, means that the Project was more firmly rooted in the locally perceived needs of the community and farming system than is the case in many FCD/I projects.

The Project was completed in 1977/78 and is reported to have operated well for a few years, despite the existence of a number of planning, design and construction defects. Probably the most important of these relate to the regulator gates, which were ill-fitting and, at least initially, not provided with effective seals. However, little or no maintenance was undertaken, and by the time of the FAP 12/13 RRA fieldwork in 1991 most of the regulators were damaged to some extent and the internal channels were silted up; only the embankment was still functioning well. In addition, the BWDB khalashis appointed to operate the regulators had either absconded or been withdrawn, and de facto operation of the system was in the hands of locally influential individuals or small groups - a situation less likely in the pre-Project period when water management involved joint action by scores or hundreds of beneficiaries.

### Overall Findings on Project Performance

The original concept of the Project appears to have been sound, in relation to the water management systems generally in use in Bangladesh at the time it was built. The Project was expected to facilitate replacement of Local Transplanted Aman by HYV Aman and thereby to increase paddy production. This objective has been fulfilled to a greater extent than originally anticipated, output having increased by 58 per cent compared to 40 per cent envisaged during planning. A provisional recalculation of economic benefits indicates an EIRR of 54.3 per cent, NPV of Tk. 86.7 million (in 1991 Taka) and BCR of 9.5 (both the latter at a discount rate of 12 per cent); planning estimates were of an EIRR of 28.4 per cent and BCR of 3.04.

The Project appears to have been largely free of the disbenefits often associated with FCD/I projects. In particular, there has been little or no adverse impact on capture fisheries, though this is largely due to the small development of such fisheries in this area of relatively

high land. Linkages with culture fisheries have been positive, with reinvestment of profits from HYV paddy in pond construction. Intensification of the cropping system has put livestock feed sources under additional pressure, at the same time that draught power requirements have increased, and a switch to power tillers has started. Employment and wage rates in agriculture and agro-industries have increased, including additional employment opportunities for women. Women of low-income groups have also benefited directly from employment for maintenance work on the embankment; this benefit would have been larger had the Project works been better maintained. Calorie nutrition has improved with increased foodgrain output. Environmental impact has been slight, since the area was already intensively cultivated pre-Project, but the effects of high use of fertiliser and chemicals need to be monitored.

Although the Project has been highly successful in increasing output, it is very doubtful that it should be replicated in its existing form. This is because the tubewell irrigation revolution, which was only starting in Bangladesh when the Project was built, has made available an alternative approach to supplementary post-monsoon irrigation. Use of tubewells for this purpose would probably be more cost-effective than single-use structures such as the regulators, since tubewells are already very widely used in the area for dry-season irrigation. A tubewell system would also probably be more flexible than regulators, due to the smaller area commanded per unit, and would offer less scope for monopolisation of operation by a cabal of the local elite. However, notwithstanding the obsolescence of the Project concept, the Project provides a clear indication of the value of project interventions firmly based on local demand and existing local practice.

### Engineering, Operation and Maintenance

The regulators, especially those in the low lying areas, have been successful in preventing over-drainage of those areas, but their effectiveness has been reduced by inadequate maintenance. The size of channels is not well adjusted to the flows of water they must carry or retain for irrigation purposes, and uncontrolled operation of regulators has been adversely affecting both irrigation and drainage since a few years after completion of the Project. Retention of monsoon water and prevention of over drainage are likely to have contributed significantly to groundwater recharge.

The embankment has improved communication on the south-western side of the Project area and most of the regulators have contributed to improvement of internal road communication.

### Institutions

The Project was initiated on public demand, articulated through the agricultural cooperative societies, but the mismanagement and disrepair of the regulators have caused public apathy towards the Project. There was public involvement in the operation of several of the regulators in the early years of the Project, but later influential people assumed control of the regulators to their own advantage. There are signs of social conflict due to this conversion of public into private property by a few wealthy persons.

Many of the regulators have become non-functional due to enforced or voluntary absenteeism by the khalashis (operators) who have not been effectively supervised and supported by BWDB.

There is no effective liaison between BWDB and the Upazila Parishad for operation of the Project.

### Agriculture

The verifiable agricultural impact of the Project is confined to the monsoon season and is overshadowed by the growth of dry season cropping with tubewell irrigation. This raises important issues of agricultural development strategy. However, it is possible that the Project has made some contribution to dry season development by improving groundwater recharge.

Crop security has improved due to the embankment, which is successful in preventing flash floods from the Nagar River, but there is still a problem of rainwater congestion which causes crop damage in the lowest areas, due to defects in the design, maintenance and operation of the regulators.

Retention of water by the regulators has assisted the move from local T.Aman to HYV T.Aman, with consequent increase in yield.

The tubewell system provides a possible alternative source of supplementary irrigation in the monsoon season which is more flexible, more responsive, and is paid for by the beneficiaries. However, the implications for groundwater depletion of substituting tubewell water for retained water require investigation.

### Livestock

The livestock population appears to have increased since the construction of the Project, probably in part due to increased availability of paddy straw. However, the food value of the extra straw is partly offset by the lower palatability of HYV straw.

### Fisheries

The Project has helped to create the economic climate for fishery development, by increasing disposable income both for fishery investment and fish consumption, though on timing grounds, it is unlikely that the recent growth of pond fish culture in the Project area is directly related to Project impact. Fish ponds remain at risk from overtopping by rainwater floods in the lower areas of the Project.

### Environment

The Project effect in increasing the area of HYVs may be leading to fertiliser and pesticide residues in surface water, especially in the lower part of the Project, which may have an adverse effect on fisheries and may lead to pesticides entering the human food chain. Project impact on groundwater recharge may have prevented falls in groundwater level detrimental to shallow drinking water tubewells. This is a benefit in itself and is also likely to have reduced incidence of diarrhoeal diseases.

### Women

The Project has increased wage employment for women as agricultural workers, in paddy processing and in embankment maintenance. Despite the extra female employment, the differential between female and male wages has not narrowed. Better communications

facilitated by Project structures have increased female access to education, family planning and other facilities.

### Nutrition

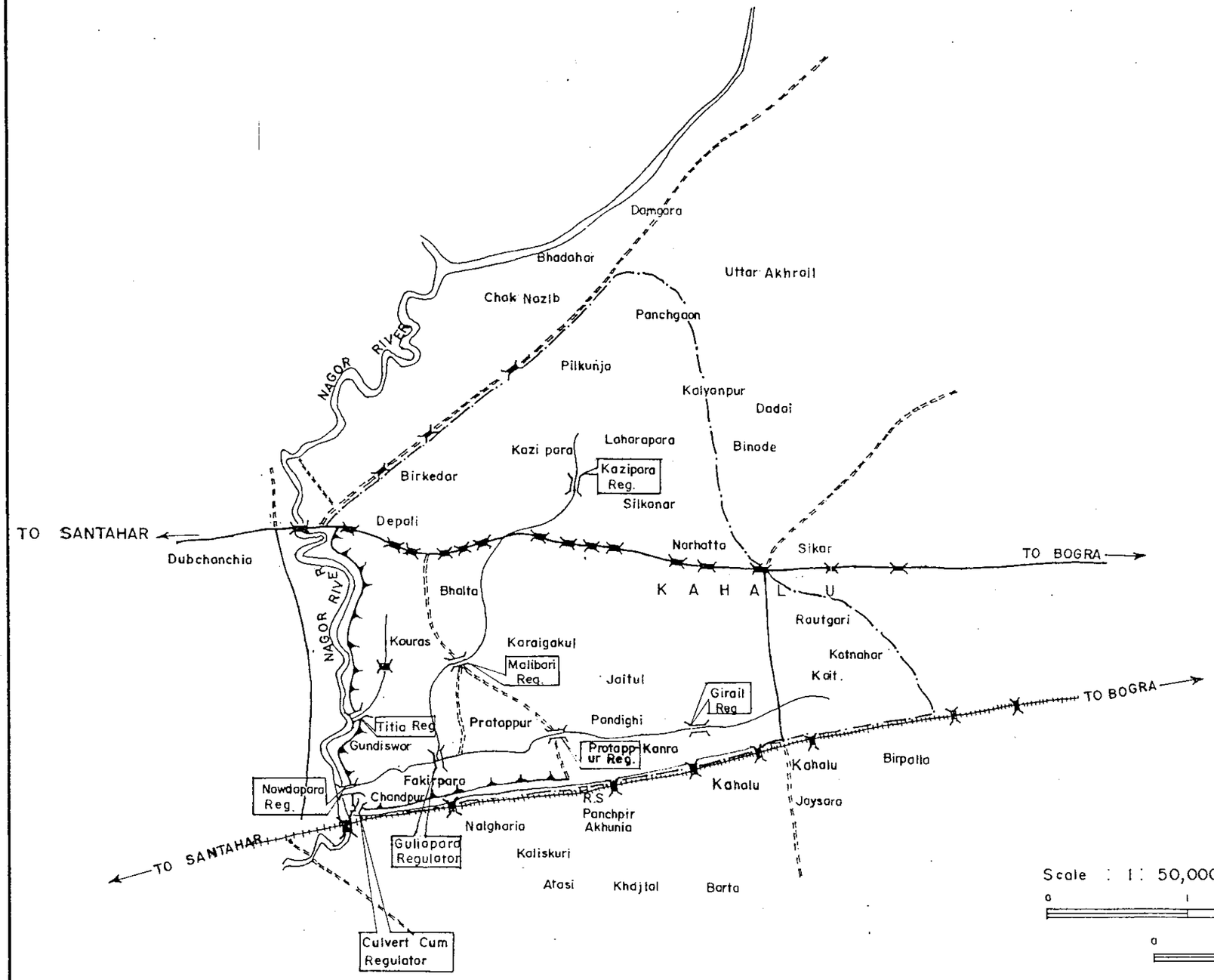
There is no food grain scarcity, and the position of the Project area as a net surplus region for foodgrains has been strengthened by the Project. The beneficial linkage between Project agricultural impact and fishery investment may in time reverse the present declining trend in per capita protein consumption.

### Economics

The Project has surpassed its economic objectives and would be assessed as viable even if only a small fraction of estimated agricultural benefits were attributable to it.

The Project has raised farm incomes by assisting the move from local T.Aman to HYV T.Aman, but the effect could probably have been achieved without the Project by use of tubewells for supplementary monsoon season irrigation. There has been a small increase in real wages for farm labour, due partly to the Project's effect on introduction of HYV Aman.

The Project has generated an increase in employment for crop production, paddy processing, transportation, input supply and manufacture/repair of farm equipment.






N

LEGEND:-

- Remaining Project Boundary---
- Embankment
- River / Khal
- Pucca Road
- Railway
- Bridge / Culvert
- Regulator
- Earth Road

Scale : 1 : 50,000

0 1 2 3 4 Miles

0 1 2 3 4 5 Km

# PROTAPPUR IRRIGATION PROJECT, BOGRA.

## Nagor River Project

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | Nagor River Project |
| **Project Type** | FCD |
| **Location** | |
| **FAP Region** | :North-west |
| **District** | :Bogra-Natore |
| **Area (ha.)** | :15,400 ha. (gross)<br>9,312 ha. (net) |
| **Funding Agency** | EIP |
| **Implementing Agency** | BWDB |
| **Construction Started** | 1983/84 |
| **Scheduled Completion** | 1985/86 |
| **Actual Completion** | 1986 |
| **Original Cost Estimate** | Tk.27.06 million |
| **Final Cost Estimate** | |
| **Major Flood Damage** | 1987 |
| **Repair/Rehabilitation** | 1988/89 |

**Overview**

A poorly conceived polder project which is an almost total failure, and has had a negative economic and social impact. In the project area flooding problems have to be tackled in a regional context.

# NAGOR RIVER PROJECT

## SUMMARY OF FINDINGS

### Introduction

The Nagor River Project was completed in 1986 and operated as planned for only one year, i.e. during 1986-87. Two public cuts were made in the wake of the 1987 floods, to release water pressure in the adjacent Nagor Valley Project. Ever since, these cuts/breaches have become a routine event, leading to severe crop damage and having an overall negative impact on the Project area.

### Objectives

The Project area is part of Polder 3 in the Bogra EIP. The north-east half of the Project area falls within the Highland and Medium Highland Subregion of the Level Barind Tract Agroecological Region (FAO,1988). The south-west differs markedly from the north-east, and it forms the eastern-most part of the Chalan Beel depression.

The Nagor River Embankment Project was completed in 1986 and was intended to (a) provide protection to crops from early flash floods and monsoon floods, (b) eliminate drainage congestion from the Project area, (c) reclaim low-lying areas for cultivation and (d) allow irrigation and flushing through sluices. The net benefitted area planned, was around 9,000 hectares.

### Location

The Project is situated primarily in Singra Upazila, but also includes parts of Nandigram and Atrai Upazilas. It is bounded by the Kaliganj-Kathom road in the North, the Natore-Bogra road in the east, the Gur River in the south and Nagor River in the west.

### Hydrology

The hydrological situation in the Project area is mainly determined by flows from the Nagor River and water levels from the Atrai-Gur rivers. Before the Project, the Nagor waters drained from the north-west to the south east, with the overland spill escaping through the bridges on the Bogra-Natore road. The Nagor River bed has silted up, especially from the junction with the Gur River upto its offtake on the Atrai. There have been considerable changes in the hydrological regime, resulting from the execution of this and other projects in the area.

The Nagor River Project has suffered more than most due to its downstream position. The Project at present is almost a total failure, because the embankment was designed for the historical 1:20 year flood along this particular stretch of river. The largely completed bunding and poldering of much of the Atrai Basin implies that the embankment at Singra needs to be at least three metres, and possibly six metres higher, to meet 1:20 year conditions in the basin as a whole.

The public cuts, which remain open for most of the monsoon period despite the limited annual repair, alleviate the impact on river flow by allowing some escape, but in doing this the

lower Nagor is effectively reversed. From the confluence with the Atrai-Gur anabranch at Karsati village, the Nagor flows rapidly upstream to the first left bank cut, where it is joined by outflow from the Nagor Valley Project on the opposite bank. This has caused serious bank erosion in the area.

### Agriculture

This area is a traditional B.Aman zone and the Project was intended to provide security from crop damage in the lower reaches and allow a change from B.Aman to T.Aman in the higher elevations. There has been a distinct change in the cropping pattern in only one union, namely Ramananda Khajura, which is attributable to the Project. This used to be an area of B.Aman, which has now been replaced by T.Aman (local 75 % and HYV 25 %). However, B.Aman production has dramatically fallen in the rest of the Project area, compared to pre-Project conditions, as the seedlings are quickly destroyed by the on rush of water into the beel through the cuts. This has meant an overall negative impact of the Project on the area.

### Livestock

The livestock population has gone down, in part because of autonomous effects (eg. displacement of draught animals by power tillers) and in part due to reduced green feed availability. On the other hand, there has been an increase in the small stock population (goats, sheep, chicken and ducks). Fewer cattle have meant more resources (food, grass etc) available for small stock.

### Fisheries

Unlike the adverse impact noted in many FCD projects, capture fisheries appear to have benefitted compared to the pre-Project situation. The general declining trend seen throughout the country does not seem to have occurred here. In part, this is due to the fact that the Project has not succeeded, eg. in reducing the flooding condition of the beels and other water bodies.

### Social and Institutional Issues

There is very strong social conflict centring around opposing interests, in particular those relating to fish and paddy. There appears to be a strong fishing group who are in favour of cutting the embankment, as it aids fishing, at the cost of B.Aman paddy.

The most important need is to solve the conflict over the public cuts. This requires careful social intervention and the will of the concerned agencies, such as the Water Board. The SE, Bogra thought that the embankment should be converted to a submersible embankment, which is effectively what it is now.

This position needs to be assessed carefully, and a careful reexamination of the hydrology of the Nagor Basin, and in particular, of the adjacent Nagor Valley Project is warranted.

Inter-departmental coordination is totally lacking and needs to be emphasised. Projects should be discussed more widely at the Upazila and union levels, ensuring greater public participation. Development works that could have an impact on project success, such as feeder roads, should be planned in association with the Water Board.

Project committees and regulator committees are needed to ensure popular participation and better maintenance.

There appears to be no systematic method for record keeping and storing of relevant project documents in the Water Board offices. All too frequently, consultants have to rely on the highly personalised knowledge of individuals for critical information. It is strongly urged that steps be taken to remedy this situation in the interest of efficient project evaluation.

**Communications/Shelter**

The embankment has facilitated road communication without causing an adverse impact on boat communication. There has been a dramatic change in the mode of boat transport in the Project area, with the advent of the STW engine boat.

The embankment was used as a shelter quite extensively in 1987 and 1988.

**Operation and Maintenance**

There are a number of khals in the Project area which have silted up, preventing proper drainage and leading to drainage congestion in the area. These khals were supposed to have been excavated by the Water Board as part of project works, but the work has not materialised so far.

The state of the embankment is extremely poor, with zero O&M efforts. Other structures were also found to be in bad shape with ruined gear boxes and missing nuts in the regulators for example. The regulators also suffer from inadequate drainage capacity.

