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 13
OPERATION AND MAINTENANCE STUDY

FINAL REPORT

VOLUME 2
Case Studies

March 1992

Hunting Technical Services Limited

in association with:

Flood Hazard Research Centre
Technoconsult International Limited

under assignment to
UNITED KINGDOM OVERSEAS DEVELOPMENT ADMINISTRATION

Sanyu Consultants Inc.

under assignment to
JAPAN INTERNATIONAL CO-OPERATION AGENCY

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
Khatakhali Khal
Halir Haor
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 (2 Volumes)

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

INTRODUCTION

PROJECT BACKGROUND

Hunting Technical Services Limited (HTS) has been engaged by the United Kingdom Overseas Development Administration (ODA) to provide consultancy services to the Government of Bangladesh for Component 13 of the Flood Action Plan, the Operation and Maintenance Study. Support for this FAP component is also provided by the Japanese International Cooperation Agency, which has contracted Sanyu Consultants Inc. to provide consultancy support.

FAP 13 is one of the supporting studies to the Bangladesh Flood Action Plan. The FAP 13 team includes institutions and engineering specialists from Middlesex Polytechnic Flood Hazard Research Centre, Sanyu Consultants Inc., and Technoconsult International Limited of Bangladesh. Although the study for FAP 13 is a separate component of the Flood Action Plan it is closely linked with FAP 12, the FCD/I Agricultural Study. In particular the two studies share a common core of fieldwork and all the team working on FAP 13 are involved in at least part of the work under FAP 12.

STUDY OBJECTIVES

Based on FAP 13's Terms of Reference, which are given in Annex A of the companion volume to this Report (FAP 13 Final Report, Volume 1) there are three main aims of the study:

- to identify the main constraints on effective operation and maintenance (O&M) of FCD and FCDI projects in Bangladesh;
- to draw up guidelines for ways of overcoming these constraints, both for existing projects and for new ones under FAP; and
- to recommend ways of maximising participation of beneficiaries and of mobilising local resources for O&M.

A further aim is to prepare, on the basis of the studies undertaken in 1991, a work programme for years 2-5 which will continue to review progress in O&M of FCD/I projects and will take up specific topics for study.

The particular focus of the study is to provide guidance for the O&M of any new projects or project types which may be taken up under the Flood Action Plan, although it is also expected to be relevant to existing projects.

APPROACH ADOPTED

There are three main components of the study:

i. assessment of O&M performance and constraints in completed BWDB FCD/I projects;

ii. review of O&M experience in Bangladesh; and

iii. review of O&M experience in other countries.

Details of the methodology used are given in the FAP 12 Methodology Report, and in Annex B in Volume 1 of the FAP 13 Final Report. A brief summary of the approaches adopted is given below.

Assessments of O&M

The key component of the O&M study has been detailed evaluation of O&M performance in 17 FCD/I projects selected for joint evaluation with FAP 12 (in fact there are 16 projects, but for one - the Brahmaputra Right Embankment - assessments have been carried out in two reaches). This has been based on a Rapid Rural Appraisal (RRA) methodology using multidisciplinary teams from FAP 12 and 13. The 17 projects were selected in consultation with the Flood Plan Coordination Organisation (FPCO) and the FAP Regional Studies. They are representative of the different O&M experiences in BWDB projects since they cover projects in all the FAP regions and a range of project types, flood hazards, and ages. Their locations are shown in the location map on page iv of this report.

The O&M assessments used checklists covering engineering and institutional aspects of O&M (see Annex B, Volume 1). The emphasis of the case studies was on identifying the key impacts of the projects and how the projects affected different 'sectors' such as agriculture and fisheries, and the reasons for differences between intended and actual impacts, such as O&M. Hence the assessments linked planning, design and construction, and O&M, with qualitative and semi-quantitative assessment of benefits and disbenefits.

Following the initial RRAs, return visits were made to a number of projects, mainly the five projects investigated in more detail using Project Impact Evaluation methods (Chapters 1-5 of this report). The follow up visits were to expand on the engineering and O&M aspects, to monitor any changes during the 1991 flood season, and to assess project performance during the period of maximum stress on FCD facilities.

Review of O&M in Bangladesh

BWDB is the main agency concerned with FCD/I projects in Bangladesh and is responsible for their O&M. Hence this part of the study has concentrated on current practice in BWDB (the case studies were also most revealing on this), and particularly on the intentions and experience to date of a number of projects which include measures to strengthen and improve O&M in BWDB either through rehabilitation of existing projects or as part of implementing new projects.

However, BWDB is not the only agency active in water management and earthworks in Bangladesh. In particular the Local Government Engineering Bureau (LGEB), through the Upazilas, is active in small water management schemes and rural roads and structures, and there have been directives that small-medium sized FCD/I projects should be handed over to LGEB. Hence the O&M strategies it has adopted have also been investigated.

International O&M review

In keeping with the TOR a short literature review of experience and innovations in O&M and water management in other countries, particularly in south and south-east Asia, has been undertaken. Much of the experience is in irrigation rather than Flood Control and Drainage (FCD) projects, but nevertheless some lessons can be drawn which appear to be relevant to Bangladesh and the Flood Action Plan.

REPORTING

This report presents a detailed assessment of O&M in each of the 16 projects studied (with a joint assessment for the two sections of BRE studied), along with brief details of the project facilities and project impacts. These assessments are based on the RRAs and later follow-up visits. Some key lessons for O&M are drawn in each case study. The overall results of the case studies, and their integration with the other aspects of FAP 13, are presented in Chapter 3 of the companion volume. Full details of the impacts of the same projects are given in the FAP 12 RRA and PIE reports.

The sections of this report covering the individual projects follow a standard layout. For each project there is a summary sheet, a project map, background information, project facility details, a summary of project impacts, separate assessments of operation and maintenance, and finally notes on the lessons for improving O&M in future FCD/I projects.

An earlier version of this report was presented and discussed, along with its companion volume, at a joint FAP 12/13 Workshop on 10-11 August 1991.

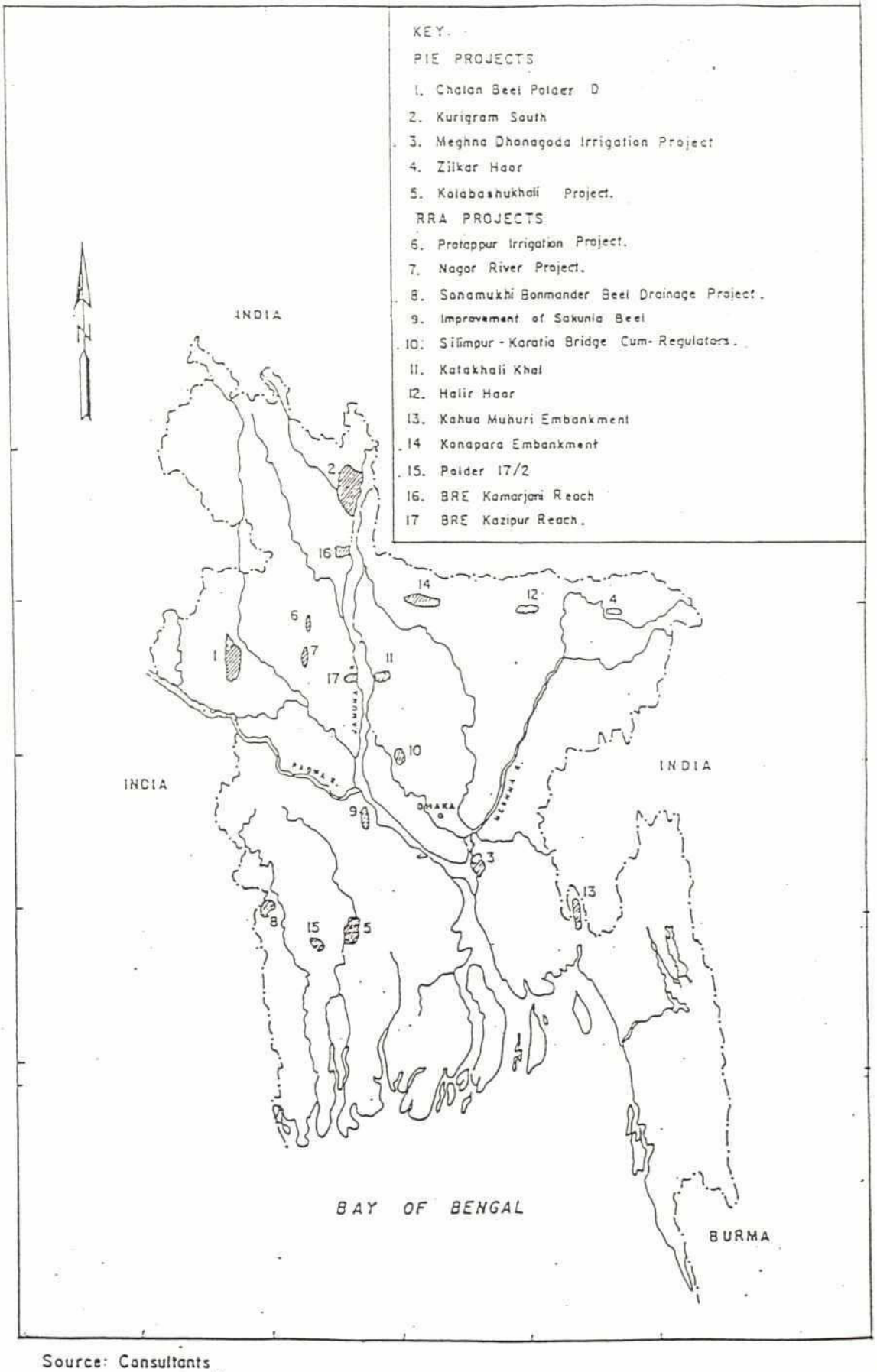
ACKNOWLEDGEMENTS

This study has depended heavily on the RRAs undertaken jointly with FAP 12. These would not have been possible without the assistance of a large number of BWDB officers of all ranks who discussed with the team the O&M situation of their projects. In addition we are grateful to officers of the Upazilas visited and to the many people operating or affected by FCD/I projects who shared their time, experiences and problems with the team.

This study has also benefited from discussions over the year with senior BWDB staff in Dhaka and the zones, and with the officials and consultants working on projects with improved O&M components: System Rehabilitation Project (Netherlands and European Community components), Second Small Scale Flood Control Drainage and Irrigation Project, Local Government Engineering Bureau, Delta Development Project, Early Implementation Project, Land Reclamation Project, Ganges Kobadak Rehabilitation Project, BWDB O&M Cost Cell, CARE, ESCAP Bangkok, and International Irrigation Management Institute (Bangladesh representative). We are grateful to these projects for showing the team around some of their projects.

The study benefited from the many comments received from those attending the FAP 12/13 workshop during August 1991, and from comments on the Draft Final Report received during the review process in November 1991. Comments from and liaison with a number of FAP components over O&M issues has also been important: notably FAPs 1, 2, 3, 5, 6, 15, 20, 23, and 25. The study has been undertaken effectively as a joint project with FAP 12. We are particularly grateful to FPCO and to all members of the FAP Panel of Experts for their continued guidance and valuable suggestions.

Location of Selected PIE and RRA Projects



Source: Consultants

REFERENCES

BWDB (1981): **Project Proforma on Improvement of Sakunia Beel in P.S. Kotwali and Nagarkanda.** BWDB, Faridpur.

BWDB (1985): **Project Completion Report on Improvement of Sakunia Beel in P.S. Kotwali and Nagarkanda.** BWDB, Faridpur.

BWDB (1986): **Project Completion Report: Construction of a regulator-cum-bridge on Katakhali Khal in Upazila Sarishabari, District Jamalpur**. Tangail O&M Division, Tangail.

EIP (1980a): **Recommendations for Projects of the 1980-1981 Programme: Katakhali Khal.** Netherlands Technical Assistance Programme, Dacca.

EIP (1980b): **Recommendations for Projects of the 1980-1981 Programme: Gangrail closure - Polder 17/2.** Netherlands Technical Assistance Programme, Dacca.

EIP (1988): **Nagor River Basin Study - Final Report**. EIP, Dhaka.

EIP (1990): **Report of the Mission on Operation and Maintenance of Early Implementation Projects**. Directorate of Planning Schemes IV (EIP) BWDB, Dhaka.

FAO (1988): **Land Resources Appraisal of Bangladesh for Agricultural Development**. Report 5 Land Resources. Volume II3 Land Resources Map and Legend Naogaon-Namalganj-Nator-Rajshahi. UNDP/FAO, Rome.

IBRD (1978): **Staff Appraisal Report: Kholabashukhali Flood Control and Drainage Project**. World Bank, Dacca.

IECO (1964): **Master Plan**. EPWAPDA, Dacca.

Leedshill de Leuw (1967): **Coastal Embankment Project Operation and Maintenance Manual.** EPWAPDA, Dacca.

Naqi, S.A. (1980a): **A socio-economic evaluation of Katakhali Khal project**. Department of Sociology, Dacca University, Dacca.

Naqi, S.A. (1980b): **A socio-economic evaluation of Konapara Embankment project**. Department of Sociology, Dacca University, Dacca.

Planning Commission: (1988) **Project Proforma on construction of a regulator-cum-bridge on Katakhali Khal in Upazila Sarishabari, District Jamalpur.** BWDB, Dhaka.

Thompson, P.M. (1990): **The Impact of Flood Control on Agriculture and Rural Development in Bangladesh: Post-evaluation of the Chandpur Project.** Middlesex Polytechnic Flood Hazard Research Centre, Enfield, London.

ABBREVIATIONS AND GLOSSARY

ADB	Asian Development Bank
Aman	Main monsoon season paddy crop
Aus	Late dry season/early monsoon paddy crop
BADC	Bangladesh Agricultural Development Corporation
Boro	Winter (dry) season paddy crop
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
BRE	Brahmaputra Right Embankment
bund	Earthen embankment
BWDB	Bangladesh Water Development Board
CE	Chief Engineer
CEP	Coastal Embankment Project
CFE	Cash Foreign Exchange Budget
CIDA	Canadian International Development Agency
CIP	Chandpur Irrigation Project
crore	Ten million (10,000,000)
CTA	Chief Technical Adviser
DAE	Department of Agricultural Extension
DB	Development Budget
DDP	Delta Development Project
DOF	Department of Fisheries
DTW	Deep tube-well (with positive-displacement pump)
EC	European Economic Community
EIP	Early Implementation Project(s)
EPWAPDA	East Pakistan Water & Power Development Authority (see WAPDA)
ERD	External Resources Division
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organisation
FAP	Bangladesh Flood Action Plan
FCD	Flood Control and Drainage
FCDI	Flood Control Drainage and Irrigation
FCD/I	FCD (see above) with or without Irrigation
FFW	Food For Work
FHRC	Flood Hazard Research Centre, Middlesex Polytechnic
FPCO	Flood Plan Coordination Organisation
FY	Financial Year
gher	Bunded area of saline water for shrimp cultivation
ghog	Animal burrow in embankment
GK	Ganges-Kobadak Irrigation Project
GOB	Government of Bangladesh
GON	Government of the Netherlands
HTS	Hunting Technical Services Limited
HYV	High yielding variety
IBRD	International Bank for Reconstruction and Development (World Bank)
IDA	International Development Agency (World Bank)
IDP	Infrastructure Development Programme (LGEB)
IETC	Irrigation Extension Training Centre (BWDB)
ILO	Intermediary Level Organisation (of SRP Water Management System)
IOM	Improved Operation and Maintenance
IRWP	Intensive Rural Works Programme
ISP	Institutional Support Programme (LGEB)

JICA	Japan International Cooperation Agency
KBK	Kolabashukhali Project
KIP	Karnaphuli Irrigation Project
khal	Natural channel/minor river/tidal creek
khalashi	'Cleaner' (actually guard) of regulator/sluice
kutcha	Locally made, not manufactured; earthen (of roads, structures)
lakh	Hundred thousand (100,000)
LCS	Labour Contracting Society
LGEB	Local Government Engineering Bureau
LLP	Low Lift Pump
LPC	Local Project Committee
LRP	Land Reclamation Project
maund (md.)	37.3 kg.
mouza (mauza)	Revenue village (may comprise several physical settlements)
MDIP	Meghna-Dhonagoda Irrigation Project
MEU	Mechanical Engineering Unit (BWDB)
MIP	Muhuri Irrigation Project
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
MOF	Ministry of Finance
mt.	metric tonne (1,000 kg., 2,204 lb.)
MPO	Master Plan Organisation
NGO	Non-governmental Organisation
O&M	Operation & Maintenance
O&MCC	Operation & Maintenance Cost Cell (CIDA/BWDB)
ODA	United Kingdom Overseas Development Administration
OFD	On Farm Development
Parishad	Elected council (e.g. of Upazila or Union)
PC	Planning Commission
PEP	Production Employment Programme (of BRDB, q.v.)
PIE	Project Impact Evaluation
PMU	Project Management Unit (BWDB)
PP	Project Proforma
PWD	Public Works Datum
RESP	Rural Employment Sector Programme
RHD	Roads and Highways Department
RMP	Rural Maintenance Programme (CARE)
RRA	Rapid Rural Appraisal
SDE	Sub-Divisional Engineer (BWDB)
SE	Superintending Engineer (BWDB)
SO	Section Officer (BWDB)
SRP	System Rehabilitation Project
SSDFCP	Small Scale Drainage and Flood Control Project
SSSFCDIP	Second Small Scale Flood Control Drainage and Irrigation Project
STW	Shallow tube-well (with suction pump)
TOR	Terms of Reference
Union	Administrative level below Upazila (q.v.), typically 10 per Upazila
UNO	Upazila Nirbahi Officer (principal staff officer of Upazila Parishad)
Upazila	Administrative unit above Union & below Zila (460 Upazilas in Bangladesh)
USAID	US Agency for International Development
WAPDA	Water & Power Development Authority (precursor of BWDB)
WFP	World Food Programme
XEN	Executive Engineer (BWDB)