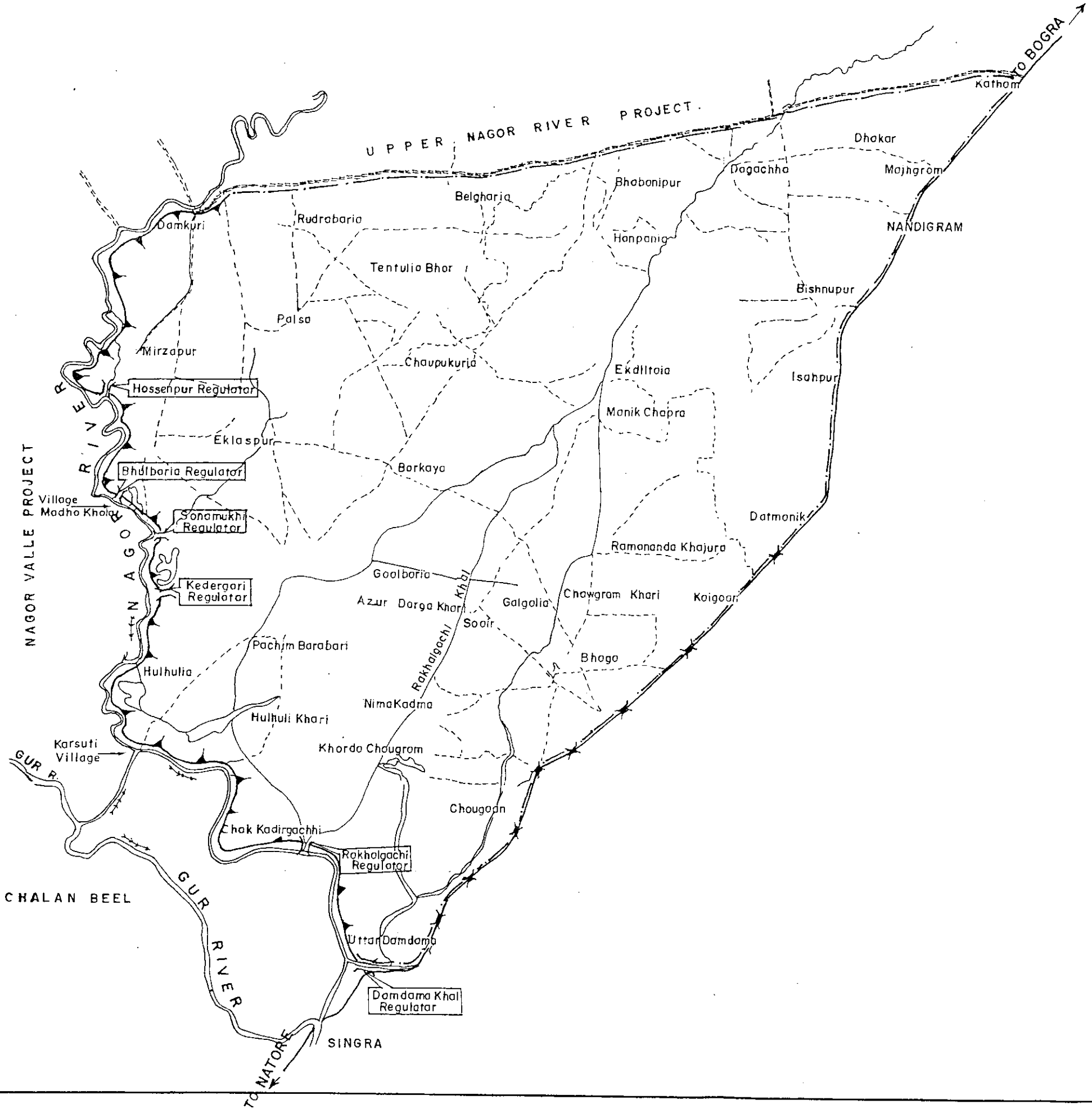
Maintenance of the embankment and afforestation Projects on it, could be coordinated or indeed passed on to the CARE RMP programme, which is already active in the area. The feeder roads are being maintained by women employed by CARE, and it would appear natural for CARE to extend its sphere of activity to include the embankment.

**Environmental Issues**

The major environmental hazard identified, stems from the changed hydrology of the area resulting from the type of FCD projects taken up and completed in the Atrai-Nagor basin. If the experience of 1987 is any guide, the area may now be more at risk of severe inundation than before, resulting from isolated planning of projects that have not taken developments upstream into account.

**Economic Impact**

The overall economic impact of the Project is negative.




# NAGOR RIVER PROJECT
## BOGRA, NATORE

## Sonamukhi-Banmander Beel Drainage Project

### Project Summary Sheet

**Project Name** : Sonamukhi-Banmander Beel Drainage Project

**Project Type** : Drainage

**Location**

**FAP Region** : South-West
**District** : Jessore



**Area (ha.)** : 9,000 ha. (gross),
7,400 ha. (net cultivable)

**Funding Agency** : GOB

**Implementing Agency** : BWDB

**Construction started** : 1970

**Scheduled Completion** : ?

**Actual Completion** : 1978

**Original Cost Estimate** : ?

**Final Cost Estimate** : Tk. 11.625 million (current at time of construction)

**Major Flood Damage:** : ?

**Overview**

A drainage and flood control project aimed primarily at reducing rainwater congestion, the Project has been successful in reducing depth and duration of inundation in part of the area, but its impact is limited by inability to control river flooding originating across the international border. The project is nevertheless very successful economically (EIRR at least 60 per cent); there has been no adverse impact on the small capture fishery, and the long-established culture fishery has benefited.

# SONAMUKHI-BANMANDER BEEL DRAINAGE PROJECT

## SUMMARY OF FINDINGS

### PROJECT BACKGROUND

Sonamukhi and Banmander are two beels in the Upazilas of Sharsa and Jhikergacha in the district of Jessore. A project for draining out excess water during the monsoon period was proposed and implemented during the better part of the seventies (1970-78). The boundary of the Project area as given in the approved PP is the Kobadak river in the east and in the north, the Jessore-Benapole road and railway in the south, and the Kodla (or Kodalia) river in the west. In the north and the west, the boundary is also defined by the international border between Bangladesh and India.

The PP of the Project identified the following flood and drainage problems:

- early monsoon flood water from India and local rainfall together caused early flood in the beel areas resulting in submersion of immature aman paddy plants;
- the low lands of the beels were permanently under water and the medium highlands were submerged under 2'-5' (0.6 - 1.5 m) depth of water causing damage to B. Aman paddy; and
- poor drainage conditions delayed post-monsoon drainage causing delay or even absence of sowing of rabi crops in medium-low beel areas.

The main objectives of the Project were, therefore:

- removal of drainage congestion;
- prevention of damage to crops from monsoon flood; and
- reclamation of low-lying areas for cultivation.

### PROJECT AS IMPLEMENTED

To achieve the objectives the following engineering features were implemented:

a) Five drainage sluices of 1 - 3 vents each.

b) Six bridges. Four bridges are inside the Project area: Keralkhali bridge, Khaskhali bridge, Sialghona bridge and Kulpala bridge, and two are outside the Project area: Ulashi bridge and Jadunathpur bridge.

c) Embankment: 2 km.

d) Excavation/improvement of drainage channels:

| | | |
|---|---|---|
| i. | Improvement of Betna river | = 25 km. |
| ii. | Loop cutting of Betna river | = 7 km. (2 nos) |
| iii. | Re-excavation of Subarnakhali khal | = 2 km. |
| iv. | Re-excavation of Amrakhali khal | = 16 km. |

Two other regulators constructed outside the Project area have a great impact on the Project drainage system. These are:

i. Shankarpur regulator - 6 vents (on Betna river)
ii. Rudrapur regulator - 3 vents (Dudkhali khal)

In the PP practically nothing was mentioned regarding the huge volume of flood water entering the Project area from the R. Kodla, which causes floods in Sarsa Upazila, and as such no flood protection measure was taken to overcome the situation. The Project seemed to be planned only with the specific aim of draining out excess rain water. As a result the drainage facilities are inadequate to cope with the actual situation. No irrigation facility was planned.

## PROJECT PERFORMANCE AND IMPACTS

### Performance

After implementation, the Project was successful in reducing the magnitude of flood depth, its peak and duration, especially in the eastern part of the Project. In the western part, it failed because it did not consider the effect of flood water carried by the Kodla and the overspilling of its banks.

At present the Project suffers from twin problems of drainage and flood. The problems of drainage are due not only to frequently encountered issues (siltation of rivers and khals; the failure to take into account the volume of water that needs to be drained, leading to design and implementation failures related to the regulators; and inadequate re-excavation of the connecting khals) but also to the fact that the rivers are cross bunded in many places for cultivation of fish, a "problem" peculiar to the area.

The problem of flood is also the result of the above failures and cross-bunds. The Betna and the Hakor are both unable to carry much water during the monsoon because of the latter obstructions.

### Agriculture

Improvement in drainage congestion has resulted in some agricultural growth within the Project area. The cultivable area has increased and appreciable changes in cropping pattern and intensity have also occurred. There has been an expansion of the double cropped area. Cultivation of T. Aman and early planting of Boro rice crops have become possible due to the reduction of drainage congestion, especially in the eastern part, the area which is almost entirely irrigated by STW. In addition to this, the area under HYVs has also increased.

In certain parts of the Project area one finds a rapid growth of vegetable cultivation facilitated by the reduction of flood depth and improved drainage.

Two negative impacts on agriculture were noted. These are water shortage for jute retting and increased rat and insect infestation due to the drying-up of beels.

### Fisheries

No fishery objectives were set at the planning stage. Fishing grounds were the rivers and baors. Some of the Project's effects in terms of fisheries are:

a) Creation of loop cuts has allowed fish culture in the old course of the river Betna;

b) As there is little change in hydrological conditions during the monsoon in the western side, there is little effect on fish breeding and fish production;

c) The Project has encouraged some people to cultivate fish in the low-lying areas in large enclosures;

d) The Project has helped in changing the aquatic environment of the baors to encourage better fish growth and fish health, hence fish production;

e) Dead and seasonally almost dead (e.g. Hakor) rivers are cross-bunded and utilized for fish cultivation.

### Livestock and Poultry

Changes that have occurred in the area may not necessarily be ascribed to the Project. Overall there is an increase in the chicken and goat populations and there is a decrease in incidence of worm infestation among livestock.

Increased cropping intensity and the change in cropping pattern have restricted the area for cattle grazing and there is, therefore, now an acute shortage of cattle feed which may be a cause of decline in the cattle population.

### Environmental Aspects

The Project has helped in improving drainage conditions, especially in the eastern side of the Project area. The duration and depth of water logging has somewhat declined.

As the area has become more free from long duration floods the rodent, particularly rat, population has increased. A decline in the visits of migratory birds was noted in the area. It is possible that long term use of STWs may have increased iron toxicity in the soil but definitive information is lacking to prove this.

### Social and Institutional Aspects

Social and institutional aspects of the Project were studied from three angles which are discussed below:

a) Social and Institutional Impacts

There was no stated objective relating to social and institutional aspects in the Project Proforma. Generally, overall socio-economic life has shown progress but it is difficult to relate this to the Project as such. However, in some areas still ravaged by flood, particularly after the Indian Border Security Force cut on the embankment of the Kodla, the situation during floods must have worsened.

There is an increase in seasonal in-migration in the area and the wage rate shows signs of an improvement compared to what it was a decade back. Here again it is difficult to say why this might have happened. There appear to be substantial informal cross-border trading activities which employ a lot of people who are taken out of the local agricultural labour market. The area has always depended to a certain extent on outside labour. However, it must also be true that the improved agricultural condition would encourage more in-migration.

There seems to be a lack of general public collective consensus in getting involved in the Project. However, the local people in some cases carried out works on construction of small embankments (e.g. at Hatkhola) and excavating channels (Ulashi-Jadunathpur) for drainage improvement and irrigation.

The Project has created social conflict between baor lease holders and cultivators. On the other hand one hears a lot of complaints about absentee khalashis. BWDB as an institution has failed to provide proper planning for O&M.

b) Impacts on Women

The overall pattern of women's activities has remained virtually unchanged under the Project. The impact on agriculture has resulted in increased post-harvest work at home but has also resulted in better wage earning opportunities (e.g. in the rice mills) for women. An additional source of income (RMP) was created due to the development of internal road communications (as decline in water logging and depth has created a need for alternative communication facilities).

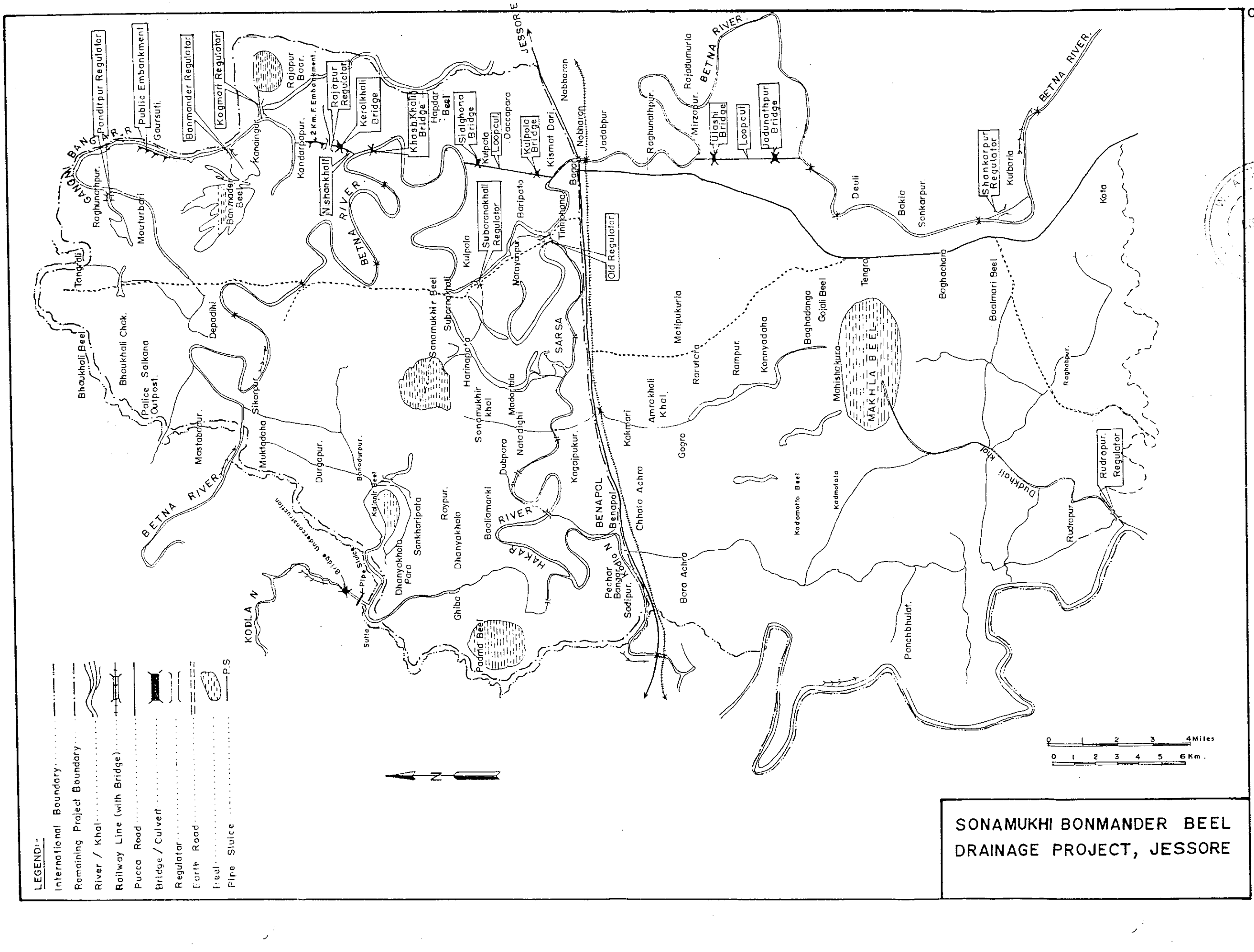
c) Impacts on Nutrition and Health

In the Sonamukhi-Banmander beel area the increase in paddy production has not had a significant effect on the food habits of most of the people. The availability of safe drinking water has increased due to the widespread use of STWs and HTWs in the area.

A declining trend was noted in the case of consumption of protein foods - namely fish and pulses - due to lost opportunities for informal fish catching throughout the year and to a decline in pulse cultivation.

**Aggregate Economic Impacts**

The estimated economic IRR for the Project is 181 per cent. The result is sensitive to the level of net incremental benefit and the rapidity with which full benefits are reaped. Even under a set of very stringent assumptions, however, the IRR is estimated to be 60 per cent.




# SONAMUKHI BONMANDER BEEL DRAINAGE PROJECT, JESSORE

## Sakunia Beel

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Improvement of Sakunia Beel in P.S. Kotwali & Nagarkanda |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : South-Central (in South West Regional Study) |
| **District** | : Faridpur |
| **Area (ha.)** | : 5700 ha. (gross),<br>4400 ha. (net) |
| **Funding Agency** | : GOB |
| **Implementing Agency** | : BWDB |
| **Construction started** | : 1981-82 |
| **Scheduled Completion** | : 1983-84 |
| **Actual Completion** | : 1984-85 |
| **Original Cost Estimate** | : Tk 19.6 million |
| **Final Cost Estimate** | : Tk 12.1 million |
| **Major Flood Damage:** | : 1988 |
| **Repair/rehabilitation in** | : 1990-91 |

**Overview:**

A flood control and drainage project which has not achieved its targets, partly due to poor operation and maintenance and substantial disbenefits to capture fisheries. The EIRR is estimated to be 10 per cent.

# IMPROVEMENT OF SAKUNIA BEEL

## SUMMARY OF FINDINGS

### Introduction

The Project to improve Sakunia Beel is a flood control and drainage project located in Faridpur District in the south-centre of Bangladesh. The Project falls in the FAP South Central Region.

The Project covers a number of small beels including Sakunia as the main one. In the pre-Project situation this area of about 5700 ha was partly surrounded by roads. There were already embankments on the south-east and southern boundaries of the Project area along the Kumar and Gobrakhal Rivers which were not adequate to withstand flood water overflowing from the Kumar river. There were minor drainage channels from the Sakunia beel to the areas of Bakhundia, Beelnalia and Mridhadangi which were quite inadequate in draining out the monsoon water. Thus, drainage congestion was a chronic problem in that area. The build up of monsoon water started from mid-April, and remained up to October every year. This stagnant water sometimes caused severe damage to field crops.

It was possible to locate the PP, PCR and Index Map relating to the Project. The Project was clearly intended to provide flood control and drainage, presumably to protect the late Boro crop, Aus, Jute and Aman crops from flood damage.

There are substantial differences between the Project as planned in the Project Proforma and the Project as built, partly due to problems encountered during implementation. The Project comprised a total of 11.4 km of flood embankment along the Kumar river, of which 8 km was actually constructed by the BWDB under the Project, two drainage regulators and excavation of 16 km of drainage channels.

The Project has not fully achieved its intended impacts due to changes in the Project as implemented, and subsequent deterioration in its condition. Parts of the beel have become better drained (or silted up) and HYV Boro can be grown in place of L Boro. However, drainage conditions are reported to be worse now in some parts of the Project than they were before. In some higher areas T. Aman has been protected from floods by the Project, but this is not true of all areas or all the Project life to date, since part of the embankment was never built and the remainder has suffered many breaches since 1988.

The major agricultural and economic change in the area has been rapid growth in HYV Boro cultivation, irrigated by a mixture of LLPs and tube-wells. It seems unlikely that this has been encouraged entirely by the Project since early flooding remains a risk (due to poor drainage of early rainfall), and in 1990 much of the Boro in the Sakunia beel area was lost just prior to harvest. There are, however, conflicting statements that lower parts of the beels can now grow HYV Boro due to improved drainage.

In addition to its main function, the embankment has been serving the purposes of a road from Joyjhap to Faridpur town via Bakhundia, although the previous boat transport has been disrupted, partly due to low flow and water hyacinth infestation in the river.

However, against these mixed impacts must be counted a considerable loss of captured fish (perhaps a 75 per cent decline) in the Project area because the natural flooding of the beels has been ended.

## Engineering

The construction of the embankment had some positive impact on flood control during the normal flood years prior to the 1988 flood. During 1988, the Project area was flooded and many sections of the embankment were inundated. Sections of the embankment that were not inundated or breached, were used as flood shelters for people from both within and outside the Project.

Reduction of normal flood incidence, partly due to the embankment and partly due to large scale embankment along the Ganges, has reduced damage to the mixed B. Aus/Aman crop. However, there have not been any floods since 1988, so the impact of the embankment, which still has many unrepaired natural breaches and public cuts, is not clearly known.

The number of sets of irrigation equipment (LLPs along the river Kumar and STWs inside the Project) and the total area covered by irrigation have increased, facilitating change of cropping patterns from the traditional mixed B. Aus/Aman - pulses/oilseeds to - local T. Aman/HYV Boro.

The drainage objective of the Project has not been fully realized, and uncertainty of HYV paddy production in the Boro season still prevails in the Sakunia Beel areas. The Project was launched on the basis of inadequate designs in relation to capacity of regulators and provision for drainage requirements.

The 2.5 km embankment along the Gobrakhal from Joyjhap to Gotti bridge in the southernmost part of the Project was never completed. Another 8 km embankment constructed along the Kumar river from Bakhundia to Joyjhap has many breaches and public or rain cuts, which have not been repaired nor even taken account of by the BWDB, on the grounds that there are no funds for O&M.

The two drainage channels, including the lead channel from the Sakunia Beel, have silted up, causing drainage congestion in recent years, and these two channels were inadequately re-excavated in 1991. One of the two regulators collapsed immediately after construction, but has not been repaired since, nor has any effective action been taken against the contractor. All the structures (embankment, drainage channels and sluice gates) are very poorly operated and maintained, and there is virtually no supervision of the structures, indicating inefficiency and lack of responsibility by BWDB.

## Agriculture

The primary objective of the Project has been realized to some extent by creating an increase in irrigated HYV Boro paddy production through:

i. drainage of Sakunia Beel and bringing previously submerged land under cultivation;

ii. replacement of local Boro by HYV Boro in the lower portion of the Beel;

iii. replacement of mixed B. Aus/Aman by HYV Boro followed by local T. Aman in medium low and medium high land.

B. Aman production has declined since the Project was implemented because of:

i. decrease in depths of water in the monsoon;

ii. decrease in soil fertility due to non-availability of silts.

Pulse production has declined, because of the expansion of irrigated HYV paddy production in the Rabi season, a phenomenon commonly observed in areas where mechanized irrigation has been introduced, though oilseed production remained unchanged.

**Livestock**

The cattle population has declined due to a shortage of cattle feeds, especially green feedstuffs. The incidence of parasitic diseases of cattle such as liver fluke has increased due to an apparent increase in the snail population.

Now that roads and communication facilities have improved as pre-conditions for socio-economic development, government and NGO programmes for income and employment generating activities such as goat rearing, cattle fattening and poultry raising have been promoted, although these are limited to high land villages, mainly in Kaijuri Union, which are closer to Faridpur town.

The goat and poultry populations have increased by 25-30 per cent as there are now more open access grazing lands on the slopes of the embankment and village roads, and NGO programmes are being taken up.

**Fisheries**

Fisheries were not at all considered in the Project planning, since the Project was conceived of for promoting HYV Boro paddy production by draining beel water.

Open water fish production has dropped by about 75 per cent due to drying up of beels, rivers and canals. This has caused loss of employment and income of full time or part time fishermen, who constitute by and large the poorer section of rural households.

The Project has created opportunities for the expansion of pond fish culture through:

i. reduction of flood risk to cultured fisheries;

ii. increase in profitability from fish cultivation. However, these opportunities are not yet realized due to inadequate extension advice and support services from the relevant departments.

**Health and Nutrition**

The nutritional status of the diet has declined due to:

i. decrease in fish availability;

ii. decrease in traditional sources of protein such as pulses.

This has affected the poor more severely than the richer households, because the former lost the opportunities for subsistence fish catches in the beels and rivers.

Peoples' eating habits, especially those of poor people, have changed, as more wheat/wheat flour is consumed now than before because of:

i. distribution of wheat for the construction of embankment and drainage channels;

ii. increase in wheat production within the Project area.

**Women**

The Project has had a number of positive impacts on women as follows:

i. increased rice production has increased employment of women in post-harvest activities;

ii. women obtain some employment in re-excavation of drainage channels and earth work for the embankment;

iii. improved road transport encouraged NGO programmes, most of which are directed towards women's development.

**Social Impact**

The embankment, acting as a road, created social and economic infrastructure in the southern portion of the Project area, which facilitated movement of goods and services to and from these areas. It has also promoted diverse occupations such as rickshaw vans, machine repair facilities, petty trades, etc. However, the development of village roads has not been adequate to compensate for the decline in boat transport after the Project.

Re-excavation of drainage channels has not taken care of the need for small culverts and bridges, the absence of which has caused tremendous difficulties for trafficking animals across the very deep channels, especially in villages such as Bilnalia and Char Mongolkot.

There is public resentment and complaints about the efficacy of the drainage regulators, which in recent years were reported to have failed to clear drainage congestion from the Sakunia Beel and local depressions around the Bilnalia and Mongolkot areas.

In areas surrounding the Sakunia Beel, there has been some "psychological" improvement as people are conscious that their living conditions have improved, especially in the wet season.

The availability of drinking water has improved as a result of increased provision of HTWs and increased installation of STWs.

## Environment

The Project has had both positive and negative environmental impacts:

i. reduction in flood inundation improved living conditions, especially in Sakunia Beel areas;

ii. reduced water hyacinth infestation caused a reduction in damage to the B. Aman crop, but the increased water hyacinth infestation blocked boat transports and boat fishing in the Kumar river;

iii. decrease in wetlands has caused virtual disappearance of migratory birds;

iv. silt deposition is stopped, causing a decline in Aman production;

v. sanitation problems worsen, as the open-pit latrines are not washed away annually.

## Economic Impact

From a provisional and partial economic re-evaluation based on agricultural and fishery impacts only, the Project appears to have been non-viable. The estimated BCR is less than unity and the EIRR is estimated at 10 per cent. There are two main reasons for this poor performance:

i. poor construction and lack of maintenance and rehabilitation have made the originally 50 year operating life estimated in the PP completely unrealistic. A 20 year life has been assumed instead;

ii. the very substantial disbenefits to capture fisheries offset about 40 per cent of the net incremental value of crop production.

The level of employment has increased, due to:

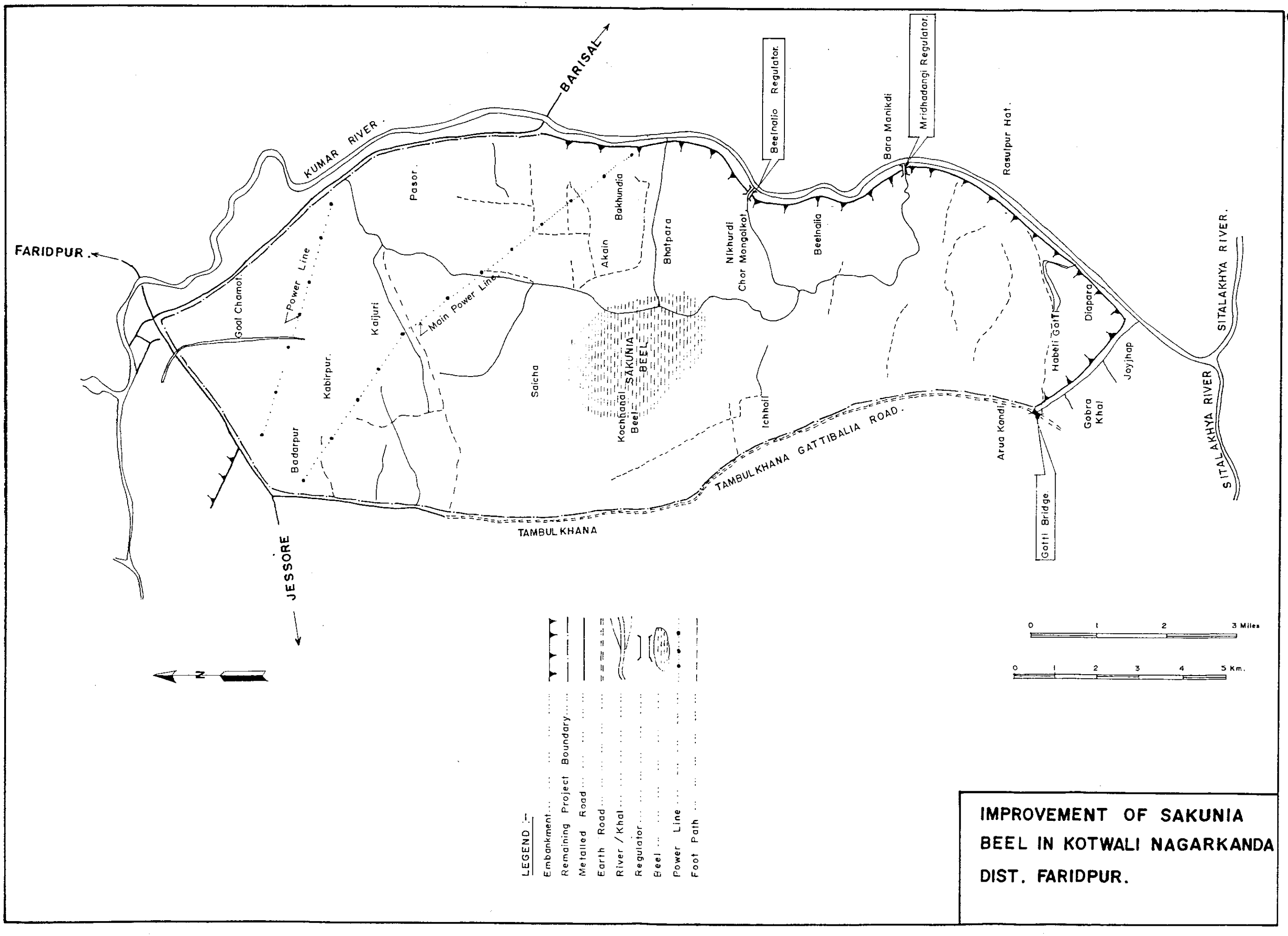
i. construction of the embankment and excavation/re-excavation of drainage channels;

ii. increased Boro output, which has increased employment in areas with access to mechanized irrigation;

iii. the move from B. Aman and Aus/Aman to T. Aman which has higher labour requirements.

Increase in employment appears to have benefited poor wage labour households and small holders because increased employment is available at a time which used to be an agriculturally lean period under the traditional cropping pattern.

Prices of land have increased three to four times in the Sakunia Beel, and the rate of increase has been more or less similar to that observed in other areas. The rate of increase in prices is higher for irrigated land than for non-irrigated land. In high land villages close to Faridpur town, a private market for power tiller hire services has also expanded. These changes are not ascribed to the Project.




# IMPROVEMENT OF SAKUNIA BEEL IN KOTWALI NAGARKANDA DIST. FARIDPUR.

## Silimpur-Karatia Regulator Cum Bridges

### Project Summary Sheet

**Project Name** : Silimpur-Karatia Regulator Cum Bridges

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

**Location**

**FAP Region** : North-Central
**District** : Tangail

**Area (ha.)** : 2833 ha.(gross, all embankment),
1012 ha (approximate area claimed to be served by structures)

**Funding Agency** : IDA (World Bank, SSDFCP, 955-BD)

**Implementing Agency** : BWDB

**Construction started** : 1982

**Scheduled Completion** : 1983

**Actual Completion** : 1983/84

**Original Cost Estimate** : Tk.2.4 million

**Final Cost Estimate** : Tk.6.36 million

**Major Flood Damage** : 1988 area flooded, embankment washed away in places.

**Repair-rehabilitation**: maintenance comprises periodic resectioning of embankment.

**Overview**:

A poorly conceived project which has provided limited agricultural benefits (EIRR approximately 10 per cent) but had strong negative impacts on navigation and social harmony. The gates have rarely been used, all irrigation uses groundwater and the area remains vulnerable to flooding.

# SILIMPUR-KARATIA REGULATOR CUM BRIDGES

## SUMMARY OF FINDINGS

### Introduction

The project area is situated in the district of Tangail and encompasses the unions of Dhainnya, Porabari and Silimpur, on the left bank of the Dhaleshwari and Elanjani Rivers. The project consists of four one vent gates built in 1983-84 on the embankment at the mouth of khals at Belta, Indra Belta, Fatehpur and Binnafair. These gates are described as flushing inlets in project documents, suggesting their use as irrigation structures. In practice these gates have rarely been used during their lifetime for various reasons, which are indicated in the following paragraphs.

### Hydrology

The western and southern sides of the project area are bounded by the Dhaleswari and the Elanjani Rivers, while the northern and eastern sides are bounded by the Lohajang River. The normal pattern is for the Dhaleshwari and Elanjani to drain into the Lohajang, through the khals and overspill. The southern parts of the project area, (eg. Baruha and Charpara) are higher than the northern parts, (eg. Baghil), which were beel areas some twenty years ago.

The khals in the area completely dry up during the Boro season, and are able to retain water for only two to four months in a year. The general project area has become drier than before.

There are very few ponds in the area.

### Operation of the Structures

The sluice gates were rarely operated (closed) since their construction in 1984. An attempt was made for the first time during the monsoon of 1991 to close the gates at the initiative of the BWDB, but with little success. Fall boards could not be traced, or when located were difficult to put in place. There are mixed feelings about these structures amongst the local people, but most agree that they have not served any purpose.

### Agriculture

The traditional cropping pattern (as exemplified by the practice in the set back distance of the embankment) consists of Aus followed by B.Aman. Jute and sugarcane are also popular here, especially in the more elevated, sandy areas. The winter crops are mustard and wheat. Boro HYV cannot be cultivated in elevated areas because of the high water cost involved in a sandy environment. The cropping pattern within the project area consists of Boro HYV under irrigation in the deeply flooded land, sometimes followed by B.Aman (transplanted). In the medium-low land, it is possible to have T.Aman after Boro HYV and in the medium to high land, jute or aus, rabi crops or sugarcane are found. These lands are typically too sandy to be suitable for HYV Boro. While these changes are a direct consequence of the embankment, none can be attributed to the sluice gates.