CONTENTS

Tables

Figures **Page**

Figures

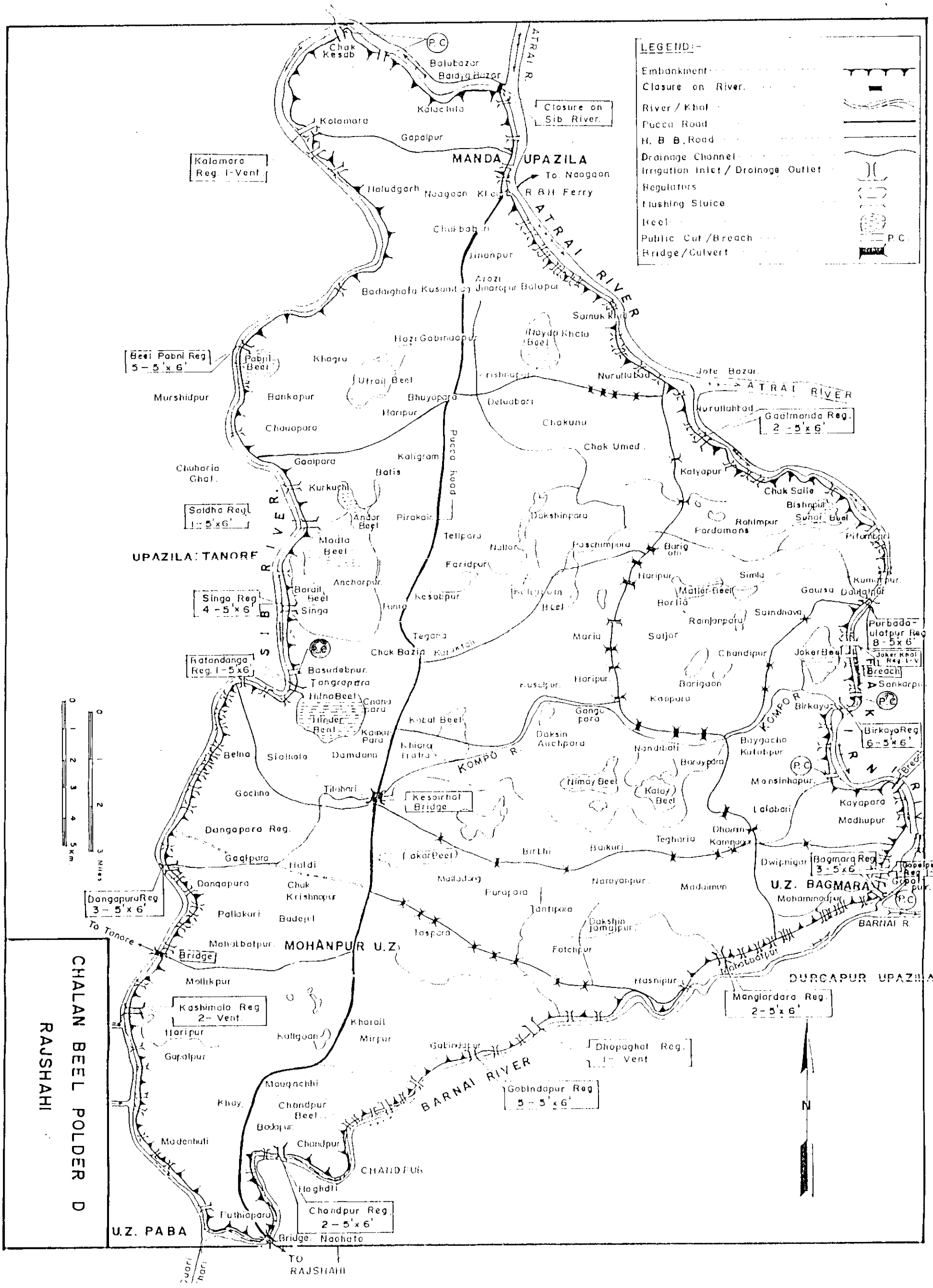


Figure 1.1 Chalan Beel Polder D showing locations visited and key features

1. CHALAN BEEL POLDER D

1.1 PROJECT BACKGROUND

1.1.1 Project Summary Sheet

Project Name	: Chalan Beel Polder D
Project Type	: Flood Control, Drainage and Irrigation
Location	
FAP Region	: North-West
District	: Rajshahi and Naogaon
Area (ha.)	: 53,055 ha.(gross), 37,235 ha. (net cultivable)
Funding Agency	: IDA
Implementing Agency	: BWDB
Construction started	: 1981/82
Scheduled Completion	: ?
Actual Completion	: 1988/89
Original Cost Estimate	: Tk. 285.0 million (1982)
Final Cost Estimate	: Tk. 342.4 million (1991 prices)
Major Flood Damage	: 1986, 1987, 1988
Repair/rehabilitation	: 1987/88 to present

Recurrent problems of public cuts and breaches

1.1.2 Background

Chalan Beel Polder D is one of many embankment projects in the general Chalan Beel-Atrai Basin area in north-west Bangladesh. The project area includes the whole of Mohanpur and parts of Bagmara, Tanore and Paba Upazilas in Rajshahi district and a part of Manda Upazila in Naogaon district.

Polder D is enclosed by the river Atrai and its distributary, the Fakirni, on the eastern side. The river Sib, which originated from the Atrai, but now has a closure at Baidya Bazar and later renamed river Barnai when it turns east defines the western and southern limits (Figure 1.1).

Much of the area of Polder D, prior to the construction of the embankment, used to be inundated every year due to annual flooding. The pre-project flooding depths indicate more than one-half of the area was submerged up to a maximum of 1.52 meters (5 feet), most of it covering the southern part of the area. Another 25 per cent of the area with pre-project submergence of up to 0.9m (3 feet) lies at the north-eastern side, mainly along the river Atrai. Very low-lying areas including perennial water bodies are scattered all over the polder but are more concentrated in the north-western and south-eastern parts of the project.

Farmers in the project area adjusted their cropping patterns to regular flooding. B. Aman which is low-yielding has been the major crop. Floods obviously caused some damages to crops and property from time to time. The project objective as defined in the Feasibility Report was to reduce crop damage and increase cropping intensities and crop-yields. The construction of a flood protection embankment and water control structures, drainage improvements, provision of supplementary irrigation facilities, and provision of agricultural extension services were all expected to contribute to such impacts. Consequently a 1-in-100 year flood protection embankment with a length of 132.28 km has been designed and constructed.

The project, as planned and implemented, is not a multisector one, as it was justified as an agricultural development project. It must be mentioned, however, that at least in three aspects the Feasibility Report sounded sometimes rather severe warnings of potential adverse impacts. These related to ground water hydrology, fisheries and the livestock situation in the project area. Unfortunately these were either not heeded or brushed aside with a single-minded pursuit of 'development' of crop agriculture.

1.2 PROJECT AS IMPLEMENTED

A key point in understanding the polder is that although there is an encircling polder embankment, there is a varied topography in the project involving some four agro-ecological zones, rather than a more uniform large central low area (as in Chalan Beel Polder C, for example). Hence there are many natural compartments in the polder, which were only connected in extreme floods.

The project comprises a, reportedly 132.28 km, encircling embankment. However, in three places, in Murshidpur and Chawapara village of Bharso Union, it was reported that the embankment had not been finished (remains open) due to land acquisition problems.

The Feasibility Study also stressed improved drainage, and proposed pumped drainage, but the project as implemented depends on gravity drainage. Nine regulators were originally proposed but four additional ones were added in later revisions. A further revision

to the Project Proforma (PP) resulted in the construction of 77 irrigation inlets/drainage outlets, and eight flushing sluices/drainage outlets.

It was originally planned to excavate 193 km of drainage channels. This was reduced to 123.6 km of re-excavation (existing channels), and 10.7 km of new channels (FFW additional to the project). It is unclear whether this work was done fully or adequately (see Section 1.5.1).

1.3 PROJECT PERFORMANCE AND IMPACTS

Problems of repeated public cuts and natural breaches mean that during implementation and subsequently, there has been much uncertainty regarding flooding. However, some land has shallower normal flood levels as a result of the Project, but this is at the expense of adjacent areas outside where flood levels are higher.

The Project was expected to lead to a very substantial increase in cropping intensity (from 157 per cent to 235 per cent), to reduce crop losses and increase yields. In practice much of the Project is single cropped, the most important crop is HYV Boro which has been stimulated by expansion of groundwater irrigation not FCD. Overall there appears to have been a small positive impact on agriculture: an increased area and higher yields for TL Aman for example, but it is much less than anticipated.

The Feasibility Report estimated a 75 per cent fall in the area of floodplain fisheries in the project area, but an unchanged area of beels. However, less flooding, increased Boro cultivation using STWs, and recharge of tapped ground water from the beels have reduced the depth and area under beels, while normal fish migration routes are now blocked. It is conservatively estimated that the fish catch has declined by 40-60 per cent since the pre-project period (a loss of 1900-2500 mt), and the project is the main (but not the only) factor behind this. There has been some growth in pond fisheries to compensate for this (perhaps 430 mt more a year).

A variety of other impacts have occurred, some external areas now have worsened flooding, employment in agriculture has grown, and road communications have improved although boat transport within the Project has declined. Overall there appeared to be no difference in incomes from the control area, nor in indicators of wealth such as house type. The economic rate of return appears to be low - about 8 per cent, and does not include estimates of all the negative environmental impacts.

1.4 OPERATION OF PROJECT

1.4.1 Technical Assessment

During the floods in 1986/87 there were altogether 33 natural breaches and public cuts (BWDB Flood Damage Report, 1987). Six public cuts were made at Gopalpur, Mansinhapur, Birkaya, Basudebpur, Chak Kesab and Balubazar; and two natural breaches occurred at Sankarpur and Madhupur Saldha during the flood of 1988. It is reported that during the 1988 floods the river stage at the gauging stations at Jotebazar, Noahata and Bagmara on the rivers Fakirni, Sib-Barnai and Barnai respectively exceeded what had previously been estimated as the 1-in-100 year return period river stage (but standards of protection have probably declined considerably due to river confinement by multiple polder projects).

Two public cuts were made in 1990 at Tangrahata (Ratandanga) and Madhupur although there was no abnormal flood in this year. Conflicting interests of fishermen and farmers and among farmers led to these cuts. There is a general fear of the cut at Tangrahata as the onrush of water sweeps away paddy plants and homes, in July 1991 there was again a cut here.

Some of the regulators appeared to be under designed and therefore were found to be in defective condition. The gear boxes of some regulators need minor repairs. Three regulators were found to be in need of protective works. Four additional flushing-and-drainage regulators are proposed by concerned BWDB officials.

Operation is restricted to that of structures, it is unclear to what extent there are problems with their operation, or the extent to which public cuts are by project "beneficiaries" to alleviate drainage problems, compared with cuts by outsiders trying to relieve flood pressure in the effective floodway. An O&M manual has been developed but it was found not to be in use by the two SDEs responsible for O&M of the project.

However, it would appear that drainage facilities cannot operate as intended due to poor maintenance, while the project may also hinder ground water recharge. Integrated reassessment of water management is needed, and should include the implications of private sector irrigation, and of the project on outside areas.

1.4.2 Institutional and Social Assessment

The apparently inappropriate and inadequate provision of irrigation inlets, drainage outlets and drainage channels in the project may be because there was virtually no consultation with local people at the planning stage. This means that BWDB missed the benefits of local knowledge with respect to local soil type, topography, flood incidence and flood depth, and irrigation and drainage requirements.

The project has not succeeded in involving local people in the routine operation and maintenance of regulators, irrigation inlets or drainage outlets. There are no local committees for these structures and they are operated or not operated at the will of local influential persons, some of whom were reported to have taken home some removable components of the control structures.

In areas, where BWDB did not keep adequate provision of irrigation inlets, farmers have innovated positively by cutting the embankment in the dry season to make temporary irrigation inlets for HYV Boro cultivation, and then close these cuts immediately after their irrigation needs are fulfilled. No doubt, such cuts undermine the strength of the embankment, but they imply that there is a need for pucca irrigation inlets, and that farmers have a responsible attitude to the embankment. Irrigators should pay the costs of their actions, by being required to lay pipes and resection the embankment under BWDB supervision and approval. It also indicates that if structures such as irrigation inlets and drainage outlets are properly designed and constructed, they can benefit many farmers; and that the farmers can organize themselves to operate and maintain irrigation works, provided they see the positive benefits of such actions.

The borrow-pits along the river sides remain dry for most of the dry period, and therefore there is no significant instance of leasing of borrow-pits for fishery development as envisaged in the project. A limited number of borrow-pit areas which retain some water are leased out together with the adjacent Khas land, but the lease holders are usually the local influential people, not the landless people as expected in the project plan.

As a direct result of the project, social conflicts and tensions with respect to public cuts of the embankment and access of people to the fishing grounds have intensified. The major conflict of interest arises during the high flood period along the Sib river - the insiders fearing breaches and cuts do everything possible to protect the embankment, while the outsiders become desperate and organize public cuts of the embankment in an attempt to get rid of inundation. The regular problem of the Tangrahata cut, which takes place almost every year, causes a sudden on-rush of water within the polder and leads to a chain of cuts of the main roads and village roads further down the polder, and then it finally compels the project insiders to cut the embankment in places such as Madhupur, Mansinhapur and Birkaya along the Fakirni river, to let out the water.

Another type of conflict is the one between farmers who lease in parts of the beels for growing Boro paddy and those who take lease of these beels for fishing. Conflict arises as the farmers after the Boro harvest dig small ponds in the lowest part of their land and put branches of trees in these ponds to be used as fish shelters, but this reduces the catch of the fishermen (fisheries lease holders) because the fish take shelter in these ponds during the fishing time, called **Baich**. The increase in these conflicts has, by implication, increased the demand for official interventions to resolve conflicts, although there are also instances of social interventions to resolve or avoid conflicts.

Pucca irrigation inlets are constructed and supplied by the government free of cost, but many of these structures have been taken over by local influential people, who act as the *de facto* owners of these structures. For example, a number of pucca irrigation inlets were constructed by BWDB along the western bank of the Atrai river near Pratappur at the request of a few individuals who have been operating low lift pumps (LLPs) at these inlet points to sell irrigation water privately for many years. Similar evidence of privatizing BWDB-built modern irrigation inlets with long pucca conveyance channels can be found near Char Laxmipur village along the Atrai river in Naogaon polder. Since these structures are location-specific to lift surface water from the river, these private entrepreneurs operate LLPs in a natural monopoly environment and charge exorbitant prices for water, ranging from Tk 600-1000 per bigha. Such monopoly rent reaped by private individuals aided by state provided resources is a natural candidate for taxation, the proceeds of which could be used to cover operation and maintenance costs.

1.5 MAINTENANCE OF PROJECT

1.5.1 Technical Assessment

Discussion with the BWDB staff, interviews with local people and on-site observations indicated that about 40 per cent of the whole embankment length is damaged - for example due to raincuts, and needs to be repaired or rehabilitated by resectioning.

All the irrigation inlets are in good condition, except two which need to be reconstructed as these fell into disrepair due to public cuts in the embankment.

The drainage channels are now partly silted up and BWDB reported that 23 km required re-excavation.

The condition of the main structures of the Project are described in Table 1.1.