### Fisheries

The narrow gates have facilitated fishing at the gate mouths. This is a highly seasonal activity, lasting two to three months in a year. The quantity of fish caught is small.

### Livestock

Livestock has declined in the project area due to decrease in grazing land, but this is not attributable to the gates.

### Non-Farm Activity

The area supports a rich variety of non-farm activity, including weaving, boat and rickshaw transport, carpentry, saw mills and husking mills, trading and horticulture. The Grameen Bank is the main NGO in this area, and supports both men's and women's groups.

### Communications

The gates have allowed the embankment to be closed at those points, facilitating road transport, both pedestrian and rickshaw. At the same time the impact on boat navigation has been very adverse, and a source of unhappiness even now, seven years after the construction was completed.

### Social Conflict

The potential for social conflict has been aggravated due to the project. A number of contradictions have been sharpened: boatmen versus farmers, char people and those inside the project, fishermen against farmers and high landers against low landers.

People in the char areas outside the project area are disbenefitting because of a riskier agriculture and greater probability of inundation of homestead areas. This has also contributed to tensions.

### Observations and Recommendations

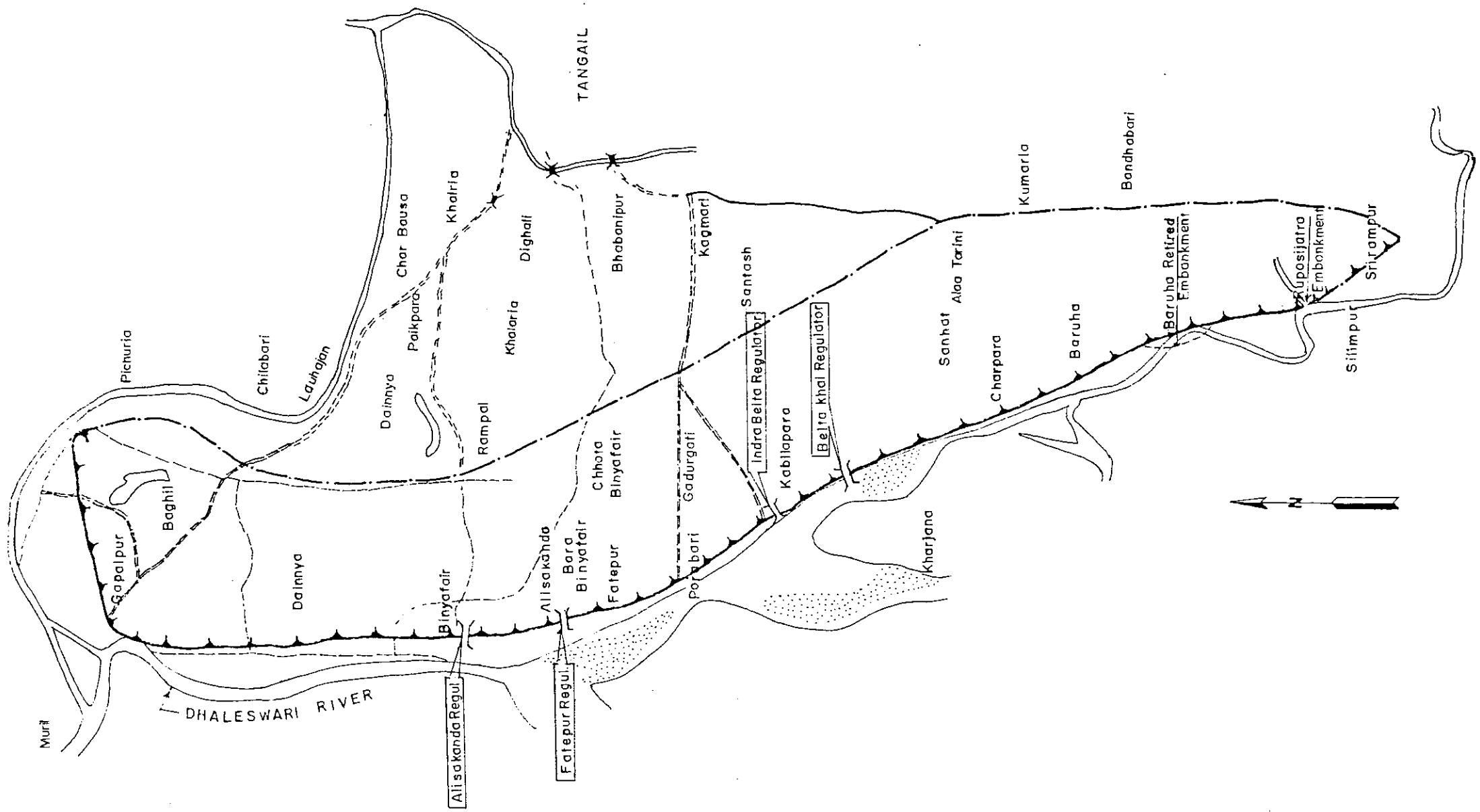
1. There is a need to re-examine the raison d'etre for the gates very carefully, taking into account the often conflicting positions and opinions of the local people in and around the area.

2. Now that the gates are there, they are a fait accompli, and efforts should be made to make them easily operable. It is therefore important to provide appropriate fall boards that are easy to put in place or take out as desired. Existing wooden boards, even when traceable, are extremely unwieldy.

3. Successful operation requires effective gate committees that enjoy the support of the vast majority of the inhabitants of the area. This requires a degree of social intervention and organisation which is totally absent. A concerted effort in this direction will require the involvement of not only the Water Board but also the participation of NGOs, union and upazila officials and peoples' representatives.

4. The problem of drainage congestion requires de-silting the khals, which need to be re-excavated.

5. The gates cannot of course be considered in isolation from other developments in the area. Thus the amount of water entering through the gates, even at peak flow levels, is small. The water from the Lohajang enters the area from the eastern side of the project anyway, and is the major source of inundation during the monsoon season. In normal years, the degree of flooding does not appear to cause any problem. Even in 1991 when floods have been more intense than normal, crop damage has been slight in the area. The potential danger has begun to recede with the flood waters.




LEGEND:-

- Embankment
- Remaining Project Boundary
- River / Khal
- Regulator
- Bridge / Culvert
- Earth Road
- Foot path

Scale : 1 : 50,000

0 1 2 3 4 Miles

0 1 2 3 4 5 Km.

# SILIMPUR - KARATIA BRIDGE CUM- REGULATORS, TANGAIL

## Katakhali Khal Project

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Construction of bridge-cum-regulator at Katakhali Khal |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : North-Central |
| **District** | : Jamalpur |
| **Area (ha.)** | : gross: 2660 ha. (project appraisal), 3000 ha. (post-evaluation) net cultivable: 2226 ha. (project appraisal), 2520 ha. (post-evaluation) |
| **Funding Agency** | : EIP (Netherlands and Sweden) |
| **Implementing Agency** | : BWDB |
| **Construction started** | : 1980-81 |
| **Scheduled Completion** | : 1981 |
| **Actual Completion** | : 1982-83 |
| **Original Cost Estimate** | : Tk 8.36 million (1983 financial prices) |
| **Final Cost Estimate** | : Tk 9.5 million (1983 financial prices) |
| **Major Flood Damage:** | : 1988 |
| **Repair/rehabilitation in** | : none to date |

**Overview**

A flood control and drainage project aimed at reducing flood levels and delaying the rise of floods, the Project has succeeded in reducing maximum depth of flooding in the monsoon and facilitated a move to higher-yielding types of paddy. Capture fisheries have been almost destroyed, but the Project is economically successful, with an estimated EIRR of 27 per cent. Long-term viability of the Project is threatened by poor maintenance, breaches having remained open for several years.

# KATAKHALI KHAL PROJECT

## SUMMARY OF FINDINGS

### Project Background

Katakhali Khal Project is located in Sarishabari Upazila of Jamalpur District and Modhupur Upazila of Tangail District, about 40 km. south of Jamalpur in the FAP north-central region. The boundary of the Project to the west is the embankment along the Jhinai river, but elsewhere the boundary of the impacted area is unclear. The Project has had some effect on a wider area than had been claimed and probably benefits about 2520 cultivable ha. (gross area 3000 ha.).

### Project Objectives

The Project aimed to benefit Aus and Aman cultivation by reducing monsoon water levels by 1.5 m. in a 1-in-5 year flood (on the Jhinai river), and by reducing the rate of rise of flood water. This was expected to result in an increase in the area of T Aman at the expense of B Aman, and to an increase in average annual yields. These aims were to be achieved by constructing an embankment along the Jhinai river with regulators and sluices to prevent river water flowing up the drainage khals but to permit drainage at other times. The standard of flood protection was up to a 1-in-20 year flood.

### Engineering Assessment

The Project was taken up under EIP, designed by BWDB, and implemented by BWDB. Although intended to be completed within one season (1980-81), work was not completed until 1982-83. During implementation the Project was substantially modified, although there are no documents to justify this. Only 7.25 out of a planned 14 km. of embankment were built, the remainder of the effective embankment being a strengthened village road (a rare example of integrating FCD infrastructure with local roads, and so reducing land acquisition). Additionally the capacity of the main regulator was reduced, and an extra box sluice was built, the project thus comprising two regulators, three box sluices and two pipe inlets.

The structures appear to have been well built, but poor planning means that part of the Project area is cut off from natural drainage by the embankment and earth roads, resulting in public cuts when local rainfall is heavy.

### Operation and Maintenance

Poor maintenance now threatens the effectiveness of the structures: the surrounding embankments are deteriorating, and two regulator gates are in a poor state of repair. Drainage provisions are inadequate - there appears to have been no khal re-excavation. Additionally there are three breaches in the embankment dating from 1988 when weak points failed in an exceptional flood. These breaches had not been repaired by 1991 and so the effective standard of protection is much reduced.

Thee are no khalashis for the structures, but local committees have been established for the main regulators. The committees are dominated by local influential persons, while the box sluices serve small areas and effectively are privately operated. There is no formal public

participation in maintenance, and only the earth road is maintained, there having been no resectioning of the embankment since completion. However, local people were mobilised to raise part of the embankment in 1988. Unfortunately the embankment breached and overtopped upstream.

### Agricultural Impact

Despite problems of drainage congestion, the Project has resulted in reduced monsoon water levels on most land levels, although the duration of flooding is little different in some areas. As a result there have been substantial changes towards growing higher yielding Aman varieties: B Aman has disappeared, and short stemmed HYV Aman has been introduced on 49 per cent of the Aman area. These changes can be attributed to the Project, but over the same period HYV Boro has come to dominate winter cultivation (86 per cent of cultivable land), while Aus and jute cultivation have declined. It is unlikely that the Project has encouraged Boro cultivation which has also expanded in adjacent areas and which is not protected from early floods in this area. However, the drying up of beels may have been accelerated by the Project. Overall paddy production has trebled, but the monsoon season gain from the Project has been about a 50 per cent increase in paddy output.

### Livestock Impact

Livestock impacts have been mixed. The expansion of Boro cultivation and reduction in Aman crop failures from flood damage have reduced the area of grazing with a consequent decline in the cattle population, which has not been counteracted by the increased production of paddy byproducts. However, the increased availability of bran does appear to have encouraged growth of poultry raising.

### Fisheries Impacts

The Project area contained a small but locally important capture fishery based on seven beels in the Project area. This has been all but destroyed. The decline in the area of beels might have happened to some extent without the Project, but the embankment and structures have prevented movement of fish between the rivers and beels and floodplain. Consequently it is estimated that at least 80 per cent of open water fish production has been lost in the Project area. There has been a major increase in pond fish cultivation with new ponds being constructed, but this represents only a small fraction of the lost production. It is likely that the Project has also reduced fish production in adjacent rivers, whose stock depended on the nearby beels and floodplain. However, this loss is difficult to quantify and may not be linked with any one project. There is some sign that stocking of the beels is partly compensating for the loss, but this will need further work to be effective.

### Infrastructure and Flood Losses

There has been some development of local road transport, but this would probably have happened in any case as part of the embankment is also a local road. The embankment has provided a sense of security from flooding, but this may be unwarranted as the Project could not prevent widespread flooding in the area in 1988 when about 35 per cent of houses collapsed. Since similar damages would have occurred without the Project, it is unlikely that it has brought much benefit from non-agricultural flood protection. Even crops are not immune from flood damage, although the frequency of damage is clearly reduced.

### Socio-Economic Impacts

Associated with the general increase in paddy production (part of which is due to the Project) there has been a rapid growth in rice milling and in trade in paddy, turning the area from a deficit to a surplus grain producer. Employment has thus increased both in agriculture and in secondary activities, but the increase is relatively small and has not prevented the incidence of out-migration for work increasing since the Project.

The Project is likely to have widened the income differential between larger landowners (the main beneficiaries) and the landless. However, it does provide some security from flooding and damage to property for all categories of households. Fishermen have been a particularly disadvantaged group. Many of the previous fishermen have changed occupation or moved away and the real incomes of those who remain have declined since the Project. Associated with the reduced fish availability is a reported absence of a major improvement in nutritional status for most households.

The Project's impact on women does not appear to have been great, but is positive: there is more work available in post-harvest activities, poultry rearing has been encouraged, and vegetable production is reported to have increased (possibly reflecting the loss of rabi crops).

### Environmental Evaluation

The Project has had a substantial positive impact on crop production, but has had a proportionately greater adverse impact on fisheries. Underlying these impacts are some important changes in the physical and biological environment. The area of wetlands in the Project area has been substantially reduced in favour of cultivation. This change extends over a wider area than the original Project definition and reflects a mixture of natural drying out of beels and accelerated local siltation, which may be because flood water does not carry sediment out of the Project. Surface water quality appears to have declined without the cleansing effect of floods. The loss of wetlands has reduced the biological diversity of the area. In particular the fish community has been severely reduced. There do not appear to have been any important physical impacts of the Project on areas outside the embankment.

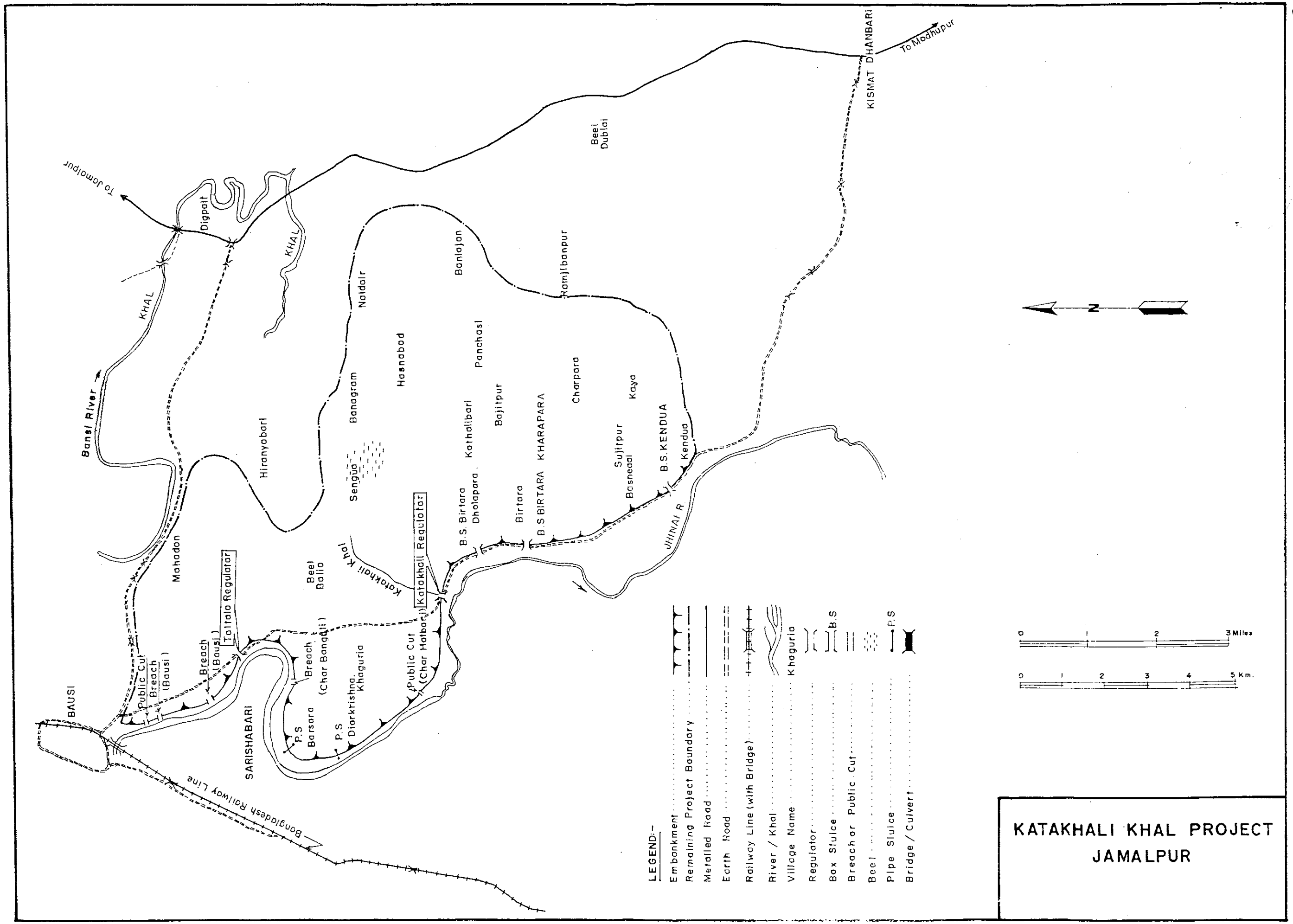
### Economic Post-appraisal

Despite cost overruns the cost of the Project was relatively modest at about Tk 7500 per net cultivated ha. (1991 financial prices) or Tk 4200 per net cultivated ha. (1991 economic prices). The annual agricultural benefits to Aman cultivation are about three times the disbenefit to fisheries inside the Project (any impact on fish production outside the Project could not be quantified). As a result, even allowing for the continued risk of crop damages from flooding because of the poor maintenance of the Project, a high Economic Internal Rate of Return (about 27 per cent) was estimated, with a Benefit-Cost Ratio of 2.8:1. These estimates are fairly robust - they are not sensitive to changes in the key crop yield and fisheries loss assumptions.