Table 1.1 Summary of Condition of Main Drainage/Flushing Structures in Chalan Beel Polder 'D'

Type and Location of Structure	Present condition of structures									Present Condition of Drainage Channel	
	Regulator/Sluice							Gate			
	No. of Ventage	Type of Gate	Wing wall		Box	Apron		Gate	Rubber Seal/ Groove		
			C/S	R/S		C/S	R/S			C/S	R/S
Kashimala Drainage Regulator	2	V.L.	G	G	G	F	F	G	R.S to be provided	F	F
Dangapara Drainage Regulator	3	V.L.	G	G	G	F	L.A. to be constructed	G, one gear box missing	R.S to be provided	G	F
Ratandanga Drainage Regulator	1	V.L.	G	G	G	F	F	G	R.S to be provided	G	F
Singa Drainage Regulator	4	V.L.	G	G	G	F	F	G	R.S to be provided	F	G
Saldha Drainage Regulator	1	V.L.	G	G	G	F	F	G	R.S to be provided	F	F
Beel Pabni Drainage Regulator	5	V.L.	G	G	G	F	F	G	R.S to be provided	F	F
Kalamara Drainage Regulator	1	V.L.	G	G	G	F	G	G	R.S to be provided	F	F
Goalmanda Drainage Regulator	2	V.L.	G	G	G	F	F	G, 1 gate need repair	R.S to be provided	F	F
Purbadaulatpur Drainage Regulator (Brick Masonry)	8	V.L.	G	G	G	G	F	G	R.S to be provided	G	G
Joker khal Drainage Regulator	1	V.L.	G	G	G	G	F	G	R.S to be provided	G	F
Birkaya Drainage Regulator (Brick Masonry)	6	V.L.	G	G	G	G	G	G	R.S to be provided	P	F
Gopalpur Drainage Regulator	1	V.L.	G	G	G	G	F	P, penium is missing	R.S to be provided	F	P
Bagmara Flushing cum Drainage Regulator (Brick Masonry)	3	V.L.	G	G	G	G	G	G	R.S to be provided	F	F
Monglardara Drainage cum Flushing Regulator	2	V.L.	G	G	G	G	G	G	R.S to be provided	F	F
Dhopaghat Drainage cum Flushing Regulator	1	V.L.	G	G	G	F	F	G	R.S to be provided	F	G
Gobindapur Drainage Regulator	5	V.L.	G	G	G	G	G	G	R.S to be provided	F	G
Chandpur Drainage Regulator	2	V.L.	G	G	G	G	F	G	R.S to be provided	F	F

Source: Consultants
Note: C/S - Country Side; R/S - River Side; V.L. - Vertical Lift; G - Good; F - Fair; P - Poor; N/A - Not Available

Already in the last few years emergency repair/replacement type of maintenance has been undertaken by the O&M Division, as reported by BWDB. For example, the damage due to the 1986 flood was made good by closing breaches in the embankment, while resectioning was done in other places, costing nearly Tk 14.5 million. After the 1988, flood brick mattressing was installed in some places to strengthen the embankment against wave action, but is now damaged due to poor construction. There is no routine maintenance of the embankment.

1.5.2 Institutional and Social Assessment

People within the project appear to have cooperated towards the protection and maintenance of the embankment. Especially in medium and deeply flooded areas along the Sib river, people fear breaches and cuts in the embankment. There is evidence that people did respond to BWDB's call and have participated voluntarily in watching the vulnerable sections of embankment, and drop sand bags to protect the embankment during peak floods. However, this is on an ad hoc basis, rather than a systematic cooperative venture between BWDB and local organisations.

1.6 COSTS

O&M related costs were obtained from BWDB for the project for 1989-90 and 1990-91, plus the bid for repair works following the 1991 monsoon season (Table 1.2). While revenue budget expenditures on structures (embankment, regulators and BWDB buildings) was relatively constant at Tk 0.41 million in 1989-90 and Tk 0.46 million in 1990-91, the figures for establishment (staff) show a large increase during the two years (even including a separate estimate of transport costs in the establishment cost of 1989-90): from Tk 0.19 million in 1989-90 to Tk 0.43 million in 1990-91.

However, as can be seen the vast majority of expenditure is under food for work programmes and for 'flood damage repairs', during three years 1988-91 some Tk 52.1 million has reportedly been spent on such repairs and the proposal for winter 1991-92 is even higher than that average. The Project is relatively recent and ought to be in good shape without requiring repairs of regulators or major works on the embankment. Of course the early years of the Project have been marked by exceptional floods, but much of the damage appears to be recurrent and not a result of high floods. It is uncertain whether the Project will in future be able to function with the low level of revenue budget funding or whether it will be perpetually dependent on rehabilitation funds. Moreover repairs and rehabilitation mean that it is not functioning properly and hence the intended benefits are not being achieved, bringing into question the long term viability of the Project.

The excessively high recurrent expenditures ought to have been preventable by:

- better planning and compensation for people outside the polder who are adversely affected, such as provision of safe homestead land; and
- patrols and emergency repair of vulnerable sections, plus routine preventative maintenance.

Table 1.2 Reported O&M Costs (financial, current prices)

Heading	Cost (Tk) 1989-90	1990-91	1991-92
Revenue budget (head 163)			
embankment	127736	160282	?
regulator	268911	203123	?
colony	15788	96033	?
establishment	141951	431226	?
transport	51167	0	?
food for work related	28639	131032	?
total	634192	1021696	
Food-for-Work			
metric tonnes	446	910.5	1795[1]
cost (1991 financial prices: FPCO, 1991 and 10% pa inflation)	3340000	6810000	13430000
Flood damage repair costs rehabilitation/resectioning and bank protection works			34680000

Note: 1 1991-92 figure is BWDB request for repair work following 1991 monsoon season as detailed in Rajshahi WD Division Flood Damage Information dated 14.10.91

Source: BWDB unpublished data

1.6 LESSONS FOR O&M

1. Responsibilities for regulator operation lie with khalashis and not with (or involving) beneficiaries. There is a lack of supervision and overall planning of operations in this large project.

2. There is no project manager or management as such, although such coordination is clearly needed.

3. There was no local involvement in planning. Consultation might have reduced conflicts by leading to modifications in the design and planning, by highlighting remedial action and compensation needs, and by publicising the aims of the project.

4. The project has provided 'limited' irrigation inlet facilities in the embankment according to the project plan. Now there is a demand for irrigation. BWDB should be more active in involving local beneficiary farmers in installing, operating and maintaining the inlets.

5. Ultimately O&M has been handicapped by the planning and implementation of the Project, specifically:

- constriction of the external waterways and floodplain, with adverse impacts on people outside the Project;

- insufficient setback distance of the embankment from the rivers resulting in damage and hence higher repair and embankment protection costs;

- inadequate/poor quality repair works resulting in further damage in subsequent years and hence further needs for damage repairs; and

- drainage congestion results from a mixture of limitations on gravity drainage, public cuts and flooding from outside and poor maintenance of the drainage khals.

Hydrological-hydraulic modelling of flood flows should have revealed where water flowed without the project, and the implications of this and other polders in the area on flood levels. Smaller polder units in between flood ways might have eased the risk of insider-outsider conflict. The polder is liable to have had external downstream impacts on river levels by reducing flood storage. The implications of Chalan Beel Polder D for O&M (and for the technical viability) of other projects have not been assessed.

2. KURIGRAM FCDI PROJECT (SOUTH UNIT)

2.1 PROJECT BACKGROUND

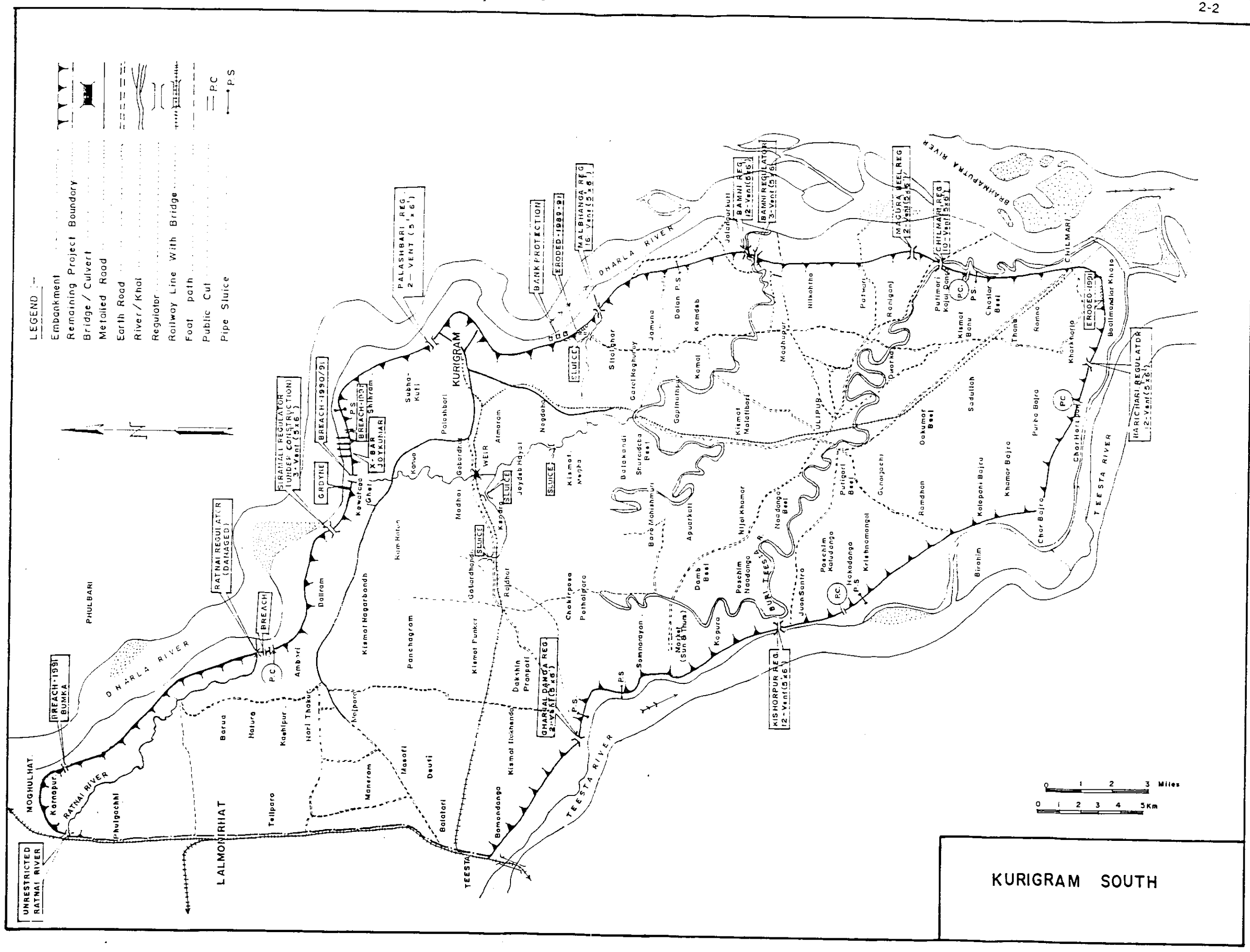
2.1.1 Project Summary Sheet

Project Name	: Kurigram Flood Control and Irrigation Project (South Unit)
Project Type	: Flood Control & Drainage (Irrigation not provided)
Location	
FAP Region	: North-West
District	: Kurigram and Lalmonirhat
Area (ha.)	: 63,765 ha.(gross), 50,000 ha. (net cultivable)
Funding Agency	: Government of Bangladesh
Implementing Agency	: BWDB
Construction started	: 1975
Scheduled Completion	: ?
Actual Completion	: 1984 (FCD component)
Original Cost Estimate	: ?
Final Cost Estimate	: Tk. 683.6 million (1991 prices)
Major Flood Damage	: Continued erosion problem, flood damage 1988, 1991
Repair-rehabilitation	: Ongoing from 1988

Comments:

Project appears to have been built piecemeal with whatever resources came to hand. The embankment is not complete - there are eroded, breached and cut sections of embankment at several places. One river, the Ratnai, still flows into the project unrestricted. The drainage system is silted up, and appears never to have been excavated or improved. Fortunately the irrigation component was never implemented.

Figure 2.1 Kurigram South Unit showing locations visited and key features



2.1.2 Background Information

The Kurigram Flood Control and Irrigation Project - South Unit ("Kurigram South") is located in Kurigram and Lalmonirhat Districts adjacent to the northern international boundary with India. The project area is bounded by major rivers: to the north-east by the Dharla river, to the east by the Brahmaputra river, to the south-east by the Teesta river and on the west by the Kaunia-Moghulhat railway line (Figure 2.1).

The physical features of the area are directly related to these river regimes and regional climatic conditions. The land has a gentle slope of about one foot per mile, equivalent to 1:5300 from north-west to south-east. Land elevation varies from 22-34 m (70-110 feet) PWD. There are occasional undulations with irregular relief due to low pockets, gulleys and depressions. The area was subject to short duration floods from the main rivers.

About 40 per cent of the area was flooded almost every year before the project resulting in extensive damage to Aus and Aman crops, disruption of communication and damage to infrastructure. Large tracts of agricultural lands were (and are) also lost every year due to bank erosion caused by these three major rivers. In the dry season there is a lack of surface water which constrained agriculture until the introduction of tubewells.

The primary objective of the project was to effect improvements in the water regime to facilitate crop production by means of flood control, drainage and irrigation in the area. Out of the gross area of 63,765 ha, the project was to provide flood control and drainage to 25,506 ha and irrigation to 49,000 ha. The project area was protected from spilling of the rivers by construction of embankments on the right bank of the Brahmaputra, the left bank of the Teesta, and the right bank of the Dharla.

For the drainage of internal run off during the monsoon, existing channels were to be developed into an efficient drainage system. Drainage sluices (regulators) would be constructed to drain out excessive run off through the embankment into the rivers, but pumped drainage was also proposed for when river stages do not permit gravity drainage.

For the irrigation of the area, the Dharla river was to be headed up by a barrage. Gravity canals would carry and distribute irrigation water. In order to reach those areas which could not be commanded by the Barrage, because of their relatively higher elevation, a pumping plant was to be installed on the right bank of the Dharla river. Out of a total irrigated area of 49,000 ha, about 28,200 ha was proposed to be irrigated by the Barrage and 20,800 ha would be provided with irrigation by pumping plant.

2.2 PROJECT AS IMPLEMENTED

The features in Table 2.1 were planned to be constructed. The project actually comprises 110 km of embankment (but with gaps) tied into the railway line. Eight regulators were initially built, and a further three are under construction as part of flood damage repairs to replace regular public cuts due to drainage congestion. A further four pipe sluices of uncertain origin exist in the embankment.

Expenditure up to June 1991 at current prices (1971-1991) amounts to: Tk 165.7 million on the main works of Kurigram South, Tk 16.9 million on Kurigram Town Protection, and Tk 93.1 million on "Flood Damage Repair" - this includes the small regulators built since 1989 where previously there were public cuts to drain out water. Smaller amounts comprise Tk 2.9 million from the Development Budget, Tk. 8.4 million for small structures under the

CIDA/IDA small scale programmes, and Tk 1.2 million under Food for Work. However, the coverage of these reported costs is unclear. They are presumably financial costs, and it seems unlikely that the FFW which was used to build the embankment originally was included as a construction cost.

Table 2.1 Major structures planned for Kurigram South unit

Major structures	Dimension
Embankment	103.00 km.
Access Road	25.00 km.
Bumka Pumping Plant	1 No.
Dharla Barrage	1 No.
Drainage System	
Drainage Channel	192.62 km.
Drainage Structures	
Regulator cum Bridge	16 Nos.
Bridge and Culvert	38 Nos.
Irrigation System	
Irrigation Canal	
Main Canal	84.64 km.
Branch Canal	112.30 km.
Lateral Canal	199.41 km.
Irrigation Structures	
Bridge & Culvert	37 Nos.
Regulator	15 Nos.
Syphon	22 Nos.
Escape	3 Nos.

Source: Technical Feasibility (Technoconsult, 1975).

However work is still ongoing after more than 17 years, and there are proposals to invest very large sums in surface irrigation for the area. According to the investment report work has started on the barrage, but fortunately work has not actually started. This would imply a 20+ year implementation period, but should be seen as a separate project. The existing FCD polder unit only is assessed here. There are a number of reasons for thinking that the irrigation component would not be viable (these have mostly already been stated in FAO (1988):

- groundwater is available at a shallow depth and there has been considerable expansion of STW and DTW irrigation since the original project plan in the 1960's, reducing the area which would benefit from surface irrigation;

- the project has a sandy substrata implying that seepage losses from major irrigation distributaries would be high, and water demand might be high;

- farmers already grow good rabi and early kharif crops on residual moisture, so irrigation for HYV Boro might adversely affect waterlogging and soil fertility;

- the region is prone to earthquakes which would be a risk for large structures like a barrage;

- small scale irrigation is easier to manage - in terms of water management and system O&M; and

- cost recovery is non-existent in BWDB main irrigation systems compared with private irrigation.

As will be apparent from this chapter higher priorities in making the existing system more effective are to improve embankment maintenance, effect speedy retirement of embankments threatened by erosion, and to improve drainage.

2.3 PROJECT PERFORMANCE AND IMPACTS

The impact of the project appears to have been small. It has in some areas kept out floods from the main rivers and reduced the proportion of very low land, but the internal rivers and drainage congestion still cause damage particularly in the south-east of the Project (in one location there had only been a harvest in four of the last 20 years because of drainage congestion). It may be that the Project has provided some measure of security encouraging the growth of STW irrigation. Some areas of the Project are high land little affected by the Project but overall there appears to be more TL Aman and around 15 per cent higher yields than in the control area. Also the Project appears to have been successful in 1987 and 1988 in reducing flood damages. Natural fish populations have been adversely affected as khals and beels are cut off from floods, but the loss is not as marked as in some FCD Projects (there were few large beels and some areas remain open to monsoon flooding; meanwhile pond fish cultivation has expanded inside the Project.

There appears to be little overall difference in economic conditions between Project and control areas: groups such as fishermen and people outside the Project have been disadvantaged, while incomes inside the Project are only slightly higher than the control area and there is still widespread poverty, low wages and inequality. There appears to have been negligible secondary growth in the local economy. An economic rqate of return of about 16 per cent was estimated but this is very sensitive to the paddy yield estimate used.

The long period of implementation means that project planning and data bases, such as they are, need to be revised and updated. Maps available with BWDB are badly out of date, and fail to clearly indicate, for example, the state and location of different water bodies. The inclusion of the non-existent irrigation canals is an irrelevance, whereas details of the status of the drainage system would be useful.