### Recommendations

Maintenance of the embankment has been non-existent. If the breaches continue to remain open then floods of moderate return period (perhaps 1-in-5 years) are likely to cause substantial damage. Means of achieving local participation in managing drainage (including

cuts) and in repairing the embankment are needed. Local investment in irrigation inlets might avoid embankment damage. Greater liaison between government departments is needed - earth road maintenance tends to be better than that of the embankment and the project embankment might be adopted as a local road. There is also an opportunity to manage the seasonal beels as a stocked fishery but collaboration between BWDB, DOF and NGOs would be needed to establish fishermen's cooperatives leasing or licensing the fishing rights.




# KATAKHALI KHAL PROJECT
## JAMALPUR

## Halir Haor Project

## Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Halir Haor Project |
| **Project Type** | : Submersible Embankment (FCD) |
| **Location** | |
| **FAP Region** | : North-East |
| **District** | : Sunamganj |
| **Area (ha.)** | : 8,000-8,700 ha.(gross) |
| **Funding Agency** | : IDA (World Bank: SSDFCP) and WFP FFW |
| **Implementing Agency** | : BWDB |
| **Construction started** | : embankment 1976/77-1983 |
| **Scheduled Completion** | : structures: 1983 |
| **Actual Completion** | : structures: 1987 |
| **Original Cost Estimate** | : Tk 8.5 million (1983 prices) |
| **Final Cost Estimate** | : not known |
| **Major Flood Damage:** | : 1990 (overtopped almost a month before target date) |
| **Repair/rehabilitation in** | : annual because overtopped each year |

**Overview**

A successful submersible embankment project with an estimated EIRR of about 65 per cent. The major benefits are from protecting the local Boro crop, and the disbenefits are minor. With improved O&M the project could be even more successful.

# HALIR HAOR PROJECT

## SUMMARY OF FINDINGS

### Project description

A submersible embankment project in Sunamganj District. Taken over from local bodies by BWDB sometime between 1976/77 and 1983/84, embankment length 53 km. Two regulators built 1984-87 under SSDFCP (IDA credit 955-BD) to improve drainage and reduce recurrent maintenance of annual cuts. Aim of project: to safeguard the Boro harvest by preventing floods before 15 May of more than 20' PWD. Benefited area: about 8,000-8,700 ha in total.

### Engineering assessment

The structures appear to have been well constructed, but fallboards are inappropriate because they cannot be removed to equalise the water level before the embankment is overtopped. Regular cuts are needed to drain out water after the monsoon. The embankment is maintained regularly and the cuts closed, but the crest level is less than the design standard due to insufficient FFW allocations.

### Institutional assessment

A formal arrangement for project management is lacking, and the regulators are under the control of influential local persons. There is a lack of liaison between BWDB and the local administration. Local resources are not provided for embankment maintenance, except that one person cuts and closes the embankment of his own initiative each year.

### Agriculture

There is one crop per year, mostly local Boro. Following the project the cultivated area has increased by 6% of the total area, and now 5% of the area is under HYV Boro. Before the project Boro yields were on average considerably lower than possible because of frequent early flood losses. The project does not protect Boro completely. For example in 1990 early flooding led to a total loss, but on average yields are estimated to be about 19% higher with the project than pre-project, because of somewhat better flood protection. Overall these changes result in about one third more paddy being produced on average, but output still fluctuates.

### Livestock

The cattle population has declined because of losses during high flood years, reduced areas of grazing, and continued crop failures resulting in sale of cattle, while draft power requirements have increased slightly.

### Fish

Fish catches are apparently unchanged, but there has possibly been a change in catch composition with delayed onset of flooding affecting fish migration. There is no benefit to pond cultivation.

### Environment

The rivers outside the project are silting up with an unknown effect on flooding and the environment in the long term in the haor. The area of beels in winter is reduced resulting in lower numbers of wintering wildfowl. The area of wet grassland is also reduced, affecting grazing and grass supplies. There is a shortage of trees, but the embankment could be planted with flood tolerant *Barringtonia* trees.

### Nutrition

Food intake is no better and there are severe food shortages for many households just before the (Boro) harvest. Foodgrain production is higher but so is the population, while access to the fishery is now restricted.

### Women

Women have not been adversely affected compared with men. There is some increase in paddy processing, and some women find work on repairing the embankment, but women have not yet started to work harvesting paddy.

### Socio-economic

The project benefits and management have not been targeted to help the poor. Many men migrate out of the area for work for seven months, while much harvesting is done by in-migrants. Availability of fish to casual and small scale fishermen has declined as the main Jalmahal is now controlled by outside interests. Likewise much of the agricultural gain goes to a few large landowners.

### Floods

Early floods damaging Boro are only one important aspect of life in haor areas. In parallel, assistance for the post-harvest period and in coping with high floods is needed. For example, earlier maturing Boro paddy varieties, improved/safe drying and storage technologies, cattle shelters and safe places for people in high floods would be valuable.

### Economic re-assessment

Limited data on project costs was available, but valuing the agricultural gains using MPO and FPCO data, and assuming that there were no other major economic impacts, results in an estimate of the economic rate of return for the whole project of about 65%. The incremental return on investing in the two regulators may well have been even higher. However, there would probably also be similar returns to improving embankment maintenance to achieve the intended performance.

## SOME KEY LESSONS

1 A formal institutional framework for liaison between BWDB, District, Upazila and Union administrations, and representatives of project inhabitants (including farmers, fishermen, and landless) is needed. There should be a project committee to co-ordinate maintenance and ensure that local contributions are made and used fairly. Regulator committees could improve on the operation of the structures.

2 Annual maintenance is critical in a submersible embankment, and part should be funded from local resources - a levy in cash or kind on beneficiaries according to the extent that they benefit; however resistance to this may be strong given that it would be on top of land revenue which is not charged according to the productivity of land.

3 Submersible embankments by definition do not protect people from floods. While the people of the haor are adjusted to living with annual floods, living conditions for half of the year are very poor. Applied research and small scale investments are needed to improve peoples' ability to cope with their environment: for example earlier maturing paddy, improvements in paddy drying and processing methods to help safeguard the harvest, providing safe places in village mounds during extreme floods, safeguarding livestock and fodder during the monsoon, and extension of the homestead areas to provide a minimum living area during the monsoon.

4 Complete drying out of smaller beels with low-lift pumps for fishing may adversely affect fish stocks - further research is needed and a ban might need to be imposed. Existing perennial water bodies and wetlands should be protected and not drained or encroached further to preserve the ecological balance of the haor (in particular its fishery).

C-40

SANIR HAOR.

Madnakandi
Durgapur
Kechana Beel
Hararkandi
Muhammadpur
Asanpur
Haripur
Pandu
BAULAI RIVER
Harinakandi
Haor Alipur
Enyetnagar
Rongia
Seasonal Track (Possible Compartment Bund)
Kachma Beel
Putia
Putia Khal
Harinangar
Kumaria
Harinorpur
Rajapur
Rahimapur
Alipur
Rampur
Sachna
TO SUNAMGAJ
JAMALGANJ
SURMA RIVER
Kamlabaj
Kuljr Beel
Boalar Beel
Kablia Beel
Rajabaj
SUCHIA REGULATOR
Seasonal Track (Possible Compartment Bund)
HALIR HAOR
Naya Khari
RATLA BEEL
Jotindrapur
Chhatidhar Beel
Kewali Kandi
BAULIA RIVER
Ulukandi
Nawa Beel
BREACH
Rahia Khal
Sukhair
RATLA REGULATOR
SHANGHAIR HAOR.

LEGEND :—

Embankment
River / Khal
Regulator
Earth Road
Breach
Beel

Scale : 1 : 50,000

0 1 2 3 4 Miles

0 1 2 3 4 5Km.

# HALIR HAOR PROJECT
## SUNAMGONJ

## 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

**Overview**

The project consists of a weir to facilitate irrigation, plus flood control embankment and drainage. It has led to increased production in both kharif and rabi, and the project has a high EIRR (estimated at over 90 per cent) despite fisheries losses, annual embankment breaches and severe subsequent sedimentation.

## 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 overspills, 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).

TRIPURA STATE OF INDIA.

BELONIA

MUHURI RIVER

Sahibnagar

Alaka (West)

Alaka (East)

Anantapur

Parashuram

Kalapara

Noapur

Salia

Chithalia

Dhankunda

Rampur.

Durgapur

Ratanpur

Jaypur

Chitalia Jala Khal

Existing Water Retention Structure

Beroborio (South)

Muhuri River.

Satkuchia

3 Vent Drainage Cum Flushing Regulator (Under Construction)

Ghaniamora (East)

Ghaniamora

Daulatpur.

KAHUA

RIVER

Daulatpur (South)

Muhuri River.

N

LEGEND :-

Embankment

River / Khal

Bridge

Earth Road

Railway

Foot Path

Scale : 1 : 50,000

0 2 3 4 Miles

0 1 2 3 4 5 Km.

# KAHUA MUHURI EMBANKMENT
# FENI

## Konapara Embankment Project

### Project Summary Sheet



| | |
|---|---|
| **Project Name** | : Konapara Embankment Project |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : North-East |
| **District** | : Mymensingh |
| **Area (ha.)** | : uncertain, several different estimates made: 13.4 sq miles or 3,480 ha (gross), 4251 ha or 3,116 ha (net) |
| **Funding Agency** | : Netherlands (EIP) |
| **Implementing Agency** | : BWDB |
| **Construction started** | : 1980/81 |
| **Scheduled Completion** | : ? |
| **Actual Completion** | : 1983/84 |
| **Original Cost Estimate** | : ? million |
| **Final Cost Estimate** | : ? million |
| **Major Flood Damage:** | : 1988 |
| **Repair/rehabilitation in** | : 1989 |

**Overview:**

A successful FCD project which has yielded substantial agricultural benefits (EIRR over 20 per cent), which are offset to a limited extent by negative impacts on fisheries, livestock and social relations.

# KONAPARA EMBANKMENT PROJECT

## SUMMARY OF FINDINGS

The Konapara Embankment Project lies along the left bank of the Kangsa River under Haluaghat Upazila in the district of Mymensingh. This is an "early implementation project" (EIP) of the BWDB, financed by the Netherlands Technical Assistance Program. It's objective was to protect standing crops such as Aus and jute from early flooding, and T.Aman from monsoon floods. Although the overall economic impact of the project has been positive, mainly through greater protection afforded to T.Aman, it suffers from poor project design and resulting social problems.

### Project Area

The project area consists of four unions, namely Amtail, Swadweshi, Bildora, and Sakuai. According to project documents, the gross benefitted area is 8,600 acres and the net area is 7,700 acres. The project essentially consists of an embankment of 21.54 km in length along the Kangsa River, stretching from Bahirshimul in the west to Phutkai in the east. In other words, it is open on three sides, making it difficult to delineate the boundaries of the project area. It is however the view of the RRA team that the benefitted area is actually much more than suggested by the project documents.

### Structures

According to the Project Completion Report, there are supposed to be 11 drainage inlets or irrigation outlets built into the embankment. The XEN reported a much higher figure, with 21 drainage outlets and 5 irrigation inlets. The entire length of the embankment was resectioned in 1989, following the 1988 floods.

### Pre-Project Agriculture

Three crops were grown: Aus, jute and T.Aman. About 26 percent of the area was devoted to Aus and 10 percent to jute. In the Aman season, the entire project area was used for T.Aman. Yields were very poor, ranging from 10-15 mds per acre for paddy and 15 mds per acre for jute, and the cropping intensity was 135.7 percent (see Project Report). Our field interviews however suggest much higher pre-project yields: 20-25 mds per acre for paddy (local) and 30 mds for HYV.

### Post-Project Agriculture

The current cropping practice has evolved in response to a number of changes in the crop environment, not all of which are project related. The hydrological regime has altered, making it safe for Aus, jute and Aman cultivation. At the same time, and quite independently, irrigation has expanded rapidly, leading to a rapid expansion in the area under HYV Boro. Therefore, despite greater protection afforded to Aus, its acreage has declined as Boro cultivation expanded under irrigation. This has reduced project impact, with the Aman crop gaining the most, mainly through a switch from local to HYV varieties. Current cropping intensity is around 200 percent. The increase in cropping intensity would appear to be largely related to acreage expansion in Boro, and cannot be attributed to the project.

### Other Impacts

Apart from agriculture, the project has had significant (positive) impact on a number of other areas:

1. Communication has improved, facilitating haulage to markets and access to schools;

2. More local employment has been generated reducing out-migration;

3. Incomes and nutritional status have improved;

4. Protection from floods has led to more fruit trees in the area;

5. Small stock and poultry have increased;

6. Pond fish culture has increased significantly.

Negative impacts have also been recorded:

1. Capture fisheries have declined as migratory routes have been blocked;

2. Grazing land has decreased but fodder availability has increased with expanded Aman production. The former is probably due to more intensive cultivation under irrigation, and cannot therefore be attributed to the project. The latter is a project effect. The net effect has been a reduction in the livestock population.

3. Adjacent areas have been strongly disbenefitted, leading to acute social tensions.

4. There are areas of drainage congestion and sand deposition, causing environmental damage.

### Overall Evaluation

The agricultural benefits of the project are substantial, and after deduction of fishery disbenefits yield an EIRR of 37 per cent, a Benefit Cost Ratio of nearly 7.5 and an NPV of Tk.42.4 million (the two latter measures at a discount rate of 12 per cent). These positive returns are offset to a limited extent by negative impacts on livestock and on external areas which could not be accurately quantified.

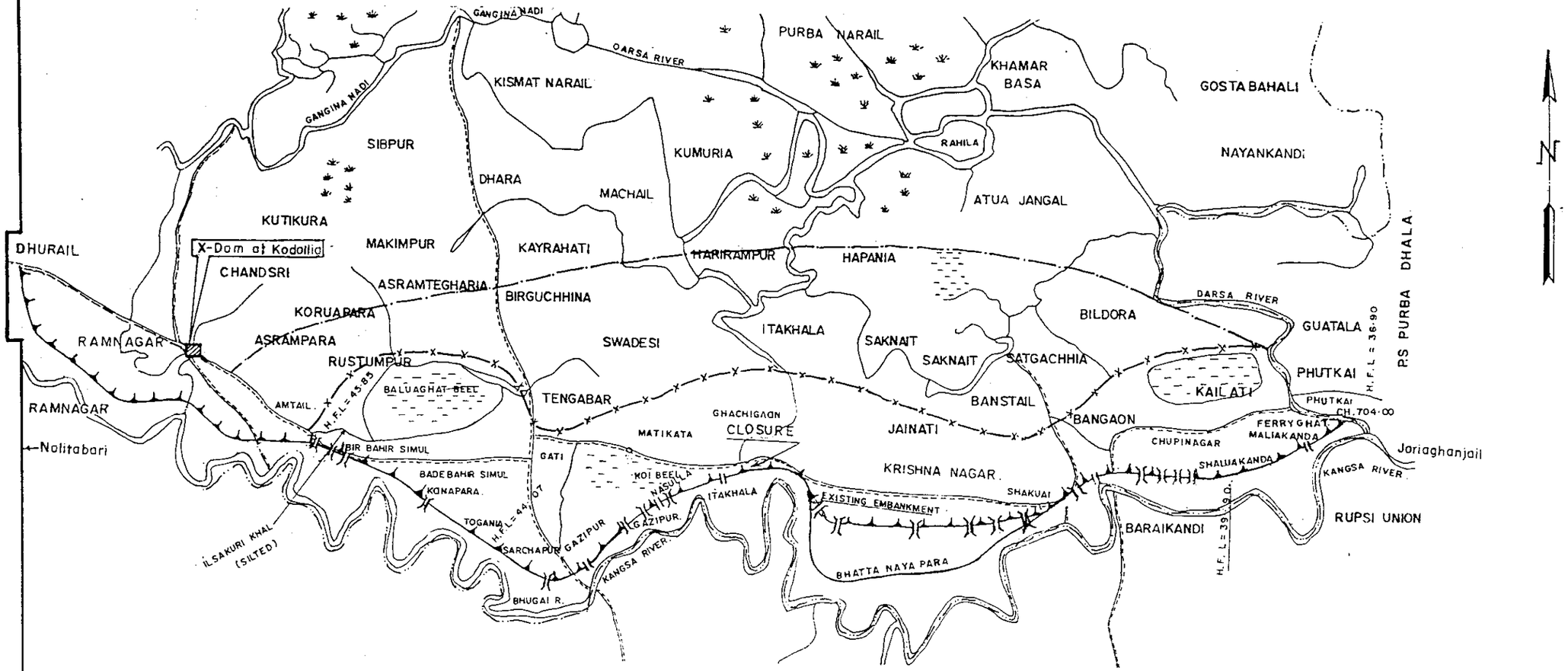
### Recommendations/Observations

1. The project is incomplete in design. This needs closer examination. At present it is just an embankment that does not seem to begin or end in any logical place.