The FAP 12 study concluded that the planned Dharla Barrage and the pumping plant at Bumka should be abandoned (see also Section 2.2). The original plan was to provide irrigation by gravity flow for the Aman crop. While supplementary irrigation for Aman is indeed desirable, it is unlikely to be cost effective. Furthermore, the command area of around 28,200 ha, is too small to justify the huge capital expenditure that would be required (around Tk. 250 crores).

Minor irrigation, on the other hand has expanded rapidly (largely irrespective of the project), and this trend should instead be encouraged. Canal re-excavation for example, will not only help with drainage, but can also improve surface water availability for irrigation, during the dry season.

2.4 PROJECT OPERATION

2.4.1 Technical Assessment

The original plan cannot be assessed, since drainage (which is integral to flood control) as well as irrigation works were suspended. The project as it has been built, and its operating success, or lack of it, is the important issue.

Drainage congestion has been observed in the lower parts of the area, resulting in numerous and frequent public cuts. Completion of the drainage component of the project according to the original design might be necessary to counteract these negative effects. However, the old plan should not be blindly followed, but instead reassessed and modified following re-modelling. In some cases drainage problems are likely to be the result of upstream openings in the embankment which result in flood water flowing into the project. While in September 1991 the railway line which is supposed to form the flood protection barrier on the project's north-west side was overtopped just north of the Teesta bridge. Since BWDB is well aware that the adjacent Sati Nadi project which would provide flood protection to the railway has been eroded and open since 1987-88, prioritisation of at least an assessment of the protection afforded by the railway might have been expected.

The embankment has at one point been left open where the Ratnai river enters the project, resulting in flooding by the Ratnai River near the north-east boundary of the project. This could be rectified by creating a diversion channel and extending the embankment up to the railway line, as in the original design. There is agreement about this between the BWDB engineer and local people.

Effective operation of the regulators is handicapped by the silting up of the natural drainage channels, and by open sections of embankment. However, the impression is that the regulators are relatively well operated: khalashis were present at all the completed regulators and where there are no breaches and openings they function to keep out floods. The problem is in the lack of capacity to drain out excess quantities of water inside the project when river levels fall, they are not operated to retain water. The main public cuts for drainage are discussed below.

In Hokodanga there is a public cut of about 30m (100 ft) made by people from outside the embankment dating to immediately after its construction. The reason for cutting the embankment according to the local people is that the people living on the riverside of the project embankment are encircled by a ring bund made by Rangpur Dinajpur Rural Services (RDRS) and water within this area tends to drain into the project area. So to release the

drainage congestion the people in the ring bund area never allow any repair works to this cut by BWDB.

In Haripur there is a public cut of about 46m (150 ft), this was made by the local people in 1990. The local people opined about this cut that the Harichari regulator (12-vent) was not fully operable at the time (4-vents only out of 12-vents, although it appeared to be fully functioning in September 1991) which caused the water level to rise frequently in the country side inundating and damaging standing crops. This seems to be a persistent problem, in 1988 there had been a public cut some 150m upstream of this regulator to speed up drainage since this regulator drains a substantial low lying area, that cut had been repaired during the next winter by BWDB.

In Chaslar Beel there is a public cut of about 46m (150 ft) which is close to a 1-vent pipe sluice ("Chaslar regulator"). This cut was made by the local people to drain out flood water in the 1988 flood. About 10-11 small beels within and outside the Putimari Kajal Danga area drain out through this cut.

At the Ratnai regulator there are two openings. One is a cut of about 38m (125 ft) which drains an ox-bow of the Ratnai river. Immediately beyond this is a 150m (500 ft) breach surrounding the Ratnai regulator, which has collapsed as a result of the breach and lies abandoned. Both of these openings occurred in 1988 flood. The large breach at the Ratnai regulator started with a public cut made to drain out flood water from the Ratnai river, but quickly expanded to take the flow of the river, and might well have breached without a cut. Operating problems here are ultimately due to poor planning/implementation since a live river draining areas outside the project has been left entering the project and draining out through a regulator. Although according to local people the problem in severe floods (1984, 1987, and 1988) is of breaches in the embankment north of here which result in flood water flowing down to the regulator. The floods on the Ratnai have been sufficient to completely erode the approaches to the large bridge over it on the Phulbari road.

The recently constructed regulators under FDR funding are to take the place of public cuts, thus the "additional Bamni regulator" at Gaberjawan replaces a public cut which had been open since 1987, but the regulator had not been finished during the 1991 flood season - for which it had been closed with fallboards (Table 2.2).

It is unclear who implemented the pipe sluices in the embankment, but these do not always serve the objective one might expect. Thus the Dalan pipe-sluice appears to be permanently open and drains an area outside the embankment into the project since there would otherwise be drainage congestion in the area between the embankment and a village road outside the embankment. This implies that the road and size of opening determine the flood protection standard in this area.

Facilities under Kurigram South system are not the only BWDB water management facilities within the project area. A khal from the Dhaolia Beel area (north of Rajahat Upazila centre) was excavated during the canal digging programme of the late 1970s, it links to an old river/drainage channel from Sarala Beel near Rajahat and flows out of the project through the 16 vent regulator at Sitaighar. This sub-system has a series of water control structures intended for retention of water in the post monsoon period for irrigation. There are four sluices dating from 1961: apparently abandoned two vent sluices at Chhat Modha and Tograhat, an operated one at Ramarghat (not visited) and a functioning four vent sluice at Kismat Malbhanga close to the 16 vent regulator. The latter has been successfully operated with fallboards since completion, and the fallboards have been replaced twice. The khal is closed off in Ashin-Kartik to retain water which is lifted by LLP onto the fields.

Table 2.2 Summary of condition of main drainage structures in Kurigram South Unit.

Type and Location of Structure	Present condition of structure									Present Condition of Drainage Channel	
	Regulator/Sluice							Gate		Need reexcavation (km)	
	No. of Ventage	Gate	Wing wall C/S	Wing wall R/S	Box	Apron C/S	Apron R/S	Gate	Rubber Seal/ Groove	C/S	R/S
Gharial danga Regulator	2	V.L.	G	G	G	F	F	G	R.S to be provided	F	F
Kishorepur Regulator	12	V.L.	G	G	G	F	F	G	R.S to be provided	F	P
Harichari Regulator	12	V.L.	G	G	G	G	G	G	Nil		
Chasler Beel Pipe Sluice [a]	1	F.B.	P	P	F	P	P	-	-	-	-
Chilmari Regulator	10	V.L.	G	G	F*	G	G	G	-	G	G
Raniganj Pipe Sluice[a]	1	F.B.	P	P	F	P	P	-	-		
Raniganj Regulator[b]	2	V.L.	G	G	G	G	G	1 G, Other not installed	Nil	-	-
Bamni Regulator(additional) [b]	3	V.L.	G	G	G	G	G	V.L. not yet installed, Closed by F.B.	N/A	-	-
Bamni Regulator (main)	12	V.L.	G	G	G	G	G	G, 1 not operating	Nil	G	G
Dalan Pipe Sluice[a]	1	F.B.	P	P	F	P	P	damaged	-		
Malbhanga Regulator	16	V.L.	G	G	G	G	G	13 G, 3 not operating	Nil	G	G
Palashbari Regulator	2	V.L.	G	G	G	G	G	G	Provided		
Char Modajalfara Pipe Sluice[a]	1	F.G.	G	G	G	G	G	G	Provided	-	Needed
Siramali Regulator[b]	3	V.L.	Not yet completed								
Ratnai Regulator	8	V.L.	Collapsed due to public cut - now a breach on both sides								

* Minor Crack in Vertical Wall
[a] not listed in project infrastructure
[b] built in 1991, remaining sluices date from 1970s.

Note: C/S - Country Side; R/S - River Side; V.L. - Vertical Lift; F.B. - Fall Board; F.G. - Flap Gate; G - Good; F - Fair; P - Poor; N/A - Not Available

In addition a pipe-sluice with fallboard provision was built by RDRS in 1986/87 near the Kismat Malbhanga sluice, but has not been operated. On the same sub-system close to Tograhat a weir has been built in 1980/81 this is already in poor condition (wear of concrete aprons and loss of earth from the bunds. It is reported that the contractor provided poor quality fallboards and after the first season's operation they were taken by a UP member and used as firewood. The weir is now only used as a fish-trap.

All of these "small" structures are under Dinajpur O&M Division and are not managed as part of the Kurigram South system, despite being entirely within the project, and despite Dinajpur being far from the project.

Overall the Project has a limited impact on water levels, for example at Bamni in 1990 most flood peaks were reduced by about one foot (30 cm) inside the Project compared with external flood levels, but internal levels followed closely external levels (BWDB data).

2.4.2 Institutional and Social Assessment

At all the main regulators of Kurigram South project (excluding new regulators built under the FDR programme), khalashis were found. Although they had not received detailed instructions or practical training in operating needs, the khalashis appeared to be operating the regulators sensibly. Most regulators had some gates open and others closed when the inside and outside water levels were equal during the visit in early September 1991, but were closed during a flood peak shortly afterwards. It was reported that fully opening or closing such large regulators can take three days, but this seems an excessive estimate. In general, middle gates are opened first to avoid damaging the regulators and their aprons. The khalashis are full time employees with the exception of the main Bamni regulator who's khalashi is paid on a daily basis - a part-time arrangement seems sensible for regulators in general as there are times of the year when little work is needed.

In no case was a committee found, operating decisions are a mixture of the khalashis discretion and at the request of farmers. Conflicts of interest between farmers were reported - in particular it was reported that the regulators helped drain more distant areas but did not relieve waterlogging near the regulators. Public cuts, as noted in Section 2.4.1, have been a frequent response to drainage problems when interior water levels are higher than river stages, however public cuts have **not** been repaired by local initiative. Additionally on the Buri Teesta river (which lies within the project) a problem of uncoordinated operation of regulators was reported since the Kishorepur and Chilmari regulators are located at either end of this river and when one is closed to keep water out, the other may be open resulting in water draining into that area.

For only one of the water retention structures, under Dinajpur O&M Division was a khalashi found to be working. However, it was notable that he had been successfully working for 30 years - placing fallboards to retain water for irrigation. Although the concrete structure is worn it is clear that sluices can have working lives of at least 30 years (and wooden fallboards about 10 years). There is no committee for this structure, but the khalashi is a local person farming some land in the area served by the sluice, and hence with an interest in it functioning properly.

2.5 MAINTENANCE OF PROJECT

2.5.1 Technical Assessment

The current state of the project structures is given in Table 2.2, in general the regulators are in good condition, although some repairs to gates, replacement of seals, and routine maintenance of the gates and gears is needed. In the case of Kishorepur regulator erosion of the river side guide bund in 1991 by the Teesta may threaten the regulator itself.

However, embankment maintenance is not adequate. The total length of flood embankment should be 110 km according to the BWDB project documents, but there are a number of openings (cuts and breaches). In addition about two thirds of the total embankment has been occupied by medium to dense development of homesteads on at least one side, and in some places on both river side and country side. In general the concentrations of homesteads are near areas with rapid erosion of land on the riverside - for example for several miles around Chilmari ghat. Homesteads on the side slopes of the embankment may cause sufficient damage in some places to contribute to failure in the near future. A majority of the embankment thus has maintenance problems of some sort.

There are many rain cuts along the embankment from the 2-vent Raniganj (Magura beel) regulator to 16-vent Malbhanga regulator (see Figure 2.1). These rain cuts are due to the embankment being built of cohesionless soil (sand and silt) from the active floodplain.

In addition to the public cuts discussed in Section 2.4.1 which remain unrepaired after several years, there are major problems of erosion.

In 1991 about 150m (500 ft) of flood embankment near the Malbhanga regulator was breached and another 460m (1500 ft) next to this portion has been severely eroding. An attempt to embank the 150m breached portion was ongoing in September 1991 but was yet to be completed. Just upstream of this erosion BWDB has been protecting the embankment with concrete blocks, but the erosion continues.

About 250m (830 ft) of the flood embankment a little down stream of the "Joykumar project" (four cross-bars constructed to deflect erosion and avoid a breach) was severely eroded by the current of Dharla river in mid-1991. BWDB, Kurigram, has completed resectioning works on the eroding embankment, this together with the remaining undamaged one-third portion might well fail in 1992.

At Chilmari ferry terminal erosion has been continuing in recent years, during 1991 the river bank moved about 90m (300 ft) in towards the embankment, as a result perhaps one mile of embankment has either eroded completely or has only the countryside slope left. The embankment erosion is also displacing people who had taken shelter on the embankment when their previous homesteads were eroded. BWDB expects that the brick and earth roads from the ferry ghat to Harichari regulator will act as a retired embankment for the moment, but plans a substantially retired embankment which would abandon the areas flooded by this breach in 1991.

Near the Kawahaga ghat there are two adjacent breaches totalling about 460m (1500 ft). One occurred in 1989 and was closed off by a retired embankment in the same year. In 1990 another breach (erosion) took place together with the erosion of the previous year's retired embankment. BWDB tried to construct a retired embankment, but did not complete it. In an attempt to protect the above-mentioned breached areas BWDB has completed in 1991 construction of a groyne in Kawahaga ghat.

Cuts and breaches have remained in a state of disrepair for years. While the engineers give the lack of funds as the excuse, resources have been available for regulators at some cuts, and resectioning work has been undertaken under FFW. This suggests that BWDB has not reassessed priorities for repairing the project - there appears to be a bias towards larger works (structures and bank protection), which may mean less efficient use of the limited resources available. No plan identifying or giving reasons for abandoning areas or spending large sums on bank protection was indicated, there appears to be no difference in the agricultural areas protected or not protected, and in the case of Kawahaga ghat high land and the main Kurigram-Rangpur road would limit the area flooded from the breach anyway.

Large works need to be carefully monitored and reviewed, and even terminated mid-way, when the need for them is no longer urgent, and priorities reordered towards repairs and rehabilitation of the existing infrastructure, and then to routine maintenance. As an example, a cross-bar was being constructed on the Teesta in April 1991, although the river had moved far away and no longer posed a threat to the project. At the time of initiation of the work, the threat was of course real.

All the natural drainage channels and rivers which feed the regulators have become silted up. It is not clear whether BWDB ever developed a drainage plan for the project as implemented, or rationalised the channels (some are very meandering, in some places ox-bows are adjacent to the embankment), or did any re-excavation. The drainage system should be re-assessed and drainage and flood problems throughout the project mapped and quantified so that priorities for drainage improvement can be set. FFW has not been used for drainage improvements in 1989-91.

Likewise a programme of work to rehabilitate the embankment would be needed, but should aim to rectify local negative impacts on drainage and floods inside and outside the embankment at the same time.

2.5.2 Institutional and Social Assessment

What maintenance has been carried out has been entirely through the BWDB and depends on donor funding - flood damage repair grants and food-for-work wheat. There is a complete lack of routine maintenance, the only maintenance work observed in September was a team of ten labourers who had been hired for two days to repair raincuts in the embankment in the Harichari regulator area which dated from the previous year (they were being repaired in advance of a visit by the Superintending Engineer!).

Just as khalashis receive no specific or general guidance on regulator operation, so they do not receive guidance on simple maintenance of their structures.

There has been no move by local people or the local administration to fill in public cuts voluntarily (although they are cut voluntarily), in part this is because there is much more work involved in repairing a cut, in part because drainage congestion may be frequent so people prefer to have an opening rather than repairing it each year in the knowledge that there will be a cut and opening of the same size next year. Yet in the case of the cut at the site of Bamni additional regulator people suffered when the 1988 floods came through the open cut of the previous year, although they petitioned for a closure they did not repair it themselves.

There is public resentment and conflict over the payment of compensation money for land acquisition, and the legal problem of paying land revenue. On some reaches of embankment the final instalment has not been paid to the landowners. Hence the villagers

who lost their land due to acquisition continue to pay land revenue, because BWDB has not yet transferred the ownership titles of the land, even after ten years.

Illegal permanent settlements, which resemble "rural slums", are widespread on the embankment, resulting in damage to the embankment slope and aggravating the maintenance problem. This is a maintenance problem but also a benefit conferred by the embankment which is particularly important close to the Brahmaputra, where river erosion causes major dislocation of human settlements, but in its present unplanned and uncontrolled form is a threat to the embankment.

There are conflicts between BWDB and the local people over the breaches and cuts in the embankment, the problems are essentially of drainage congestion and inadequate regulators, which reflect a mixture of lack of repairs, and poor maintenance and planning.

2.6 O&M COSTS

There is no historic record of O&M costs, the only figures available being for the immediate past. O&M amounts to the project establishment, plus food-for-work. In August 1991 there were 79 staff working on Kurigram South Project (including Town Protection) at a monthly cost of Tk 0.35 million or Tk. 4.2 million a year (Tk 66 per ha). This compares with an O&M set up of 87 people outlined in the PP and of 84 people approved by BWDB.

Out of 79 staff 19 per cent are engineers/technical - (comprising 1 XEN, 3 SDEs, 1 Assistant Director, and 10 Section Officers, the latter amount to one per 11 km of embankment (since BWDB is not active in maintaining the drainage channels) - too many for simple monitoring and surveying of the embankment, but insufficient to physically carry out routine maintenance. During four days of travelling along the entire embankment by the FAP 13 team no Section Officers were encountered in the field, despite this being during a peak risk period (early September) and just before a late flood peak in mid-September 1991.