2. The embankment is in very poor shape although completely resectioned in 1989. Complete lack of O&M is evident.

3. Inappropriate placing of drainage outlets has been reported. These need to be lowered to facilitate their function.

4. There is huge potential in the field of social forestry on the embankment, which has gone largely unnoticed. Similarly, there is considerable scope for fish cultivation in flood-free water bodies, but this is constrained by legal tangles about ownership rights.




LEGEND:—

- Embankment
- Remaning Project Boundar (Actual)
- BWDB Project Boundary
- Brick Soling Rood
- River / Khal
- Beel
- Irrigation Inlet
- Drainage Outlet

0 1 2 3 Miles

0 1 2 3 4 5 Km.

# KONAPARA EMBANKMENT MYMENSINGH.

## Polder 17/2

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Polder 17/2 (of Coastal Embankment Project) |
| **Project Type** | : Flood Control, Drainage and salinity exclusion |
| **Location** | |
| **FAP Region** | : South-West |
| **District** | : Khulna |
| **Area (ha.)** | : 3723 ha.(gross), not all within protection of embankment<br>2792 ha. (net cultivable) |
| **Funding Agency** | : GOB, EIP (Netherlands) |
| **Implementing Agency** | : BWDB |
| **Construction started** | : 1969/70 |
| **Scheduled Completion** | : 1970/71 |
| **Actual Completion** | : 1983/84 (Gangrail closure) |
| **Original Cost Estimate** | : Tk 11.8 million ?? (initial CEP cost)<br>Tk 9.0 million (closure, 1980 estimate) |
| **Final Cost Estimate** | : Tk 11.837 million (initial investment costs, 1970s)<br>Tk 10.64 million (closure, 1982/3 prices),<br>ignores costs of two closure failures in mid-1970's |
| **Major Flood Damage:** | : none |
| **Repair/rehabilitation in** | : embankment/sluices: c.1985, also nominally in 1988/89 |

**Overview:**

The polder's aims were only achieved to a limited degree. Reduced salinity levels have permitted agricultural expansion, and there has been some move from shrimp "ghers" to cultivation of Aman, but at the cost of large fisheries losses and major social conflicts. The low net benefits and long implementation period result in a negative EIRR.

# POLDER 17/2

## SUMMARY OF FINDINGS

### Project Background

Polder 17/2 is one of a number of polders in Khulna District built as part of the Coastal Embankment Project. Polder 17/2 has a gross area of 3723 ha and comprises 10.5 km of embankment, five sluices and a major closure. The aim of the polder was to exclude saline water intrusion and protect the polder area from regular high tide flooding, thereby protecting Aman crops and freeing land which suffered high salinity levels for crop cultivation. While these were valid aims, economic circumstances have changed dramatically in the project area, and by the time it was finally complete shrimp cultivation (which requires access to saline water) was a major land use in the Polder.

### Engineering Assessment

The initial construction of the Project was a failure; the closure of the Gangrail river failed in 1971 and on two subsequent attempts. Finally as an EIP project the Gangrail was successfully closed in 1983, twelve years late. The embankment appears to be well constructed and is still in good shape 20 years after construction; although a small section was never built the land there has not been overtopped. However, the sluices leak badly due to poor installation and maintenance of the flap gates. Water management inside the Polder is largely outside the control of BWDB; instead a series of 14 private inlets and box sluices control the water flows into and out of the shrimp farms (ghers).

### Institutional Assessment

For most of the Polder's life little attention has been paid to institutional arrangements for its management since many aspects of the intended management of CEP polders were never implemented. Sluice committees have now been formed and the sluices do have active khalashis assigned to them, but operation of the Polder is heavily controlled in practice by shrimp farmers, without a mechanism for finding a compromise between the shrimp and crop cultivators, nor a means of protecting the rights of different landowners from the consequences of their neighbours' land uses (brackish water leaks into non-gher areas and drainage is congested). The embankment saves local people from building less effective bunds to keep out tidal water, but a system of voluntary labour for maintaining these bunds, built under local initiative, has been lost following the public funded embankment project.

### Agriculture

Benefits to agriculture have been slow to materialise, since the Polder was open to saline water until the final closure in 1983. Since then salinity levels on higher land have fallen and production of Aus, jute and particularly vegetables has increased (cultivated areas and yields have increased). Recently HYV Boro has started to expand due to reduced salinity levels and the availability of ground water. The closure did reduce the area of shrimp farms, and hence higher yields of Aman paddy could be achieved (Aman is grown after the shrimps are harvested but yields tend to be low).

### Livestock

There has been little Project dependent impact although the advent of shrimp cultivation meant that there was little grazing land available in part of the Polder; now that Boro cultivation is expanding this trend is likely to continue. However, grazing quality is improved where saline water is excluded.

### Fisheries

Before the Polder, and indeed before the closure, there was a sizeable fishing community based in the area and fish catches were reportedly very high because of the large area of tidal channels in the Polder. This capture fishery has been decimated by the closure of the Polder. Increased pond cultivation has had a negligible offsetting impact. Additionally shrimp farming had become a major land use before the closure; as expected the area under ghers fell because the closure reduced access to salt water, but shrimp farmers adjusted rapidly to circumstances and have been able to maintain salinity levels through their own sluices. This adverse impact has thus been less than expected in area terms although there is still a sizeable economic loss which counteracts the agricultural gain.

### Nutrition

There is now less cheap fish available in the Polder area, but food grain production is higher and vegetable and fruit production are better, so overall there may be a small improvement in nutrition compared to what it would have been without the Project.

### Social Impacts

The Gangrail closure was justified by the donor on social grounds: small farmers were often given no choice but to lease their land to large shrimp farmers and then received only a disproportionately small fraction of the profits. This may have been better than receiving no income but on balance the social tensions and physical conflicts created indicate that small cultivators were no better off from shrimp farming. The tension is heightened now that HYV Boro is possible in some areas since the profits are similar and the farmer is in control and so does not risk non-payment. Hence the Project failed to reduce the social conflict over shrimp farming, failed to terminate what was and is an important economic activity (even if the income it creates tends to be inequitably distributed), and destroyed the livelihoods of a small but important minority of traditional fishermen. The Polder does not appear to have affected women differently from men, although shrimp cultivation created some jobs for women in shrimp processing.

### Environment

The embankment and closure have resulted in slack water during the tidal cycle adjacent to the Polder and consequently there has been severe siltation of the channel south of the Polder. This Polder along with other polders in the area may also contribute to wider off-site (external) impacts on the physical environment in the delta-Sundarbans area. There has been a loss of seasonal wetlands with their associated fish, fauna and plant diversity, which have been replaced by managed shrimp ponds and agriculture. The Polder has eventually been successful in reducing salinity levels outside the shrimp farms.

## Economics

There is a lack of evidence of induced economic growth in the Project area, although the volume of road transport has increased, and the importance of boats has declined. There has been a limited increase in the availability of employment for labourers inside the Project. Overall the negative fisheries impact is only just less than the net gain to agriculture (after subtracting losses to shrimp farming) due to the Project. Much of the agricultural gain is relatively recent because of the gradual decline in soil salinity levels after saline water is excluded, whereas fisheries impacts happened soon after the closure. Hence the Project has had very small benefits, while much of the costs were incurred many years before these benefits. Not surprisingly, therefore, the project has not even achieved a positive return at a zero discount rate.

## LESSONS

1. The purpose of a Polder is to manage water for the economic development of the Polder area. This is not happening at present; there is no management plan for the Polder and no single authority which tries to coordinate water management and resolve conflicts of interest.

2. Regulations exist which would enable shrimp cultivation to be regulated and would form a means to reducing the conflict between shrimp farmers and other land owners (by means of Shrimp Regulatory Committees). However these are not enforced or enforceable at present.

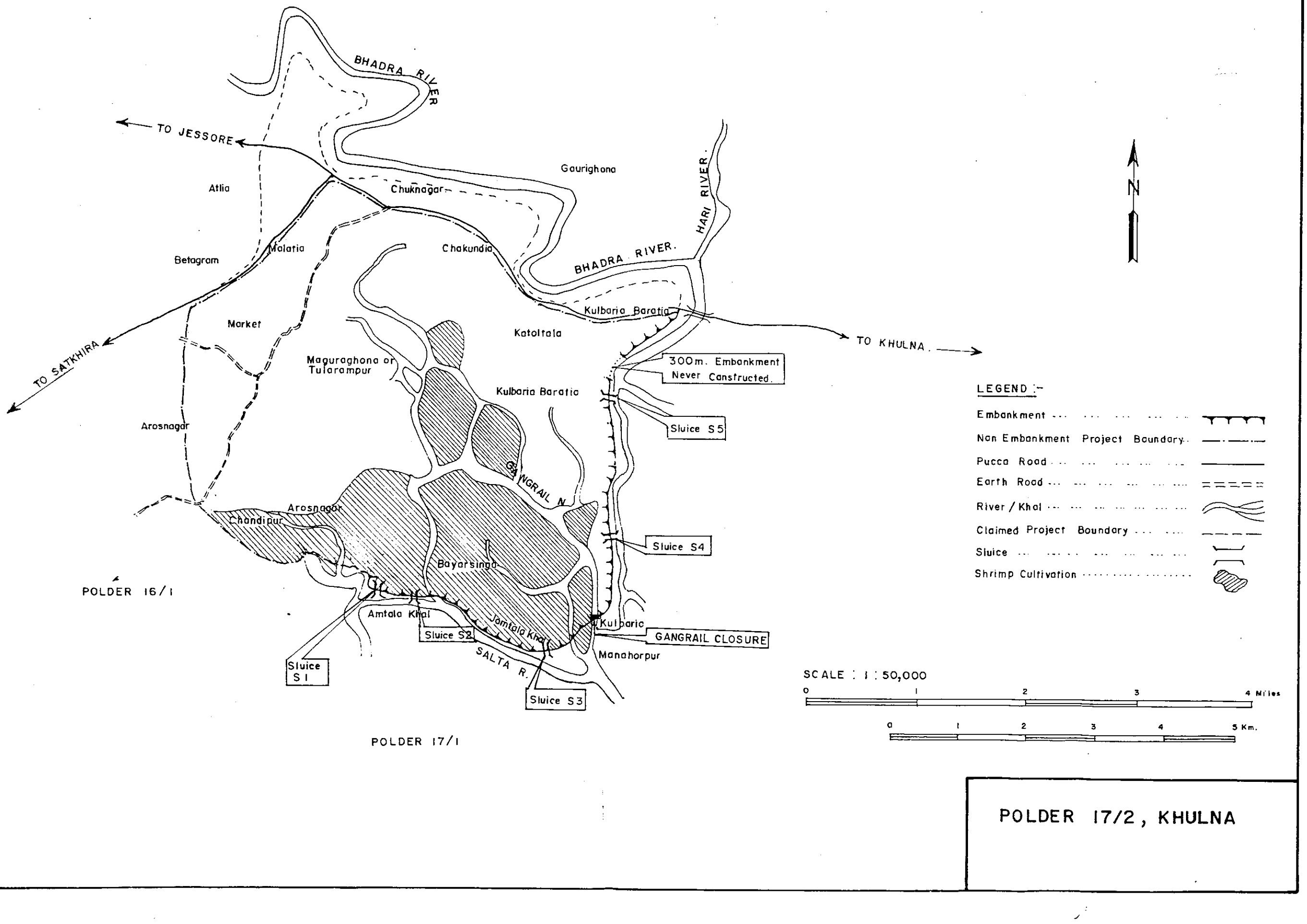
3. Project planning must take proper account of the environmental and particularly fisheries impacts of proposed FCD/I projects. The likely impacts need to be properly modelled and predicted, and projects adjusted accordingly or abandoned if they would not be viable after taking such impacts into account. This requires the active involvement of other government departments representing affected interests and extension services, such as the Fisheries Department, in project planning. Actual compensation should be made to groups disadvantaged by FCD/I projects

4. There is a need to modify the objectives and even project design and facilities of FCD/I projects as appropriate to changed economic opportunities (such as shrimp farming and HYV Boro cultivation), otherwise operating practice may be inappropriate.

5. More integrated planning of embankments and roads is needed, involving cooperation where needed in implementation and cost sharing; for example if it is predicted that in the near future an embankment will be used as a road by heavier vehicles it is better to design structures to withstand the higher loads from the onset rather than to make costly modifications later. It may be that an embankment can be developed as a road, or that it can replace an old road, or that an existing local road can be modified into an embankment. This could help to reduce drainage congestion problems due to unplanned local earthworks.

6. Delays in achieving intended project benefits should be incorporated in project appraisal sensitivity analysis. The critical problems in Polder 17/2 were inadequate planning of the Gangrail closure which delayed completion for 12 years, and the slow achievement of agricultural benefits because soil salinity takes time to decline,

compared with much more rapidly achieved losses to fisheries - this could have been predicted.




# POLDER 17/2, KHULNA

## Brahmaputra Right Embankment
## Kamarjani Reach

### Project Summary Sheet

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

**Overview**

This section of the Brahmaputra Right Embankment (BRE) has been relatively stable, so far, although it has suffered some breaches and in 1991 was at risk of further serious damage. It has delivered some agricultural and security benefits, but high capital and O&M costs and fisheries losses lead to an estimated EIRR of only 3 per cent.

# BRAHMAPUTRA RIGHT EMBANKMENT - KAMARJANI REACH

## SUMMARY OF FINDINGS

### Introduction

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

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

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

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

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

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

### Engineering

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

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

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

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

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

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

**Agriculture**

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

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

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

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

**Livestock**

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

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

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

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

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

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

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

**Fisheries**

Open water fish production in beels and khals has decreased by about 374 MT per annum as a result of :

- low water in beels;
- interrupted fish migration from and to the river due to regulators;
- reduction of major carps.

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

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

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

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

**Women and Nutrition**

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

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

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

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

**Environment**

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

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

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

**Social Aspects**

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

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

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

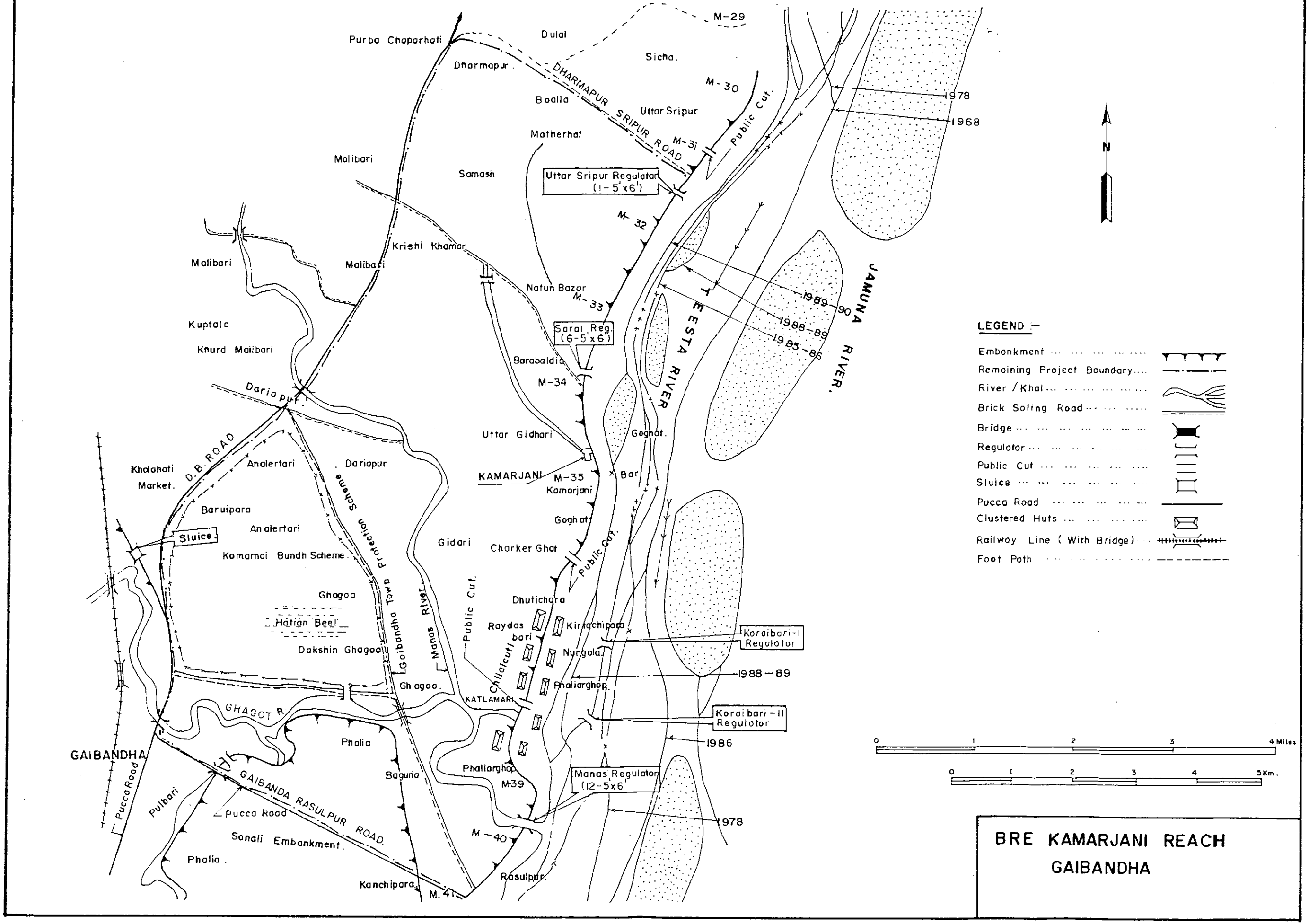
River erosion has led to unauthorised settlement by affected people on the BRE. The housing, habitation and banana plantations along the embankment have not only undermined the strength of the embankment but also jeopardize normal traffic in many reaches of the embankment.

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

**Economic Impact**

From a provisional and partial economic re-assessment based on agricultural and fishery impacts only, the Project appears to have been economically non-viable, when a 35 year project life is considered. The estimated BCR is less than unity (0.41) and EIRR is less than the assumed opportunity cost of capital (12 percent). The poor economic performance is attributable largely to the severe negative impact of the Project.

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




# BRE KAMARJANI REACH
# GAIBANDHA

## Brahmaputra Right Embankment
## Kazipur Reach

### Project Summary Sheet

| | |
|---|---|
| **Project Name** | : Brahmaputra Right Embankment, Kazipur Reach |
| **Project Type** | : Flood Control and Drainage |
| **Location** | |
| **FAP Region** | : North-West |
| **District** | : Sirajganj |
| **Area (ha.)** | : 10,500 ha.(gross) (Kazipur Reach) |
| **Funding Agency** | : IDA |
| **Implementing Agency** | : BWDB |
| **Construction started** | : 1963 original, 1974 rehabilitation |
| **Scheduled Completion** | : |
| **Actual Completion** | : 1970 original 1985 rehabilitation |
| **Original Cost Estimate** | : Tk.78.95 million (1963-70) for the entire BRE |
| **Final Cost Estimate** | : Tk.395.8 million (1974-85) for the entire BRE |
| **Major Flood Damage** | : Annual, since 1984 |
| **Repair/rehabilitation** | : Major work in 1974-85 period, frequent erosion and construction of retired embankments, particularly since rehabilitation. |

**Overview**

This section of the BRE has been highly unstable since 1984. There have been numerous breaches and embankment retirements and considerable loss of property, including Kazipur town. The area is now subject to severe and unpredictable floods. The limited agricultural benefits are estimated to be smaller than the costs and disbenefits, and the estimated EIRR is negative.

# BRAHMAPUTRA RIGHT EMBANKMENT - KAZIPUR REACH

## SUMMARY OF FINDINGS

### Introduction

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

Since BRE is a huge project, two sections only were purposively chosen for two separate RRAs - one in Kamarjani reach in Gaibandha and the other in Kazipur in Sirajganj. The rationale for selecting Kamarjani reach is that this section of the BRE has been relatively stable so far.

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

Kazipur Reach of the BRE is located in Maijbari, Sonamukhi, Kazipur, Chalitadanga, Gandail and Subhagachha Unions in Kazipur upazila and Ratankandi union of Sirajgonj Upazila of Sirajgonj District. The study area covers about 10,500 ha. inside the BRE and the area coincides with BRE mileage- 85 (near Dhekuria) to mileage 95 (near Jhunkail) or 16.0 km. in length of the reach.

The general topography of the study area comprises two directional components. One component slopes gently towards the south parallel to the Brahmaputra river flow and the other slopes steeply towards the west, away from the Brahmaputra river.

During the pre-project period the whole area used to be submerged due to inflow of flood water from the Brahmaputra river causing damage to B. Aus, B. Aman and jute crops. The construction of the BRE was expected to provide protection from floods and to permit a shift from local paddy to transplanted paddy varieties to boost agricultural production.

Between construction and 1984 the primary flood protection objective was achieved. Since 1984 however, there have been frequent embankment breaches due to erosion by the Jamuna (Brahmaputra) River. The area is now subject to severe and unpredictable floods and is probably worse off than in the pre-project situation.

### Engineering

Until 1984, when breaches of the BRE due to river erosion started severely, the primary objective of flood control was achieved. Crops such as B. Aus, B.Aman, jute were protected from flood damage and human and animal living conditions were improved to a great extent. The situation has reversed during the period from 1984. There has been a worsening flood situation rendering crop production in the monsoon season highly vulnerable as a result of embankment breaches along the Kazipur Reach.

The BRE has generated benefits by providing roads for transport and communication, shelter for human and animal population, land for linear housing, tree plantation, cattle/sheep grazing, borrow pits for fish culture, etc.. However, these should not be overestimated because they are incidental benefits of the Project and were not counted in the economic justification during the planning stage.

River erosion and subsequent retirement of the embankment has led to unauthorised settlement of the affected people on the BRE. This reduces the strength of the embankment and also hinders regular maintenance work or emergency activities relevant to safety of the embankment. A modified design of embankment should be provided to accommodate construction of houses for the destitute people without hampering the quality of the embankment.

The improper construction of the retired embankments with respect to bad quality of embankment soil, inadequate compaction, untimely start of earthwork, non-payment of land and crop compensation and finally poor repair and maintenance of the embankment, all indicate lack of capacity on the part of the authority concerned. This ultimately reduces the credibility of BWDB to negotiate funds and assistance for flood control projects.

**Institutional Performance**

The embankment section is very poorly maintained and supervised. Due to lack of proper maintenance severe damage occurs to the embankment which jeopardises the stability of the embankment and security of crops, lives and property in the project area.

There is no Operation and Maintenance (O&M) committee in existence, although this was proposed in the Project Proforma (PP). There was no public participation in the repair and maintenance of the embankment or structures. Neither was there any instance of consultation between the beneficiaries and the executing agencies at any stage of planning, design and implementation of the Project.

The inadequate and delayed payment of compensation for the land acquired often delayed timely acquisition of land. This ultimately caused delayed start of construction, which was often done very inefficiently.

**Agriculture**

As projected in the PP, the BRE did successfully change the B. Aus/Jute-B. Aman - minor rabi crops cropping pattern into a B. Aus/Jute - T. Aman pattern in the initial years and then into Irrigated HYV Boro - HYV T. Aman over a large area. There has been a 50 percent increase in T. Aman production and about 10 percent increase in the total monsoon rice production due to the Project.

The embankment breaches since 1984 have again caused uncertain and serious flooding in 3 out of every 5 years, making T. Aman production vulnerable to flood damage. Consequently both acreage and output of T. Aman has declined due to flooding caused by breaches of the BRE.

In the pre-project situation B. Aman used to be followed by minor rabi crops such as pulses and oilseeds. In the post-BRE period there has been a significant reduction in the

production of these crops. However this is largely due to the expansion of HYV Boro cultivation which is not related to BRE.

The re-emerged risk of annual flooding due to breaches and overtopping has seriously reduced the scope for crop intensification, which requires a controlled water regime.

**Livestock**

The cattle population has seriously declined compared to the pre-project situation due to:

i. abrupt and severe inundation caused by the embankment breaches/flooding;

ii. shortage of straw for fodder from HYV paddy production in the monsoon.

**Fisheries**

One of the conspicuous negative consequences of the BRE, as elsewhere in FCD projects, is the serious decline in open water capture fisheries through:

i. the blockage of fish migration routes to and from the rivers and beels, reduction of fish spawning areas and restriction of migration by the major carps;

ii. reduction of wild spawn collection in the river;

iii. annual flooding due to breaches and overtopping of embankment, limiting the scope for pond culture fisheries.

The reduction of fish production has led to an occupational change by erstwhile professional fishermen to low income, irregular activities such as boat plying, wage labour or anything that brings some supplemental income.

**Nutrition and Health**

People's nutritional status, especially that of women and children, has deteriorated, due to decline in fish and pulse production. Also, in flood times the poor are the most hard hit nutritionally because their food consumption goes down seriously.

Family planning activities and health care facilities have been improved to some extent as a result of the improvement in road communications, but this seems to be only partly due to the BRE.

**Women**

The BRE has had some positive impact on women as it has increased employment opportunities for women in agricultural activities, especially in post-harvest operations. As a secondary effect of the project, better communication within the project area has facilitated increased female access to education, family planning and income generating activities.

Better communication has also helped in the extension of NGO and GO activities in respect of women's development.

However, occasional breaches in the BRE and river erosion not only affect crop production but also cause a lot of suffering for women. Day-to-day life, especially in terms of communication between places, household working pattern, drinking water availability and sanitation, becomes difficult. For the same reason sometimes women's groups are unable to continue with their activities.

**Social Impact**

The BRE has generated considerable unintended benefits as it has been commonly used as both a temporary and permanent shelter for flood affected people and animals. The BRE as well as the internal village roads connected to it have facilitated the developmental activities of the GO and NGOs in the Project area.

Improved communication on the embankment road networks has facilitated distribution of inputs and movement of goods and services to and from the Project area. It has also created some opportunities for income generating activities, especially for distressed women.

The BRE has had some positive impacts on employment creation through direct employment for the construction and maintenance of the original and retired embankments.

There has been a large loss of infrastructure and buildings due to severe river erosion in the post-Project period. There is no long-term investment in land, tree plantation, housing or business installations in the vicinity of the embankment.

Only partial payment has been made for the land acquired for the retired embankment and this has created dissatisfaction amongst the land owners.

**Environment**

The environmental impacts of the Project have been assessed with respect to physical, biological and human issues.

The project succeeded in protecting the area from Brahmaputra flooding in the initial years e.g. upto 1984, but the situation worsened since 1984 when major severe river erosion caused frequent breaches of the embankment leading to a series of retired embankments.

The increased sand deposition due to sudden inflow of flood water as a result of breaches has taken a large area out of rice cultivation, but some of these lands are now used for sugarcane cultivation.

The other main negative impacts include decrease in soil fertility, changes in soil physical properties, decline in capture fisheries, deterioration of social attitudes and failure to achieve institutional effectiveness.

## Economic Impact

The BRE Kazipur Reach has achieved a moderate increase in the incremental value of monsoon paddy production. However, because the Project also led to a loss of capture fishery, the Project yields an overall net negative economic return.

The project has had a positive impact through creation of substantial employment in the construction of the original embankment and construction and repair of the retired embankments. The project has also generated additional employment in the crop sector at an annual rate higher than the population growth rate.



The overall equity implications of the Project are not at all clear, although it appears that a substantial portion of the additional employment created in the construction, repair and maintenance of the embankment sections went to the poorer section of the population.

## Lessons

The delayed payment or non-payment of land compensation has created frustration amongst those who have lost land to allow the construction of the embankment. This complicated the acquisition of land and ultimately resulted in the late start of work, incomplete construction and wastage of money, manpower and administrative resources. One of the lessons is that the whole process of land acquisition, all the way from BWDB to the President's Secretariat via DLAC and Ministry of Land, should be subjected to review and reform.

The arrangements for embankment construction and maintenance by the BWDB seem unsatisfactory. Despite the fact that the embankment does not last or fails to protect the crops, life and property of the poor from flooding, disgruntled flood affected people told the RRA team members that a group of people - contractors, labourers, local influential individuals and in some cases officials, with access to political and other sorts of patronage, are skimming the flood control project through rent-seeking, deceitful acts and collusion. This is a delicate area no doubt, but the prevention of such tendencies is no less important than prevention from floods. Rather the former is a prerequisite for the successful implementation of the latter.

The most important lesson of all is that an embankment project with inadequate set-back on an erosion-prone reach of a major river is almost certain not to deliver the expected long-term benefits (due to short working life before being breached by erosion, and subsequent insecurity of retired embankments). Such an embankment cannot provide permanent stable conditions for development, and probably should not have been built.

# APPENDIX D

# PIE AND RRA RESULTS COMPARED

# APPENDIX D

# RRA AND PIE RESULTS COMPARED

## D1 INTRODUCTION

### D1.1 Background

The methodologies which FAP 12 set out to apply in the RRA and PIE surveys have been described in detail in the FAP 12 Methodology Report, and the experience of using those methodologies in the field is described in Chapter 2 in Volume 1 of the present report. Five of the seventeen projects surveyed during 1991 were covered by RRA before being surveyed by PIE methods. The pre-PIE RRAs were carried out in two rounds, Zilkar Haor and Meghna-Dhonagoda Irrigation Project being covered in the first round, and Kurigram South, Chalan Beel D and Kolabashukhali in the second round. The purpose of this Appendix is to compare the effectiveness of the two techniques, based on the findings for the five projects surveyed by both methods.

### D1.2 Limitations on Comparability

While it is believed that comparison of the RRA and PIE findings is valuable, its conclusiveness should not be overstressed, for several reasons. The RRAs of the projects selected for PIE study were, for reasons of overall study scheduling, the first RRAs to be carried out by the FAP 12 team. The consultant team was newly assembled and the majority of members had not participated in RRA before, so the pre-PIE RRAs had a substantial familiarisation and training element. Field procedures were being modified in the light of experience, and some important components of the matured FAP 12 RRA methodology, in particular the use of an Agricultural Assessment Matrix, were only adopted after the first round of pre-PIE RRAs; skills in using them were therefore still evolving when the pre-PIE RRAs ended. Any shortcomings in the effectiveness of the pre-PIE RRAs may therefore reflect their position in the FAP 12 work programme, rather than inherent characteristics of the methodology. It should also be borne in mind that staff availability dictated that some subject areas on some RRAs had to be covered by staff of other disciplines; these include livestock and environmental impacts (where three out of five pre-PIE RRAs were conducted by a stand-in) and fisheries (two out of five).

Over and above this limitation, the projects selected for eventual PIE study were (with the exception of Zilkar Haor) all large, with gross areas above 15 000 ha.. Clearly, it is not possible to cover projects of this size as intensively, in the same space of time, as those under 10 000 ha. which were the target of the main programme of PIEs. While the RRA teams in the pre-PIE rounds made a conscious effort to cover the range of variation present in the large projects, it is possible that some details were missed, especially as internal communication in some projects is poor and field team mobility was limited. These limitations do not apply to the Zilkar Haor RRA, which was on a project of just over 5 000 ha. gross area.

### D1.3 Scope of Comparison

The following sections of this Appendix compare the findings of the RRAs and PIEs on a subject-area basis. It should be noted, however, that investigations in several key areas covered by FAP 12 were studied *only* by RRA, since they were not suitable for the sample

survey methodology used in the PIEs. These include assessment of the planning, design and construction of the projects, assessment of their operation and maintenance and of their institutional performance, and appraisal of their ecological impacts. It should be borne in mind, therefore, not only that no comparison of the techniques is possible for these areas, but also that data collection by PIE methods cannot cover a comprehensive range of topics, and must be supplemented by RRA-like studies of the areas not amenable to sample survey methodology. Even in the areas amenable to sample survey, some impacts may require data from outside the sample for their accurate measurement.

In addition to the subject areas which were covered only by RRA, some areas which were covered by the PIEs were not covered, in full or at all, by the pre-PIE RRAs due to lack of methodological development and/or specialist staff. The most important of these is the gender impact of projects, since FAP 12's female specialists in women's issues did not join until the main RRA programme. Taking account of all the limitations on comparability, the subject areas covered in this Appendix have therefore been restricted to agriculture, livestock, fisheries and socio-economic issues.

## D2 AGRICULTURE

### D2.1 Comparability of RRA and PIE Estimates

The RRAs assessed the project impacts on a time-series (before and after) basis, the implicit assumption being that in the absence of project intervention conditions would have remained essentially static. While the rural economy in Bangladesh is in a state of constant change, the assumption that pre-project conditions are equivalent to without-project conditions is less unrealistic than might at first appear, at least so far as monsoon season agriculture is concerned. This is because the main avenues of potential change involve introduction of higher-yielding types of paddy, which require shallow and stable water levels, and these conditions are only likely to be produced by the types of intervention found in FCD projects.

Where the assumption breaks down is in dry season agriculture, since although some FCD projects have irrigation components, there demonstrably exist viable alternative irrigation strategies which in many cases could have been introduced without an FCD project. The RRA approach is on safer ground, however, when it can be shown that dry season cropping development could not have taken place without flood protection, either for the maturing crop at the end of the season, or for the irrigation facilities themselves (the motors of electrically powered deep tubewells, for example).