Field staff comprise about 16 per cent of staff: guards are not specified by function, but there are eight functioning regulators in the project each with a khalashi (FAP 13 field work - usually present), hence we presume the remaining 16 are guarding BWDB offices. There are also four full time surveyors, although presumably SOs can survey their sections. Consequently office and administration staff comprise 49 per cent of project staff, with a further 9 per cent in accounts - presumably mainly accounting for the office staff. There are a further six (7 per cent) in stores and driving pumps although the project has no pumps.

It seems plausible that normal O&M could be managed and carried out by a much smaller establishment so freeing resources for physical maintenance such as materials to keep regulators in order, parts for faulty vertical lift gate gears, and replacement gates. By drastically cutting unproductive staff the project might easily run with an establishment of some 50-60 per cent of the present, and even less if khalashi posts become part-time (the regulators are mostly large and so a trained khalashi paid on the basis of work done plus either an honorarium or free house would probably be necessary).

The salary costs which might be freed by this could go, for example, to routine maintenance by women's maintenance teams - at Tk 25 per person day and a 30 day month this would be a monthly routine maintenance cost of Tk 165,000 assuming two women per km and that all the embankment exists (a lower rate than the usual one in routine maintenance programmes might be acceptable as wages and prices are low in this District).

A 50 per cent cost saving on BWDB establishment costs would be just enough to cover routine maintenance.

However, given the extensive housing development on the embankment, maintenance teams might not be needed for these sections (over 33 per cent of the embankment), if householders can be persuaded to carry out routine maintenance, this would free some resources for work on the much neglected drainage system. In the long term a more sustainable locally resourced programme would be needed, this change would reduce the need for resectioning and embankment repair, freeing FFW to plug the gaps of cuts and erosion breaches, and start on drainage channels once these have been surveyed and priorities set.

So far actual embankment maintenance has been through periodic resectioning and rebuilding under FFW programmes. In 1990/91 9.8 km were repaired for Kurigram South and 3.3 km for Kurigram Town Protection, and in 1989/90 13.9 km for Kurigram South and 0.6 km for Kurigram Town Protection. Earth work (as opposed to bank protection) the town protection project may be regarded as integral to the whole project, so expenditure has been 446 MT and 14 MT of wheat respectively. If this is typical it indicates expenditure equivalent to Tk 3.8 million in 1987/88 financial prices (FPCO, 1991) per year.

Assuming that basic construction took place between 1971 and 1980/81 (the Tk 165.7 million) and that on average a factor of 3.4 times will bring this to a 1987/88 price base (BBS, 1991), then some 1.3 per cent of construction costs may be spent on annual establishment and maintenance costs at present (in constant prices).

2.7 LESSONS FOR O&M

1. The project needs careful reassessment before any investments are made. The correction of existing problems such as drainage congestion, repair and realignment of the embankment, where necessary, should be the first step.

2. Erosion is clearly a problem. Planning for social welfare in the face of this should be integral to the project's development plan. Isolating project implementation from a wider development plan (adjusted with changing circumstances) creates an "O&M problem" where a planned embankment settlement programme might benefit people.

3. Public consultation, as a two way process, is needed to improve the details of project planning (which appears to be an important part of the problem). This might identify alternative alignments or needs for structures.

4. It is essential to have a minimum period of development after completion, before commissioning a project (which amounts to abandoning it to "O&M"). This period of development funding would allow time to fine tune and trouble shoot for problems. Its absence may have contributed to numerous teething problems (drainage congestion and public cuts) and a rapid degeneration of physical works. A corollary of this is speedier implementation. A minimum transition period of two years is suggested, with the money for this coming out of the capital budget.

5. There is virtually no public participation in the project at any level. It is important to explore ways and means by which local institutions could be associated with managing the project. There is only likely to be an incentive for such involvement if there are clear benefits from the project.

5. There is potential to involve NGOs and government agencies in fully exploiting the potential of the embankment as a forestry resource, and as a source of employment to both distressed men and women. Already Rangpur Dinajpur Rural Services (an NGO) has expressed interest in taking up social forestry on the embankment. They had earlier planted trees on it and handed this back to BWDB, but the programme degenerated due to a lack of maintenance. In future NGOs might be contracted for the O&M of the project.

6. Likewise the project borrow pits are an under-utilised resource. The use of borrow pits should be regulated by the project authority, and those who gain from fish cultivation, for example in the borrow pits, could then bear some responsibility for O&M of the project.

7. The compensation money for land acquired should be paid fully, and legal issues need be settled urgently. Such problems cause additional conflicts for project management.

8. Better use could be made of the resources available for O&M - both in repairing flood damage and responding to the changing problems revealed by floods, and in routine maintenance and establishment staffing. This will require incentives and penalties to encourage management efficiency.

3 MEGHNA DHONAGODA IRRIGATION PROJECT

3.1 BACKGROUND

3.1.1 Project Summary Sheet

Project Name	: Meghna-Dhonagoda Irrigation Project (MDIP)
Project Type	: Flood Control, Drainage and Gravity Irrigation
Location	
FAP Region	: South-East
District	: Chandpur
Area (ha.)	: 17,584 ha. (gross), 14,367 ha. (irrigable)
Funding Agency	: Asian Development Bank
Implementing Agency	: BWDB
Construction started	: 1978/79
Scheduled Completion	: 1983/84
Actual Completion	: 1987/88
Original Cost Estimate	: US$ 46.0 million
Final Cost Estimate	: US$ 54.9 million (Tk 2418.8 million, 1991 prices)
Major Flood Damage:	: 1987, 1988 (embankment failed twice)
Repair/rehabilitation in	: 1987 to present

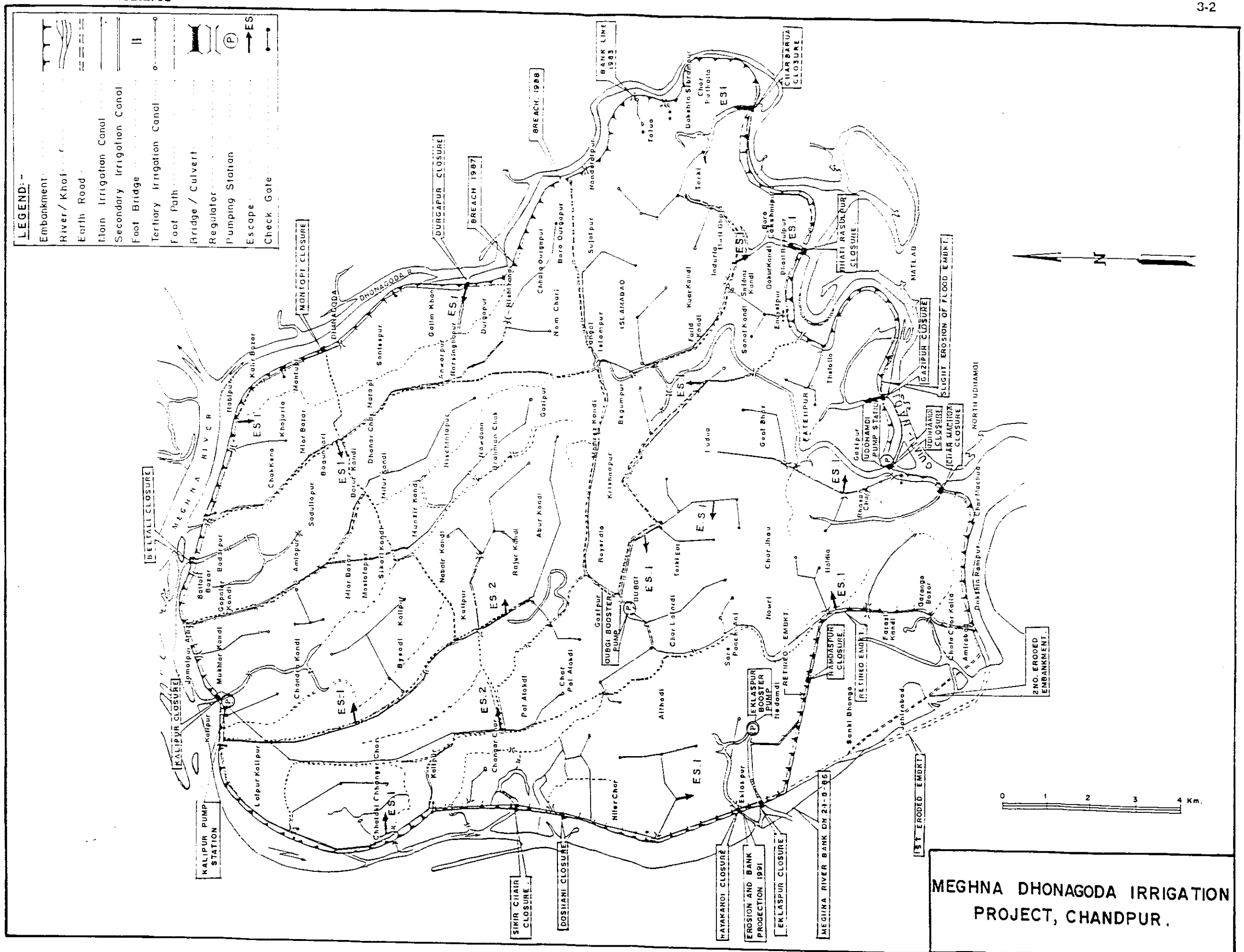
Major works still required for completion/rehabilitation:

Reconstruction of sections of secondary and tertiary irrigation system following flood damage.

Strengthening of main embankment.

Construction/upgrading of internal road system.

Figure 3.1 Meghna Dhonagoda Irrigation Project showing locations visited and key features



3.1.2 Project area description

a) Location

Meghna-Dhonagoda Irrigation Project (MDIP) is situated in Matlab Upazila of Chandpur District in south-eastern Bangladesh, falling in the Flood Action Plan's South-East Region and in BWDB's Chandpur Operation and Maintenance (O&M) Circle. The project has a gross area of 17,584 ha. and occupies the major portion of 14 out of the 22 Unions in Matlab Upazilla. It is located on an island surrounded by the Meghna River on the north and west and the Dhonagoda, a distributary of the Meghna, on the east and south (Figure 3.1). There are no large towns or administrative centres above Union level in the project, though Matlab town lies immediately south of the project across the Dhonagoda River.

b) Physical Characteristics

The project area is low-lying, with general elevations ranging from about 7 to 12 feet (2.1-3.7m) above PWD datum. Rainfall averages 2300 mm. per year. Before the Project large areas flooded to a depth of 6-9 feet (1.8-2.7m) every year and almost all areas experienced some flooding, while soil moisture for agriculture was deficient in the rabi and early kharif seasons. Over most of the area either only a single aman paddy crop, or a mixed aus/aman crop followed by rabi crops of low water demand, was grown. The project area is intersected by a network of fresh water but tidal khals. These provided the main means of access pre-project but were little used for irrigation.

c) Outline of Project Design and Objectives

MDIP is a combined Flood Control, Drainage and Irrigation (FCDI) project. The main design features are a ring embankment around the perimeter for flood protection, and internal networks of irrigation canals to provide water during the dry season and drainage canals to remove excess water from rainfall in the monsoon. Evacuation of drainage water is by two pump stations, one at the northern and the other at the southern end of the project, which also lift water from the Meghna and Dhonagoda rivers into the canals for dry-season irrigation. Water distribution within the project is mainly by gravity flow, but there are two internal booster pump stations to provide water to higher areas. The canal system commands a total of 14,367 ha., the balance of the gross area being excluded because it is too high to be commanded economically.

The objectives of the main embankment and drainage system design were to protect the project interior from river flooding and drainage congestion respectively during the monsoon, thus improving agricultural conditions in the monsoon (with special reference to encouraging introduction of HYV Aman) and increasing the security of the population, crops and livestock. The objective of irrigation development was to improve soil moisture in Rabi and early Kharif, again facilitating the introduction of HYV paddy varieties.

d) Project History

The project was originally in the portfolio of FCD projects proposed in the 1964 Master Plan (IECO, 1964), and a detailed feasibility study was made in 1966-67, but the idea was then shelved. The project was re-identified by BWDB and the Asian Development Bank in 1973. Feasibility studies were conducted with ADB funding in 1976-77, and the project was appraised by ADB in 1977. Construction by BWDB commenced in 1978, and the embankment was closed in 1987. Breaches of the embankment on the eastern (Dhonagoda) side of the project occurred in both 1987 and 1988, with deep and rapid flooding of the project interior,

major damage to the irrigation canal system and much sand deposition in the vicinity of the breaches. A rehabilitation programme is being implemented by BWDB, but at the time of RRA in March 1991 over 3,000 ha. of the irrigable area remained without canal supply due to unrepaired flood damage.

3.2 PROJECT AS IMPLEMENTED

3.2.1 Facilities

The Meghna-Dhonagoda Irrigation Project was the subject of two Feasibility Studies, the Consultant for the second Feasibility Study also being retained for detailed design and construction supervision. Both Feasibility Studies suggested identical types of flood control embankment, pumping stations, drainage and irrigation system, but in the detailed design some major design aspects of the flood embankment and the irrigation and drainage system were changed. Some changes to the irrigation and drainage network were also made during construction.

The Meghna-Dhonagoda project work was officially started in 1977/78 and completed in 1987/88, although the project was scheduled to be completed after five years. In the Feasibility Report the total length of flood embankment was 65 km. but this was revised during detailed design to 61.60 km. Construction overran considerably due to problems with the pumping stations and particularly because of erosion.

3.2.2 Erosion

During construction the portion of the flood embankment from Mohanpur to Eklaspur, at the confluence of the Meghna and Dhonagoda, was retired in 1980 due to erosion by the Meghna river, further retired alignments were selected in 1985, and the portion from Eklaspur to Amirabad was retired in 1986/87 for the same reason. The final embankment is up to 3 km inside the original alignment.

3.2.3 Performance in 1987 and 1988

During the 1987 flood a portion of the flood embankment on the Dhonagoda, near Durgapur on the eastern side of the project, was breached, and another portion at Rishikandi near Durgapur was breached by the 1988 flood. During 1987 the highest river stages in the Meghna and the Dhonagoda were only about a 1-in-2 year level (MDIP PIE Report, hydrological analysis) yet the project is designed to withstand much more severe floods. Even in 1988 when the peak flood stage was about a 1-in-18 year return period (MDIP PIE Report, hydrological analysis) the breach was due to embankment and/or subsoil failure (as it was in 1987), not to overtopping. Both the 1987 and 1988 floods caused widespread damage to the recently completed irrigation system, and an area of several thousand acres inside the breaches was badly affected by sand carried by the resulting high-velocity flows. The vast majority of Aman paddy in both years was destroyed. Housing damage was limited in 1987, but more widespread in 1988.

3.2.4 Positive aspects of Design

The constructed 14 ft (4.25m) crest width in most parts of the flood embankment seems to be adequate for road traffic although this width is hardly sufficient for two motor vehicles to pass each other. At present Tempo services are well established from Matlab Bazar to Kalipur Bazar. Road transport has been found quite attractive to local people,

compared with the previous water transport system, due to reduced travel time, but the road network within the project is incomplete. Rickshaws are plying in areas of embankment near Matlab Bazar.

Discussions with BWDB staff, interviews with local people and on site observations in 1991 indicated that about 30 per cent of the repair or rehabilitation work on damaged irrigation and drainage canal systems has yet to be completed. About 75 per cent of the peripheral irrigation canal systems along with its branches up to certain length into the interior part of the project is functioning well (with some minor difficulties). The people in these areas are achieving good agricultural output and are happy with the project.

3.3 PROJECT IMPACT AND PERFORMANCE

Section 3.2 has highlighted problems with the implementation, design, and performance of the project. Project performance falls into two phases: 1987 and 1988 when it failed and 1989-91 when it has been technically very successful. In the latter years 65 per cent of cultivated land is no longer flooded when previously all had been under water in the monsoon. By 1991 the irrigation system was functioning well. Consequently there has been a very large increase (69,000 mt) in paddy output, with a cropping intensity 60 per cent higher than in the control areas and yields of 4.4 mt/ha for all paddy varieties compared with 2.5 mt/ha for the control area. B Aman has been replaced by HYV Aman and rabi crops by HYV Boro, while there has been a substantial growth in the area under Aus (HYVs). Perhaps as a result farmers have invested in more livestock.

The open water fishery which had existed within the project area has been decimated since the floodplain is no longer under water and khals are cut off from the rivers outside, also there are limited numbers of ponds where fish cultivation is carried out. Boat transport had been very important in the project area, but the khals have now been cut off from the main rivers. Internal roads have not been built, so although the embankment itself helps by acting as a road, internal communications have been worsened.

Consequently there is more work for agricultural labourers and household incomes are substantially higher than in the control area, although most of this benefit has accrued to larger landowners and fishermen and boatmen have been disadvantaged. The long term impact of the flood control and drainage element of the project will ultimately depends on how reliably the benefits of 1989-91 can be achieved. However, despite the large agricultural benefits the Project had very high capital costs and suffered delays during construction resulting in a low economic rate of return of about 7 per cent.

3.4. OPERATION OF PROJECT

3.4.1 Technical assessment

Most of the operational problems during the first five years of this project's life stem from problems in the planning and construction phases of this project, rather than to negligence in post-completion operation.