The PIEs, in contrast, attempted to explicitly account for changes subsequent to, but independent of, project intervention, by comparing the impacted area of each project with a control area. As noted in Chapter 2 (Volume 1) of this report, this approach also is not without problems, since finding an undisturbed control which is strictly comparable with the impacted area is not easy. Assuming a good control is found, however, one test of the effectiveness of the RRA approach would be how closely the pre-project parameters estimated by the RRA match the without-project parameters estimated by PIE for the control area. The second test for RRA performance is, naturally, the match between the RRA and PIE estimates of parameters for the impacted area post-project.

The number of parameters estimated even by the RRAs was considerable, so the analysis here is confined to two key indicators, overall paddy yield, and the proportion of area occupied by HYVs. Table D1 summarises the relevant estimates from the RRAs and PIEs.

**Table D1 Comparison of RRA and PIE Estimates of Agricultural Parameters**

| Project | Without (pre) Project Paddy Yield mt/ha | | With (post) Project Paddy Yield | | Without (pre) Project % HYV | | With (post) Project % HYV | |
|---|---|---|---|---|---|---|---|---|
| | RRA | PIE | RRA | PIE | RRA | PIE | RRA | PIE |
| Chalan Beel D | 2.42 | 2.69 | 2.92 | 2.88 | 5.5 | 47.1 | 50.8 | 35.8 |
| Kurigram S | 1.75 | 2.19 | 1.97 | 2.84 | 8.7 | 20.4 | 71.6 | 28.1 |
| Meghna-Dhonagoda | 2.4 | 2.5 | 4.2 | 4.4 | 16.6 | 14.2 | 90.0 | 78.5 |
| Zilkar Haor | 1.76 | 1.04 | 2.20 | 2.08 | 6.2 | 1.7 | 30.0 | 22.1 |
| Kolabashukhali | 2.5 | 1.00 | 2.4 | 1.71 | 0 | 2.8 | 3.8 | 7.9 |

Source: FAP 12 RRA and PIE surveys

## D2.2 Comparison of Yield Estimates

In the case of the MDIP RRA the match for both pre- and post-project estimates of paddy yield was good, but the caveat must be entered that the data collected in the field were supplemented with data from the pre-project benchmark survey (CIRDAP 1987) and from BWDB extension workers' records for the post-project situation. Although use of existing sources is an integral part of RRA, the MDIP RRA team was fortunate in the number and quality of its sources.

Of the remaining RRAs, for Chalan Beel, Kurigram and Zilkar Haor the pre- and post-project comparison matches the direction of the with-without difference estimated by the relevant PIEs, but the magnitude of the estimated yields differs considerably, those for Zilkar Haor being overestimated and for Kurigram underestimated, while for Chalan the pre-project yield estimate is lower than the PIE without-Project estimate and the post-project estimate is higher than the with-project PIE estimate. Further, in all three cases the difference between the pre- and post-project yields - a more important quantity than the absolute magnitude for evaluation purposes - is also a poor match with the PIE estimates, being overestimated for Chalan Beel and underestimated for Kurigram and Zilkar Haor.

In the final RRA, Kolabashukhali, the RRA team felt no confidence in statements of pre-project yields, which were persistently alleged to have been higher than post-project yields, and arbitrarily assumed pre-project yields to have been the same (apart from the influence of minor cropping pattern changes) as the estimated post-project levels. However, the RRA estimate of post-project yield was itself a considerable overestimate.

JAMUNA RIVER

River Bank-1988

River Bank-1990

River Bank 1988

River Bank 1990

M-85

M-90

M-95

BRE-1968

Chak Singrabari

KAZIPUR

Meghal

Retd BRE

Dhekuria

Paranpur

River Bank

Retd. BRE(Under Construction)

Kunkunia

Court & Hospital

Kabihat.

KAZIPUR UPAZILA H.Q.

Beora

Beripatal

Singrabari

Alampur.

Boraitala

Gandail

Subhagachha

Ratankandi

Sorfali Bazar.

Jhunkail

Sluice

Sluice

Eraded BRE

River Bank

Retd BRE(Partly Eroded)

Retd BRE (Under Construction)

Jalalpur Baaitola

Sluice

TO SERAJGANJ

Kurulia

Chalitadanga

Satkaya

Barsibanga

Rauhabari

Sanamukhi

Kachihara

Lichamati Nadi

Bhanudanga

TO DHUNAT

LEGEND:-

Embankment

R R A. Boundary

River / Khal

Bridge

Pucca Road

Earth Road

Sluice on Orignal B R E.

Foot path

Scale : 1 : 50,000

0 1 2 3 4 Miles

0 1 2 3 4 5 Km.

# BRE KAZIPUR REACH
# SERAJGANJ

### D2.3 Comparison of Area Estimates

For estimates of proportion of area under HYV paddy, MDIP and Kolabashukhali show a quite close match between PIE and RRA, although in the case of Kolabashukhali the quantities involved are small. For Kurigram and Zilkar Haor, the RRA estimates match the PIEs in direction of change, and for Zilkar Haor the magnitude of change is also quite close even though the absolute magnitudes are not. In Kurigram the RRA area estimates relied heavily on data supplied by the local DAE offices and the post-project estimate of HYV proportion is clearly spurious, though it should be noted that both the RRA and a subsequent FAP 12 environmental appraisal team felt that the PIE had underestimated the area of HYV Aman. In Chalan Beel the RRA team also used DAE data for post-project area estimates, and the resulting estimate of change in area is actually in the opposite direction to that given by the PIE.

### D2.4 Summary of Agricultural Results

Although the preceding discussion is based on only two parameters, the pattern is clear. Except when excessive reliance was placed on DAE statistics (which are always suspect because they are originally compiled by the Block Supervisors on whose performance they reflect), the RRAs reliably detected the direction of change in agricultural indicators. Estimates of the magnitude of change were less reliable, but it should again be noted that the techniques of quantification of RRA data were still being developed when these data were collected. In this regard, the Kolabashukhali results on area estimation, the first in which the Agricultural Assessment Matrix approached was used, are encouraging. There is cause for caution, however, in the failure to achieve a useful yield estimate in the same project, which probably indicates a need for more thorough triangulation.

## D3 LIVESTOCK IMPACTS

The RRAs assessed project impact on livestock as uniformly negative, with declining herd sizes, at least for the bovines which dominate the livestock economy. This picture was built up from group and individual interview responses, and was accepted on the basis of its agreement with *a priori* reasoning on the impacts of successful FCD development on grazing availability (expected to be reduced by increased cropping intensity) and the feeding value of crop residues (also reduced by the low digestibility of HYV straw and the replacement of pulse crops by paddy). The RRAs did not, however, attempt to measure actual herd sizes except in an impressionistic way.

Livestock data in the PIEs were gathered from the same sample of households which provided the agricultural data, though since not all households own livestock, the livestock findings were inevitably based on a smaller sample size. Data were collected on stock numbers, with a basic age/sex breakdown in the case of bovines. Table D2 compares the RRA and PIE estimates for change in bovine herd size.

**Table D2 RRA and PIE Estimates of Change in Bovine Herd Size**

| Project | RRA | PIE |
|---|---|---|
| Chalan Beel D | -25% | +ve |
| Kurigram South | +ve | -ve |
| Meghna-Dhonagoda | nil | +ve |
| Zilkar Haor | -15%[1] | -ve |
| Kolabashukhali | -25% | +ve (small) |

Source: FAP 12 RRA and PIE surveys

Notes: [1] Production estimate; herd size not estimated.

Only in Zilkar Haor is there reasonable agreement between the RRA and PIE findings, a considerably worse performance than achieved for agricultural parameters. The reason may be that, unlike monsoon season agriculture (see above), livestock keeping has been subject to continuing trends which are largely unrelated to FCD interventions. The continuing rise in human population pressure on land resources has resulted in the cultivation of all land which can grow a food or cash crop, and this must long ago have eliminated most grazing land during the Aman season. The conspicuous development of the 1980s, however, was the intensification of irrigated cropping in the dry season, a development which is only in small part due to FCD measures, but which will have increased the year-round pressure on livestock feed resources.

The lesson of the RRA livestock estimates is therefore that no general model can be applied, and that RRAs which attempt to do so are unlikely to produce useful data. The route to successful use of RRAs for livestock data would seem to be through careful triangulation and development of aids to quantification of the type used successfully for agricultural variables.

## D4 FISHERIES

Fishery data in the RRAs were obtained by group interview of fishermen and fish traders. The conclusions which could be drawn from these sources were seldom more than an indication of the broad magnitude of fishery impacts. They were supplemented by drawing on local Department of Fishery data where available, but these are normally organised by administrative subdivisions, which seldom coincide with project boundaries. Resort was therefore had in some cases to standard coefficients for fisheries impact drawn from MPO, 1987, and this practice was adopted as standard in the main RRA programme unless exceptional local circumstances made it clear that the standards were not applicable.

The PIE fisheries data were obtained from small purposively selected samples of fishermen and traders in the impacted and control areas for each project, using a formal questionnaire interview, but it was again found that it was difficult to draw firm conclusions from the answers about the total fisheries impact of a project. This may be due to the inherent

difficulty of segregating project impact on a resource which is based on a much more extensive area than the individual FCD project. It is likely, for example, that fishermen in the impacted and control areas of several of the projects studied were fishing essentially the same stocks, and that any differences observed are therefore due to non-project factors. The estimates of fishery impacts used in the PIEs were therefore again based on a refined version of the standard coefficient approach, taking account of the proportion of different types of water bodies in each project area, although they were calibrated as far as possible with the data obtained both from the RRAs and questionnaire surveys.

The results obtained by these varying approaches for project impacts on capture and culture fishery output are shown in Table D3.

**Table D3 RRA and PIE Data on Fishery Impacts**

| Project | Capture Fisheries | | Culture Fisheries | |
|---|---|---|---|---|
| | RRA | PIE | RRA | PIE |
| Chalan Beel D | -60% to 75% | -1874 to -2514 mt./yr | +ve | +431 mt/yr |
| Kurigram South | -ve (large) | -331 to -391 mt/yr (small) | +ve (small) | +240 mt/yr |
| Meghna-Dhonagoda | -ve (large) | -506 to -584 mt/yr | +ve (very small) | +132 to +160 mt/yr |
| Zilkar Haor | -25% to 30% | -117 to -153 mt/yr | +ve | +10 to +24 mt/yr |
| Kolabashukhali | -525 mt/yr | -322 to -456 mt/yr | +ve | +ve |

Source: FAP 12 RRA and PIE surveys

While the RRA estimates of fishery impacts are all in the same direction as the PIE estimates, the magnitudes differ considerable in some cases. In Chalan Beel, Zilkar Haor and Kolabashukhali the RRAs and PIEs produced similar estimates of impact, but in the case of Kurigram and Meghna-Dhonagoda the RRAs estimated much larger negative impacts than the PIEs. This may have been in part due to uncritical acceptance of a standard model of fishery impact (both RRAs were conducted by non-specialists), though in the case of MDIP the baseline study (CIRDAP 1987) also indicated heavy losses. In both Kurigram and MDIP, also, the RRA estimates of impact on culture fisheries were revised upward in the PIEs, which were analysed by fishery specialists.

One of the main lessons of FAP 12 is, therefore, the limitations of techniques developed basically for agricultural and socio-economic survey, when applied to fishery investigations. While the RRA and PIE estimates of impact are in broad agreement, this is largely because they are both based to a considerable extent on *a priori* reasoning, albeit verified by interview data. A second lesson is that, where an informed opinion is required on

a highly specialised subject such as fisheries, the participation of a fully trained specialist is essential.

## D5 SOCIO-ECONOMIC ISSUES

Project impact on the socio-economic parameters of the study areas was approached from several different angles by both RRAs and PIEs, and one of the most important methodological lessons from FAP 12 is the essentially complementary nature of the two approaches in this subject area.

### D5.1 Distributional Impacts

Because of the time limitations on the RRA surveys it was not possible to set up as many group interviews focused on specific socio-economic groups as would have been desirable (although, for example, the MDIP and Kurigram RRAs both included group interviews with landless labourers). The RRAs were therefore less effective than the PIEs in distinguishing the distributional impacts of projects *within* broad socio-economic groups - for example, whether small farmers or landless labourers benefited from agricultural changes to the same extent as large farmers.

The RRAs were however able to distinguish distributional impacts *between* the main socio-economic groups, for example between farmers on the one hand and open-water fishermen or boatmen on the other. The major exception during the pre-PIE RRAs was assessment of gender impact, since the sole female professional with FAP 12 at that stage of the study was an agriculturalist whose primary attention had to be given to her own discipline.

Post-intervention tracking of members of disadvantaged groups is notoriously difficult, and the main PIE samples in general did not produce many respondents from groups such as fishermen and boatmen which were known from the RRAs to have suffered forced occupational changes. In this respect the less structured RRA approach was superior to the formal sampling of the PIEs, in that it did produce interviews with members of disadvantaged groups and anecdotal information on the fate of such groups.

### D5.2 Conflict Identification

In a number of cases the distributional impacts of the projects studied were sufficiently marked as to generate social tensions and even conflict, particularly between farmers inside and outside the projects, and between farmers and fishermen or boatmen. The RRAs were successful in detecting such conflicts (for example between insiders and outsiders at Chalan Beel D, and between fishermen and farmers at Zilkar Haor) and were indeed better at probing for their causes than the PIEs. This is an area where the complementarity between the techniques is especially marked. The PIEs did, however, successfully obtain responses on attitudes towards the projects, including the incidence of dissatisfaction and feuds within the impacted villages resulting from project construction and operation.

## D6 ECONOMIC REAPPRAISAL

Economic reappraisals have been conducted on the basis of two of the five pre-PIE RRAs, those for MDIP and Kolabashukhali. These reappraisals used RRA data on crop areas and input-output coefficients, and used standard estimates of capture fishery losses drawn from MPO, 1987. Data for the cost streams were derived from basically the same sources (BWDB and donor PCRs, and BWDB O&M cost updates) as those used for the PIE economic reappraisals, though in general with less detail and sometimes with earlier approximations to some cost items.

The RRA estimate of EIRR for MDIP was 5 per cent, compared with 7 per cent from the PIE, while EIRR for Kolabashukhali was 17 per cent, compared with 26 per cent from the PIE. In the case of MDIP, the closeness of the estimates is clearly based on the good RRA estimates of key agricultural parameters (see Section D2 above).

For Kolabashukhali, unfortunately, the convergence appears to be due to the compensating effects of the poor RRA yield estimates in the peculiar circumstances of the particular project. The agricultural impact of Kolabashukhali (as attested by both RRA and PIE) is distinctive in that there has been little change in cropping pattern, but a significant increase in cultivable area. Using the PIE yield estimates, which show a rather low overall levels but a significant yield difference between project and control, the bulk of the agricultural benefits come from yield increases on the pre-project cropped area. Using the RRA yield estimates, however, which are higher but show no difference between pre ('without') and post ('with') project levels, the effect of the increase in cropped area nevertheless generates a large benefit stream. In a more typical project, where the 'reclamation effect' was not present, the RRA yield estimates would have led to serious under-estimation of benefits.

## D7 CONCLUSIONS

The comparison of FAP 12 PIE and RRA results is less than fair to the RRAs, in that they were undertaken at an earlier stage in the work programme than the PIEs (and indeed were specifically intended as a reconnaissance for the PIEs) and by teams short of practical experience in the technique and using methodology which was still being adapted to the particular requirements of the study. However, this may be a reasonable approximation to the typical initial conditions for a programme of RRA surveys, and the FAP 12 experience can thus be taken as a minimum standard which can be (and, the FAP 12 team believe, was) improved upon over time.

The comparison of RRA and PIE results indicates that, with care, measurement of the direction of key agricultural impacts can be dependably achieved by RRA (see Section D2). RRA results for the magnitude of such impacts are somewhat more variable, and the implications of varying estimates, especially of yields, may be critical to the outcome of an economic reappraisal. However, before judging the RRAs too harshly, it should be noted that the comparisons made in Section D2 are against the point estimates from the PIEs, which are merely the most likely single values from within a probability range. In many cases sensitivity analyses based on the probabilistic variation in the PIE results would include the results given by the RRAs.

The outcome of the comparison in the case of fisheries and livestock data is less encouraging, though not necessarily such as to indicate that PIE is superior to RRA. In both

cases there are trends over time which owe nothing to project interventions and which have a confounding effect on RRA findings using pre- and post-project comparisons. Use of control areas in RRAs might improve the situation for livestock impacts, but even this is not likely to help much for capture fisheries. The inherent mobility of wild fish stocks, and especially the interdependence of spawning and growing areas for some of the most important species in Bangladesh, means that measurement of impacts at the individual project level may not be a viable approach. This conclusion is reinforced by the fact that FAP 12 had to resort to substantially similar approaches, drawing on non-survey information, for quantification of capture fishery impacts in both the RRAs and the PIEs.

In the case of socio-economic data, comparison of RRA and PIE findings is difficult, since variables approachable by one method are generally not well suited to the other. The conclusion here is that RRA and PIE are essentially complementary techniques, to be employed in combination as circumstances dictate. In general, RRA is superior as a probing technique and for investigation of social interactions and conflicts. It is less effective, at least in the form used by FAP 12, in quantifying the detailed distributional impacts of projects.