According to the Feasibility Report the location of the flood embankment in relation to the bank of the Meghna and Dhonagoda rivers was determined on the basis of security in the face of 100 years of river bank erosion. In fact portions of the embankment (Eklaspur to Amirabad) on the Meghna river side experienced damage and consequently that portion of

the flood embankment has been retired twice. During field visits in 1991 the set back distance for the portion of the flood embankment near Uddhamdi pumping station was observed to be inadequate, and, although some protective measures are being taken by placing boulder layers on the river side slope, their durability remains questionable. Also near Eklashpur high additional expenditures were made in casting concrete blocks for embankment protection where the embankment is directly open to some 5 km or more of the Lower Meghna. There is therefore a serious question regarding the accuracy of the erosion rates assumed for design purposes, and whether these were revised according to experience during the feasibility study and construction phases, other than simply reacting to embankment loss by retreating the alignment and rebuilding.

The soil investigations of the embankment bottom indicated that the percentage of silt and sand varies with depth. Also, it was mentioned in the Feasibility Report that soil moisture in the project area directly changes with water level fluctuations in the Meghna and Dhonagoda rivers which indicates that subsoil permeability may be critical for development of piping through the foundation of the flood embankment. In fact after construction of the flood embankment this type of piping action was observed by BWDB officials in several places around the embankment and was considered to be mainly responsible for failure of the embankment in 1987 and 1988 in the Durgapur area.

In the first Feasibility Report the crest width of the embankment along the Meghna and Dhonagoda rivers was recommended to be 20 ft. (6.1m) and 17 ft. (5.2m) respectively. During detailed design the width was reduced to 14 ft. (4.25m), and it seems probable that this reduction affected the stability of the embankment. The inclusion of the peripheral canal system in the flood embankment was undoubtedly a good approach for minimizing hydrostatic pressure of flood water from the river side, but this objective could have been completely achieved only by placing primary canals along the whole embankment. If this were not possible for some portions (say the Durgapur section) then additional protective measures should have been taken for that particular portion to withstand hydrostatic pressure at high river stages.

In the BWDB Project Completion Report and the Recommendations For Embankment Damage Protective Measures a number of faults in the survey and design of different project components. These include:

- foundation design of both primary pumping stations (one of these gave many difficulties during construction and the other's foundation was cracked and later rehabilitated at high cost);

- low factor of safety in the stability of the flood embankment; and

- inadequate size of canal dykes.

During construction of all earthen components of the project labour intensive methods with manual compaction were followed. In fact, for such a massive and sensitive construction work as a full flood embankment labour intensive manual compaction hardly gives the intended degree of compaction except in some places with good soil conditions. The canal dykes were appropriate for manual compaction, but they seem to have been less well compacted than was needed. This inadequate compaction has accelerated the spread of rat holes, both in the flood embankment and in canal dykes.

The repaired embankment has successfully withstood the 1989 and 1990 floods, and on this evidence seems adequate to withstand the normal yearly floods caused by the Meghna and Dhonagoda rivers in the project area.

Discussion with BWDB staff on the operation of Uddhamdi and Eklaspur pumping stations gave no evidence of serious drainage congestion (except some minor congestion created by local people) in the project area. This situation is possible because the two primary pumping stations were designed to satisfy major drainage requirements. A visit to MDIP in the second week of September 1991 further confirmed the adequacy and satisfactory operation of the two main pumping stations at Uddhamdi and Kalipur. At that time all four pumps at Kalipur pump house and 5 out of 6 pumps at Uddhamdi pump house were operating for drainage purposes; and there appeared to be minimal drainage congestion in the project.

3.4.2 Institutional and social assessment

For efficient management of MDIP a special type of institutional structure was suggested in the PP and in the O&M manual by the consultants (Chuo Kaihatsu, 1985). This aimed at:

- efficiency in O&M including collection of water rates; and
- close coordination of agricultural activities through farmers organizations within the project area.

The new organizational set up was to come into force on completion of the Project and was to include a Project Director and his staff along with local organizations in the form of committees at various levels.

The structure provided for a Project Coordination Committee at project level, an Upazilla Committee at Upazilla level, a Union Irrigation Association at Union level, and at the lowest level the Turnout Irrigation Association (TIA). The TIAs are the primary unit of beneficiaries with irrigation facilities, and were to be formed at each turnout. The number of turnout committees would be around 408 in the whole project area of MDIP.

The committees were to be responsible for implementation and coordination of strategies, plans and programmes within the service area of the system, with specific responsibilities as described below.

a) Project Coordination Committee

The Project Coordination Committee (PCC) would be responsible for overall agricultural development, including water management, mobilization of resources, and input services. The committee was to meet at least once a month. The composition of the committee was to include heads of various departments posted at the project level who are directly related to agricultural development, input supplies and grass roots level institution building. It was made a broad-based committee under the chairmanship of a Project Director at the rank of a Superintending Engineer.

b) Upazilla Committees

The Upazilla Committees were to be responsible for coordination among Union Irrigation Associations and mobilization of agricultural inputs and credit, and were to hold meetings once a month.

c) Union Irrigators Associations

The intended objectives and functions of the Union Irrigators Associations were:

- identification of water management problems, relating to irrigation, drainage, and wastage of irrigation water, and their solution;
- guidance to the beneficiaries on construction and maintenance of farm ditches, field channels and drains;
- to receive and settle claims from among the beneficiaries; and
- holding regular meetings twice a month.

d) Turnout Irrigators Associations

The responsibilities of Turnout Irrigation Associations (TIA) were to be:

- Equitable distribution of water;
- Excavation and maintenance of field channels;
- Arrangement of agricultural credit;
- Arrangement of minor repairs;
- Resolution of disputes;
- Preparation and execution of water distribution schedules; and
- Realisation of water charges.

During visits of the FAP 12/13 team inside the project area it was found that the official committees have not been implemented as yet. Efficient functioning of such a project needs detailed operational and maintenance guidelines. In particular, the network of structures require coordinated operation, and the earthen structures by their nature demand regular maintenance work. In order to fulfil these objectives an operation and maintenance manual was provided by the Consultants. The O&M manual is in general adequate, but it fails to give any practical guidance for operation of the complex water management system (maintenance of the pump houses for example is covered separately by technical manuals). Also the institutional arrangement proposed was not field tested and no technical assistance to help implement it was provided, in particular there appears no justification for separate Project and Upazila level committees since the whole of the Project lies within one Upazila and hence primary liaison with other departments concerning Project management should be with the concerned Upazila officials. BWDB officials stated that they are not in a position to implement the manual.

However, in places private initiatives have been successful in fielding a good number of low lift pumps. In one example, a committee has been formed under the leadership of a local Member of Union Parishad to operate four low lift pumps (LLPs). The parties in the operation are:

- the maintenance contractor who supplies 4 LLPs;
- the Irrigation contractor who ensures water delivery;
- the revenue collector who collects water charges;
- the general members who receive irrigation water; and

- the committee which coordinates operations and supports debt recovery.

The members pay Tk.1200 per kani (1 kani = 0.40 acre) per season. The charges cover the cost of hire of the pumps, fuel and lubricating oil and repairs plus some profit for the operation.

This initiative shows two things very clearly: first, the people are interested and capable of organizing themselves for water management, and second, the beneficiaries are willing to pay for the service they receive. These examples should guide the Water Board in implementing the various committees envisaged in the feasibility study, the PP and the O&M Manual. Once genuinely representative committees are in place they will promote beneficiary participation in the decision making process of running a water management project, including sharing the responsibility for operation and maintenance of the project.

3.5 MAINTENANCE

3.5.1 Technical assessment

The embankment has been repaired where breached and eroded, although as noted earlier there are medium (even short-) term risks of continued erosion. Also the pumps seem to be effective for drainage (the status of infrastructure is given in Table 3.1). However, many of the internal channels (irrigation in particular) remain to be re-excavated.

A programme was started in 1988 to rehabilitate the flood damaged works and also to strengthen and protect the flood embankment. The programme, which is scheduled for completion in 1991 (at a cost of Tk 280.7 million) was reported to be 60 per cent complete in June 1990. It is expected to complete 100 per cent of the work in the scheduled time. During visits to some sample areas of the project it was observed, and also confirmed by the local people, that much of the repair/rehabilitation work on the irrigation canal systems is of **poor quality.**

3.5.2 Institutional and social assessment

During project site visits it was observed that some portions of the damaged irrigation canal system were being repaired/rehabilitated by the local people on their own initiative. A number of PVC and steel pipes inserted into the irrigation canal dykes indicate that the number of turnouts designed or implemented was insufficient to provide water to the fields or that their locations were not agreed with the eventual users. In most of the irrigation canals dense vegetation exists within the waterway which, along with thick sediment on the canal bed, causes reduction in actual flow through the canal. Due to lack of proper compaction, randomly scattered rat holes, cattle grazing along the slope of irrigation canal dykes and local people using the sides of these canals for bathing and washing clothes, severe damage is being caused to the interior sides of the irrigation canal dykes.

Some turnout locations have been found useless due to borrow pits dug on the outlet side. Pipes used in turnouts are inadequate in size in many places, and beds of turnout pipes are inconsistent with the canal bed. Due to poor workmanship water leakage has been found in some aqueducts and drainage conduits. In a few cases proper levelling of structures both internally and with respect to the canal bed was not maintained. For example, the crest level of one escape was found to have a higher elevation than the check gate and regulator on the downstream side.

Table 3.1 Summary of the Main Existing Project Features

Items	No./Length (km)		No./Length(km) Damaged 1987 and 1988	No./Length (km)		Remarks
	As Planned	As Implemented		Repaired/Modified	Need repair/modification	
A. Flood Embankment	65 km.	60 km.	46.78 km.	46.78 km.	-	
B. Pumping Stations:						
i. Main P.S.	2 Nos.	2 Nos.	-	-	-	
ii. Booster P.S.	3 Nos.	2 Nos.	-	-	-	
C. Irrigation Canal						
i. Main & Secondary		97.5 km.				
ii. Tertiary		120.5 km.				
Total:	75 km.	218 km.	162.28 km.	74.70 km.	18.50 km	
D. Irrigation Structures:						
i. Regulator	69 Nos.	69 Nos.	-	-	-	
ii. Irrigation Conduit	14 Nos.	14 Nos.	2 Nos.	2 Nos.	-	
iii. Check Gate	42 Nos.	42 Nos.	-	-	-	
iv. Turn out	387 Nos.	387 Nos.	358 Nos.	358 Nos.	-	
v. Escape	17 Nos.	17 Nos.	1 No.	1 No.	-	
vi. Aquiduct	3 Nos.	3 Nos.	-	-	-	
E. Drainage Canal	160 km.	125.5 km.	38.25 km.	-	-	
F. Drainage Structures						
i. Drainage Conduit	39 Nos.	39 Nos.	7 Nos.	7 Nos.	-	
ii. Combined Structures	14 Nos.	14 Nos.	-	-	-	
iii. Water Control Strc.	9 Nos.	9 Nos.	-	-	-	
G. Bridges	72 Nos.	72 Nos.	6 Nos.	6 Nos.	-	20 new bridges constructed

Source: RRA Survey

So far repair and rehabilitation have been funded from external sources, and with the failure of the project in the first two years farmers could hardly be expected to pay for O&M. However, they are now benefiting from the project (at least in 1989 and 1990). In the Feasibility Study it was mentioned that the annual O&M cost would be around 300 US dollars per hectare, and that the farmers in the project area would have to pay water charges which would cover fully all operation and maintenance costs. In addition, it was envisaged that after a period of income growth, farmers would be able to make a contribution to development costs.

Farmers were intended to commence paying water charges with the season during which they are first supplied with irrigation water. However, in practice even after two years of full operation of the project BWDB has neither put the Irrigation Associations in action nor have the water charges been fixed or levied. This should be done immediately, but seems destined to fail unless linked with re-excavation of channels, a management plan, and participation by farmers in developing that plan.

Operation, management, maintenance and revenue collection all depend on beneficiary participation and functioning of committees. However, due to the previous setbacks the concern of BWDB is almost exclusively focused on protecting the embankment, and little attention is being given to the people's involvement in project management. The BWDB hierarchy also seems to be isolated from the local administration. In particular, the Upazilla chairman complained that in spite of written requests, BWDB's Sub-Divisional Engineer, who is Secretary of the Upazilla Irrigation Committee, has failed to call meetings of the Committee.

3.6 O&M COSTS

Data on O&M costs are only available for MDIP for three financial years: 1988-89 to 1990-91, however this was an unusual period given the major damages to the Project from the 1987 and 1988 floods, and that irrigation was not functioning near its target level until the last of these years.

Table 3.2 summarises the O&M costs reported in these three years. It is not possible to estimate from this data what the normal level of maintenance costs will be, even the mechanical maintenance figures may be inflated by repairs to damaged gates although considering the high value infrastructure involved in the Project relatively high mechanical maintenance costs can be expected. It is also apparent that establishment costs are high averaging in 1990-91 Tk 1442 per net cultivated hectare (these establishment costs include BWDB colony running costs such as electricity). It seems clear that there is great scope for reducing establishment costs and that this will be necessary if there is to be any hope of realising O&M costs from farmers. Hopefully once rehabilitation is completed the staff allocated can be substantially reduced.

MDIP inevitably has high electricity costs since the pumps are for drainage and irrigation. The monthly breakdown of these costs provided by BWDB suggests that irrigation pumping runs from about October to June inclusive since the two booster pump stations (which are used only for irrigation) are operated in these months. However, these booster pumps incur substantial electricity costs in the off season (36 per cent of on season costs in 1990-91), moreover off season costs increased by 6.6 times between 1989-90 and 1990-91 when the peak irrigation season costs increased by only 3.7 times for the same two pumps. Detailed monitoring and adjustment of the operation of the pumps in relation to target water levels and the functioning of the system is required as there is probably scope to reduce these costs while still serving farmer's needs.

Table 3.2 **O&M costs (Tk million actual financial costs) of MDIP 1988-89 to 1990-91**

Financial year	Establishment		Electricity	Maintenance	
	Civil	Mech		Civil	Mech
1988-89	6.20	5.62	8.21	(	4.98
1989-90	8.50	5.69	6.85	202.90	3.66
1990-91	15.85	4.88	11.17	(	2.83

Note: civil maintenance refers to all flood damage repair works during the three years 1990-91 civil establishment includes electricity for BWDB buildings (presumably not pump houses)

Source: BWDB unpublished data, SE (MDIP), Chandpur, 21/10/91.

Overall the O&M costs reported amount to about Tk 2417 per net cultivated hectare in 1990-91 financial prices, which is very high. While there is room to reduce these, for example less staff will be needed once the system is rehabilitated, these figures make no allowance for routine civil maintenance - that is embankment, khal and canal maintenance and maintenance of civil structures. It is likely that these costs will be very substantial on average, and that this will more than outweigh any saving on other costs which can be achieved. Moreover there is a high probability that continued non-routine works will be needed to protect the investment such as embankment protection works, and these costs have not been allowed for. It is essential that routine maintenance costs are estimated and programmed based on the actual infrastructure and relevant maintenance experience so that the financial implications of the Project are properly understood.

3.7 LESSONS

1. The organisational problems of MDIP reflect a more deep-seated problem of BWDB attitudes towards project development. BWDB follows a technical approach which emphasises the attainment of physical targets over the social aspects of development, and frequently appears to adopt a proprietary attitude towards projects which excludes the participation of other institutions. The social aspects however cannot be ignored, since long-term sustainability depends on involving the beneficiaries in the decision making process, especially as regards water distribution, fixing and collecting water rates, and settling disputes.

2. O&M were handicapped by problems of project planning and implementation which indicate that better pre-implementation studies are required. There is no liability on the bodies responsible for such failures to compensate those adversely affected either permanently (loss of livelihood of fishermen and boatmen, for example) or periodically (whose crops and homes are flooded) by avoidable embankment failures.

3. There are opportunities to lease out project infrastructure, particularly borrow-pits for fish cultivation, which would help to mitigate a major negative impact and could benefit the landless or ex-fishermen.

4. It is unlikely that water charges will be realised effectively when the provision of water and benefits have been so mixed, and farmers have come to expect water to be available. Agreement to pay fees needed to be achieved during intensive pre-completion (preferably pre-project) discussions and group formation and not, at best, tacked on after the project was built.

4. ZILKAR HAOR PROJECT

4.1 PROJECT BACKGROUND

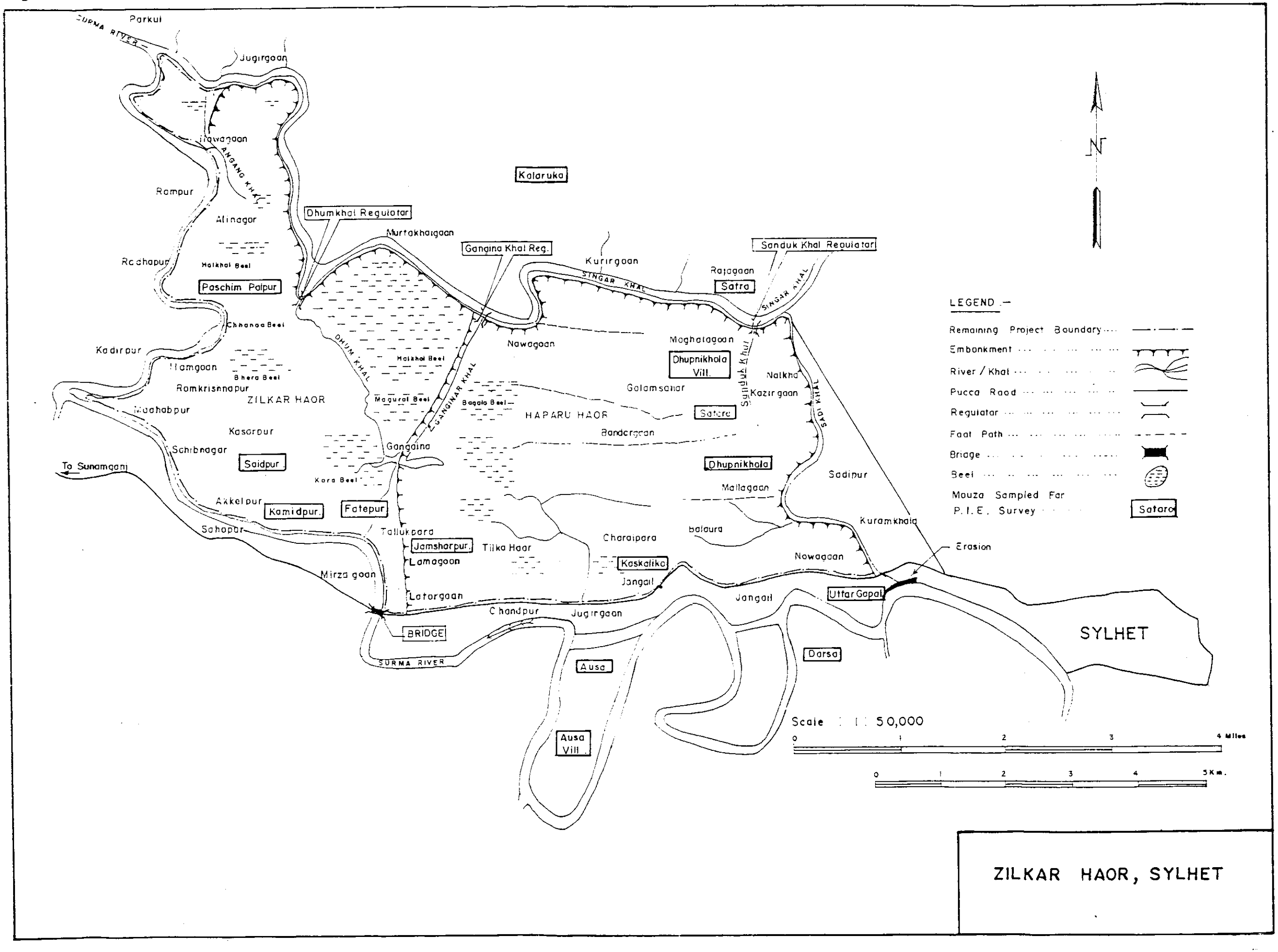
4.1.1 Project Summary Sheet

Project Name	: Zilkar Haor Project
Project Type	: Flood Control, Drainage and Irrigation (submersible and full flood protection embankments)
Location	
FAP Region	: North-East
District	: Sylhet
Area (ha.)	: 5263 ha. (gross), 4251 ha. (net cultivable)
Funding Agency	: EIP (Netherlands and Sweden)
Implementing Agency	: BWDB
Construction started	: 1983/84
Scheduled Completion	: 1986/87
Actual Completion	: 1987/88
Original Cost Estimate	: Tk 49.9 million
Final Cost Estimate	: Tk 75.5 million (1991 prices)
Major Flood Damage:	: 1988
Repair/rehabilitation in	: 1988/89

Major works still required for completion/rehabilitation:

All works have been completed. Strong local demands for enlarged regulators and an additional regulator(s) to remove drainage congestion. Need to stop serious inflow of water through culverts/control structures.

Figure 4.1 Zilkar Haor Project - Key Features



4.1.2 Background

The project area consists of two haors, Zilkar Haor and Haparu Haor, with the former being 1.8m lower than the latter. The two haors have been divided by an embankment with irrigation inlets. The overall project area is bounded in the south by the Sylhet-Sunamganj highway, which borders on the Surma River, and serves as an embankment. The Singer Khal (actually a river) forms the northern boundary (Figure 4.1).

The haors are roughly saucer-shaped, with the periphery somewhat elevated, ranging from 26'-34' (7.9-10.4m) PWD, and the centres depressed and low-lying (usually 16' - 20' PWD). In general, the gradient slopes towards Singer Khal in the north, with the eastern and southern peripheries being more elevated than the western edge. As is to be expected, the homesteads are on higher ground, concentrated around the haor periphery.

Before the project traditional Boro cultivation was the main agricultural activity, along with open water fishing and livestock grazing in Zilkar Haor. Indigenous irrigation techniques were used to irrigate local Boro. Some 37 per cent of the cultivable land was planted under Boro, but was susceptible to a high risk of flood damage during April-May. The higher reaches of the Haor were used to cultivate local Aus-Aman crops. In Haparu Haor, the farmers tried to cultivate B.Aus and T. Aman but suffered high levels of damage due to monsoon floods in July-August. The project areas faced flood damage as they were open to the onrush of flood water from both the Singer Khal and the Surma River.

4.2 PROJECT AS IMPLEMENTED

The following project facilities (see Table 4.1) were provided by BWDB:

- Full Flood Embankment = 15.8 km
  (top width = 12' for 12.3km, 8' for 3.5km; side slope = 1:3)
  Submersible Embankment = 8.91 km
  } 24.71km

- Regulators = 3 nos. (one 1 vent; one 2 vents; one 3 vents)
  Pipe Sluices = 5 nos.
  Pipe inlets = 25 nos.

- Main drainage Channel = 1.5 km.
  Minor " " = 2 km.

Pre-monsoon flash floods were to be controlled by a full flood embankment for Haparu Haor and a submersible embankment for Zilkar Haor. The full flood embankment, the drainage regulators/sluices and the drainage canals would provide protection to T. Aman crops in the Haparu Haor areas. The existing gravity irrigation system by LLP would be facilitated by constructing a number of pipe inlets in the embankments.

4.3 PROJECT PERFORMANCE AND IMPACTS

The overall impact of the project has been positive, mainly through its impact on agriculture. The Project has succeeded in protecting the area from early flash floods but in Haparu Haor full flood protection is associated with drainage congestion. Irrigation has expanded probably because of greater security from flooding.

Table 4.1 Summary of Condition of Main Existing Features of Zilkar Haor Project

	Present condition of structures									Present condition of Embankment		Present condition of Drainage channels
	Regulator/Sluice							Gate				
	No. of Vents	Type of Gate	Wing Wall C/S	Wing Wall R/S	Box	Apron C/S	Apron R/S	Gate	Rubber Seal/Grove	Full Flood Protection	Submersible	
Dhum Khal Regulator	2	FB							N/A			
Ganginar Khal Regulator	3	VL	G	G	G	G	G	G	?			
*Sanduk Khal Regulator	2	FB	G	G	G	G	G	G	F			
*Box culvert at Jangail	1	FB	G	G	G	G	G	?	N/A			
*Box culvert at Jangail	1	FB	G	G	G	G	G	?	N/A	Total length 15.80 km. Top width 12 ft. for 12.3 km. and 8 ft. for 3.5 km. Side slope = 1:3	Total length 8.91 km. Top width = 8 ft. Side slope = 1:3	Main drainage channel = 1.5 km. Minor drainage channel = 2 km.
*Box culvert at Jangail	1	FB	G	G	G	G	G	?	N/A			
*Box culvert at Jangail	1	FB	G	G	G	G	G	?	N/A		50% of length needs repair	The drainage channels need re-excavation
**Bridge at Chandpur	open									50% of length needs repair		
**Bridge at Chandpur	open											
***Bridge at Latargaon	1	VL	G	G	G	G	G	G	?			
***Bridge at Latargaon	1	VL	G	G	G	G	G	G	?			

* RHD, Box Culvert on Sylhet- Sunamganj road functioning as water control structure for this project.
** RHD, Bridge on Sylhet- Sunamganj road without any water control provision possibly due to little or no impact on the project.
*** RHD, Bridge on Sylhet- Sunamganj road modified to water control structure by constructing one vent regulator box through the bridge opening and filling the gap by earth.

Gate type: FB = Fallboard VL = Vertical Lift
Condition: G = Good F = Faulty

Consequently there has been a substantial increase in the area of HYV Boro, and an increase in average annual L Boro yields. Overall the weighted average paddy yield in the Project is double that in the control area reflecting the expansion of HYV Boro and flood damage reduction.

Road communications have improved slightly and some protection from flooding of infrastructure and property has been provided, however in 1988 damages were greater inside the Project than in the control area. The Project has increased agricultural employment and incomes and welfare overall - for example housing conditions are better. However, the benefits have not been evenly distributed, benefits accrued to landowners and particularly larger landowners (over 0.4 ha.) who have significantly higher incomes.

Three moderate negative impacts were identified:

- reduction in open-water fisheries, fewer fish traders, less access to community fishing facilities (there are few ponds to benefit from flood protection);
- slightly poorer livestock situation - fewer animals and less feed for bovine livestock; and
- boat transport has been adversely affected by blocking of routes, resulting in the virtual disappearance of boats and boatmen from a number of villages and loss of bulk haulage facilities.

Social tensions have been heightened by the Project, particularly between farmers and fishermen and farmers and boatmen, and over drainage problems. For instance, in 1990 the farmers in the north western part of Haparu Haor were actively contemplating cutting the embankment to let out the water destroying their crops, and were barely restrained from doing so. They were again threatening to do so in 1991. However, they also expressed fear of legal actions that may be taken against them if they do cause a cut in the embankment. They also realise that once cut, repairs may take a long time to be effected. Actually, these threats are mainly to draw attention to the drainage problem so that a solution is expedited. They would not want to lose whatever benefits they are currently enjoying from the project.

Overall despite high construction costs the Project has achieved substantial benefits and moderate negative impacts (which are difficult to quantify), giving a high EIRR of 41.5 per cent.

4.4 PROJECT OPERATION

4.4.1 Technical assessment

In general the embankment, regulators, sluices and pipe inlets are working as planned. The main problem is the attempt to give full flood protection and drainage to part of the project: Haparu Haor area is facing acute drainage congestion during the main monsoon season causing damage to T. Aman in the lower areas.

The structures in the embankment and the Sylhet-Sunamganj Road (which acts as a flood control embankment for the project in the south) leak and there is huge infiltration of water into Haparu Haor during high stages of the Singer Khal and Surma river. These problems appear to arise from poor maintenance and problems with the design of the structures. Local people complained that the fall boards of the pipe inlets and culverts are

lying with the U.P. members and other influential people of the locality and they do not take proper care to put these fall boards in place on time. The flap-gate at Sanduk Khal regulator needs repair, and all the regulators/sluices need timely operation to stop infiltration. The existing regulators seem to be inadequate to cope with the drainage problems due to infiltration and heavy rainfall during the monsoon.

Local beneficiary participation and repairs to the structures are needed to improve operation. After excess infiltration of water has been stopped, the existing drainage facilities (drainage regulators and drainage canals) need to be evaluated to examine the capacity of the existing facilities, and in case of inadequacy, additional drainage facilities would need to be provided at an early date, to achieve the planned objectives of the Project.

4.4.2 Institutional and social assessment

There are reports of sharp conflicting interests, as before, between fishermen/fish traders and farmers about the time of draining out water from the beels. However, the beneficiaries also seem to be aware of the rule of law, and to be optimistic about the visible positive benefits already created or to be created by the project. They did not cut the embankment nor break the sluice gates even when there was serious drainage congestion in the project area during normal monsoon floods.

Likewise, the conflicts over leasing of beels and borrow pits still exist, but these are also resolved, mainly socially as before, through the intervention of local leaders, who are socially interlocked by kinship, marriage or business and political ties. Nevertheless, now that the potential benefits of these open access resources have increased, the intensity of such conflicts has also increased with a concomitant increase in the demand for legal interventions by the offices of BWDB, Deputy Commissioner, Land Revenue Department and police. For example, the conflicts between fish traders of Fatehpur and farmers of Dhumkhal over the opening and closing of Dhumkhal sluice gate in 1990 required the office of the Deputy Commissioner to issue strong notices about when to close and open the gate.

The project has created more open access resources such as borrow-pits for fishing or for raising seedlings, and the embankment for shelter, cattle grazing and drying and storing of crops in the wet season. The leasing of borrow-pits has also been a source of modest revenue collection of about Tk 8000 annually. BWDB seems to have dealt with the leasing function satisfactorily, except that BWDB had to cancel leasing one year because the highest bidder failed to deposit the full auction money within the stipulated time.

Irrigation pipe inlets are not closed on time, so that pre-monsoon flood water enters the project area. There are no formal inlet committees, nor were any explicitly mentioned in the project documents. BWDB and/or the local administration should be more active in involving local beneficiary farmers in opening and closing the irrigation inlets in time. Specific responsibilities need to be assigned to specific groups of irrigation beneficiaries. These groups might be formed in consultation with BWDB, members of Union Parishads, and the beneficiaries themselves. An option would be to employ khalashis, but this would increase the O&M costs of the Project unless local resources could be mobilised and for most of the year they would have no work to do.

Local elites and landed households are still powerful and the poor are dependent on them for their livelihood. The Socio-economic Baseline Survey pointed out that "unless organized through institutional backing the local landed elites will never allow these people [the landless and marginal farmers] to take any share of benefits". Although this RRA could not produce conclusive evidence on changes in the dependence of the poor on landed elites,

the landed elites sharecrop out more land to the poor and share input costs, especially in irrigated HYV Boro paddy production, and they also employ the landless and marginal farmers as wage labourers on their own cultivated land, and pay the harvest labour a fixed proportion of paddy output.

4.5 MAINTENANCE OF THE PROJECT

4.5.1 Technical assessment

a) Embankments

About 60-70 per cent of the embankment length is in bad shape. The top width has been reduced by wave action and rain cuts, severely damaging the side slopes and making the embankment weaker at several locations.

b) Structures

The condition of the main structures of the Project are given in Table 4.1. Fall-board grooves have been found to be damaged at most of the structures. The floor (apron) and side slopes of the river side channel of Gangina Khal regulator have also been severely damaged. The flap gate of Sanduk Khal regulator needs maintenance.

All the culverts on the Sylhet-Sunamganj Road where it serves as the project embankment, which have been converted to control structures within the project boundary, need repair and modifications to seal them against inflow of flood water into the project area.

4.5.2 Institutional and social assessment

At present there is no routine maintenance work on the project. It is unclear from the RRA whether the embankment is maintained by FFW, or whether it is deteriorating under repeated submergence.

Possibilities of involving groups of landless men and women in the repair and maintenance of embankments, not only as wage labourers but also as work contractors, should be explored. The experience of the Early Implementation Project in working with NGOs, such as Friends In Village Development in Bangladesh, elsewhere in this region for organising Labour Contracting Societies which achieve better quality earthwork might be expanded on for annual resectioning work.

4.6 LESSONS

1. Improved drainage operation requires better maintenance and design of structures: regulator gates need to be sealed and culverts closed properly. However, most of the problems are related to organisation and management. Fall boards for pipe sluices should be made available on time and put in place when needed. There are 25 pipe sluices so this requires coordination between inlet users. This is basically a software problem requiring proper management and community participation. It is not a hard-ware problem. Local project committees need to be geared up for the purpose.

2. A positive aspect that needs highlighting is the high level of participation of the local people in project implementation. BWDB approached and involved the local people

much more than is usual in FCD/I projects - and despite a lot of initial confusion, the people became involved and identified with the project. There was consultation between BWDB and local people at the planning stage with respect to land acquisition, alignment of the embankment, construction of sluice gates, and provision of pipe inlets for irrigation.

3. Further, fixation and payment of compensation for land requisitioned, was efficiently conducted. People seemed to be satisfied with the speed of payment of compensation for acquired land, except that the amounts compensated per unit of land were much lower than the prevailing prices of land. But the people also realized that amounts of compensation were fixed on the basis of land prices quoted in recent legal deeds, which are in general undervalued to evade government taxes.

4. Such lack of complaint about land acquisition and compensation facilitated, by and large, the cooperation of local people in the closing and opening of sluice gates, although the sluice gate committees for Nawagaon and Dhumkhal are composed of members from influential large land owners and fisheries lease holders. The act of cooperation, or at least people's restraint from violent clashes, over disagreement about closing and opening of sluice gates appeared to be positive lessons to be learned for the long term viability of any project.

5. Maintenance requirements will continue to be high since wave action has considerably reduced the slope of the embankments, requiring resectioning of up to 50-60 per cent of the embankment; this is inevitable along the side of an open haor.

5. KOLABASHUKHALI PROJECT

5.1 PROJECT BACKGROUND

5.1.1 Project Summary Sheet

Project Name	: Barnal-Salimpur-Kolabashukhali (KBK) Project
Project Type	: Flood Control (saline exclusion) and Drainage
Location	
FAP Region	: South-West
District	: Khulna
Area (ha.)	: 25,500 ha. (gross), 18,623 ha. (irrigable)
Funding Agency	: IDA
Implementing Agency	: BWDB
Construction started	: 1979/80
Scheduled Completion	: 1983/84
Actual Completion	: 1983/84
Original Cost Estimate	: US$ 6.20 million / Tk 93.0 million (1975 prices)
Final Cost Estimate	: Tk 224.25 million (1991 prices)
Major Flood Damage:	: 1988
Repair/rehabilitation in	: 1990/91

Major works still required for completion/rehabilitation:

Resectioning/retirement of sections of embankment.
Repair of poorly constructed regulators.
Construction/upgrading of internal road system.

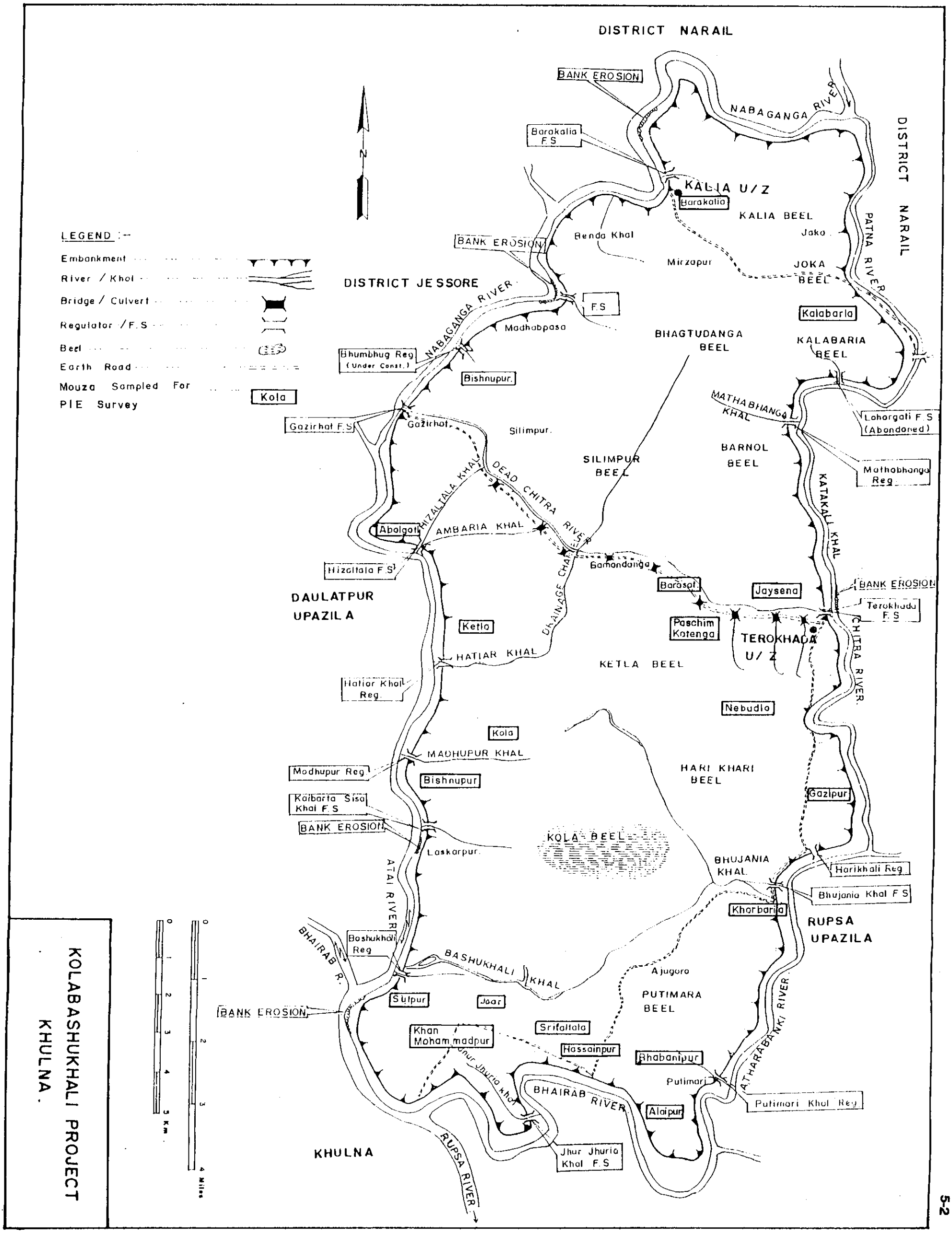


Figure 5.1 Kolabashukhali Project - Key Features

5.1.2 Project description

Kolabashukhali Project is a combined flood control and drainage project located on the border of Jessore and Khulna Districts and falling within the FAP South-West Region. Administratively the area falls under Kalia Upazila of Jessore District and Terokhada, Rupsa and Daulatpur Upazilas of Khulna District, none of the Upazilas concerned falling wholly within the Project.

The Project area is a tidal river island, approximately 25,500 ha in gross area, surrounded by the Atai river to the west, the Nabaganga to the north and north-west, the Chitra and Patna to the east, and the Atharbanki and Bhairab to the south and south-east (see Figure 5.1). The rivers have a tidal range of upto 2.44m (8 ft), sufficient in the absence of flood control to inundate the low-lying parts of the area daily. In the low water season from February to May saline water advances north-wards, making irrigation with river water impossible except at the northern extremity.

The island has a rim of relatively high ground (over 2.5m above PWD datum) around the edge and along the levees of numerous khals which penetrate the interior. Most of the interior, however, consists of low lying land, much of which was occupied by beels in the pre-Project period and was flooded both daily and seasonally by water penetrating through the khals. As a result, before the Project a large area was uncultivated, and much of the rest could grow only a single crop of deep-water Aman.

The Project aimed to control both daily and seasonal flooding by closing the outfalls of the khals into the main rivers with regulators, which could be opened at low tide and low river stages to permit drainage of excess water. Some of the regulators were also intended to admit water for irrigation, in continuance of existing local practice. To provide protection against high river stages and exceptional floods, a ring flood protection embankment was also constructed round the entire periphery of the project.

The objective of the project interventions was to make available for cultivation land which had previously been too deeply flooded, and by providing shallower and more stable water levels to encourage the move from low yielding B. Aman and Aus/Aman to higher yielding transplanted Aman. Although facilities were provided for two way operation, irrigation was not a major objective, due to the limitations posed by water salinity in the dry season.

5.2 PROJECT AS IMPLEMENTED

Aspects of the eventual Kolabashukhali Project were first started in 1961-69 by local government but could not be carried out due to insufficient preparation and changes in the scope of work. A feasibility study was undertaken in 1977, funding of the project was taken up by IDA in 1978-79. The project was declared complete during the year 1983/84.

The engineering features of the project as implemented are:

- Length of embankment = 53.13 miles (85.50 km);
- Structures: Drainage regulator = 6 nos
  Flushing sluice = 9 nos
  Drainage-cum-Flushing sluice (under construction) = 1 no.;
- Access roads = 11.75 miles (18.9 km);

- Culverts = 9 nos.; and

- Excavation/Improvement of drainage channel = 5.5 miles (8.85 km).

5.3 PROJECT PERFORMANCE AND IMPACTS

The Project generally achieved its intended hydrological impact. Previously very low land has been converted to 'medium level' land in terms of normal monsoon water levels. Consequently an additional 2000-5000 ha. of land are cultivated in the monsoon. Hence the Project has fulfilled its primary aims by creating a large increase in crop production through:

- increased cultivable land in low-lying areas;
- increased cropping intensity due to reduction of deep flooding;
- reduction of salinity; and
- increased security against water level fluctuation, ensuring safer harvests of B. Aus and B. Aman.

However, the project has not yet achieved its full potential agricultural impact, due to:

- imperfect monsoon season water control in low lying areas; and
- shortage of rabi season water supply in higher areas.

There has been little change in cropping pattern compared with pre-project conditions, and in particular there has been little increase in T. Aman due to water control problems in low lying areas. Instead, as a result of greater security in the monsoon and an expansion in cultivated area, an additional 19 000 mt of paddy are produced over the without Project estimate. There is negligible irrigation in the Project, and this is mostly by traditional means and a few LLPs, L Boro cultivation has decreased.

A major limitation on agricultural output from the Project is the shortage of water supply in the Rabi and early Kharif seasons, which prevents cultivation of HYV Boro except in a few areas where river water is fresh enough to be safely used. The Feasibility Report and the Project as implemented did not seriously address this limitation, although there are areas in the Project which cannot be drained and which may have potential for combined use for water storage for irrigation and for fishery development.

Beel drainage and blockage of fish migration routes to and from the rivers have caused a major decline in both the quantity of the fish stock and species composition in both the beels and rivers, with a consequently increased risk of over fishing. Pond owners in areas where floods no longer overtop the ponds are now restocking annually with quality fingerlings for home consumption and for sale. New fish ponds are also being constructed for carp and/or shrimp culture in marginal land areas where this would not have been possible pre-project.

Overall the capture fisheries losses are estimated at between 322 and 456 mt a year, slightly offset by an additional 39 mt of pond fish. Many full time professional fishermen who were previously able to fish both beels and rivers on a seasonal basis are now forced to concentrate only on the depleted riverine stocks.

As a result of reclaimation some important wetland areas have been lost.

Communications within the Project have improved due to the embankment and an access road built by BWDB, but in the monsoon boat transport is still very important and there are no locks connecting the Project to the rivers.

Overall the Project appears to have had only a marginal impact on incomes, although the landless appear to have gained relatively more (compared with the control area) - which is unusual among FCD projects and may reflect a relative labour shortage. Housing quality in the Project has improved and the Project was successful in slightly reducing overall non-crop flood damages in 1988. The EIRR was calculated at about 25 per cent indicating the project is a substantial success.

5.4 PROJECT OPERATION

5.4.1 Technical assessment

a) Regulators, sluices and public cuts

All the existing regulators and sluices, which were constructed for a single function (either drainage or flushing) are being used both for drainage and flushing purposes, causing damage to the loose aprons and the guide bunds on both sides.

The Madhupur Khal drainage sluice has settled down by about 18 cm (7"-8") and has been out of operation during 1989-91.

The Harikhali Khal drainage sluice also settled by about 15 cm (6") but has been brought back into operation after minor repair.

The Mathabhanga regulator is still under construction, and was not in operation in 1991.

Work on the Bhumbhug regulator, which is still under construction, has stopped because of problems with the foundations.

The Lohargati Flushing sluice (1 vent) is completely abandoned and almost buried in the soil.

About 75 per cent of all sluice gates are leaking profusely, due to deterioration of the seals, causing saline water intrusion into the project area.

In 1988 there were six public cuts to relieve internal drainage congestion, three of these were between mileages 44 and 47. However, these have been repaired and public cuts do not appear to be a regular occurrence, if public cuts were only needed in 1988 this may be an acceptable operational response to severe drainage congestion.

b) Irrigation

All the flushing and drainage sluices are being used for flushing to provide irrigation water from the rivers to the existing section of the khals and to the beel depressions. There are actual and potential conflicts between cultivators and shrimp farmers over operation of the sluices, which have in the past led to sluices being opened at inappropriate times, with consequent crop damage by saline water.

The Benda Khal, near Kalia at the northern end of the project, has no regulator but is managed by local residents who close it with a cross-dam in the monsoon. It is used to get water from the Nabaganga river during the Rabi and early Kharif seasons for irrigation of HYV Boro, water being supplied to the land both by Low-Lift Pumps (LLP) and by gravity at high tide. Irrigation was observed to be still in progress during the RRA visit in April 1991. Irrigation with river water further south is risky after February, due to increasing salinity levels in the rivers, though there is a small area of minor irrigation supporting HYV Boro production on the north-east side of the Kola Beel, drawing water from the Bhujnia Khal with LLPs. These minor irrigation developments could provide a model for increasing agricultural output in KBK by expanding the irrigated HYV Boro area - care should be taken to build on these local initiatives and not to terminate the informal locally managed schemes by public investments.

c) Overall

There is a problem of saline water intrusion into the project area through the leakages of the sluice gates. Also operation of sluices, both for drainage and irrigation requirements, is not well coordinated with agricultural needs.

5.4.2 Institutional and social assessment

There is no O&M Manual for KBK project in particular, but an O&M Manual for the Coastal Embankment Project was supplied to BWDB by the then consultants (Leedshill de Leuw, 1967), and this is supposed to also be followed in the KBK project. Following the CEP O&M manual, sluices should be operated so as to remove excess monsoon rainfall and prevent saline water from entering the polder. Flushing sluices and drainage sluices, when the latter are properly designed for reverse flow, should be operated to bring fresh water into the protected area in accordance with the written schedules and specifications of the sluice operation committee.

The East Bengal Embankment and Drainage Act 1952, as amended in 1962 stated:

> "Sluices constructed in any public embankment shall be opened or shut only by or with the general or special permission of the Executive Engineer or of the officer in the immediate charge of the embankment, under such orders, either general or special as he may receive from the Executive Engineer".

According to the CEP O&M manual, the officer in immediate charge of the embankment in KBK project is the Sub-Division Engineer (SDE). He may delegate his authority to the Sectional Officer (SO). The SDE is charged with organising sluice committees, which shall consists of:

- the BWDB Sectional Officer assigned for operation and maintenance of the sluice, or his representative;
- Union Parishad Chairman, or his authorised representative; and
- Block Supervisor of the Agriculture Department.

The next immediate charge is with the Work Assistant who is authorised to operate the sluice in emergency conditions without a sluice committee meeting if the structure or crops are suddenly threatened. Each sluice/regulator should have one Sluice Khalashi (operator

or caretaker) for guarding and taking care of the sluice. Quarterly meetings of the sluice committee (local farmers) are supposed to be scheduled by the SDE, and were intended to anticipate troubles, and thus gain the cooperation of the local people.

In practice, as provided in the O&M manual, there are sluice committees almost for every sluice but they were neither properly formed nor functioning. In particular, farmers complained that the sluice committees did not represent the interests of all persons affected by sluice operations, with the result that sluices were operated in ways which adversely affected large numbers of people. Farmers in the basin of the Bashukhali Khal in particular complained of the sluice being opened in the early Kharif period, when the Atai River is highly saline, with severe damage to the Boro rice crop. This opening is thought to be done at the behest of influential shrimp farmers to facilitate catching fry for stocking shrimp ponds.

In addition there is a conflict of interest between the farmers on relatively higher land in the northern part of the project (under Kalia Upazila), and those in the low lying Kola Beel area, both over drainage and water retention. The uncontrolled drainage channels which link between these two areas mean that the upper drainage basin may be over-drained so that the lower beel is not flooded. There is a limit to the possibility of improving operation without modifying the project.

The Staff Appraisal Report (IBRD, 1978) mentioned that the DAE would be responsible for providing agricultural extension services to fulfil the agricultural development target of the project. They would also arrange construction of extension staff quarters, training centres and procurement of vehicles and necessary equipment for a training centre. The Training centre has not yet been built and training has not been imparted to the target group as was envisaged in the project document.

It appears that agricultural extension officers scarcely visit the farmers and so services are very scarce and inadequate in general, which might have contributed to low level of project effectiveness. The only evidence of extension activity seen during the RRA, for example, was a pesticide demonstration near Kalia, which had been set up by a commercial firm. There has clearly been none of the extra extension effort (over and above the normal low level) within KBK.

5.5 MAINTENANCE OF THE PROJECT

5.5.1 Technical assessment

The state of repair of the project structures during the 1991 monsoon is given in Table 5.1. About 30 per cent of the length of the embankment needed repairs and re-sectioning at the time of fieldwork (1991). According to BWDB seven stretches of the embankment totalling 15 km (9.5 miles) have persistent (almost annual) problems of 'ghogs' due mainly to crab and rat holes. During the three flood seasons 1988-1990 natural breaches due to ghogs were reported at two locations: one of four miles at mileage 30-34, and a smaller one at mileage 44.5-45, these had been repaired during 1989 under externally funded Flood Damage Repair projects.

The network of drainage channels has almost disappeared in most of the locations and does not reach to the lowest parts of the beels.

Almost all the outfall channels on the river side of the regulators are silted up to a great extent.

Table 5.1 Summary of Conditions of Water Control Structures in Kolabashukhali Project.

Type and Location of Structure	Present condition of structure									Present Condition of Drainage Channel	
	Regulator/Sluice							Gate		Need reexcavation (km)	
	No. of Vents	Gate Type	Wing wall C/S	Wing wall R/S	Box	Apron C/S	Apron R/S	Gate	Rubber Seal/ Groove	C/S	R/S
Madhabpasa F.S. (Used for Flush & Drg.), (M:2-3)	1	F.G.	G	G	G	P	L.T. to be provided	G	P	G	P
Kalia Khal F.S. (Used for Flush & Drg.), (M:6-7)	1	F.G.	G	G	G	P	L.T. to be provided	-	P	G	F
Lohargati Khal F.S.(Abandoned), (M:17-18)	1	F.G.	G	G	Filled up with soil	Buried in Soil		Not visible (Buried)	Buried	1.0 km	0.5 km
Mathabhanga Regulator, Flushing cum Drg. (M:18-19), Incomplete (New)	2	V.L.	G	G	G	G	G	G	G	2.0 km	0.5 km
Terokhada F.S. (M:21-22)	1	F.G.	G	G	G	G	G	P(C/S)	P	1.0 km	0.15 km
Harikhali Reg., (M:28-29), The Reg. operation was stopped for about 3 years	2	V.L. (C/S) F.G. (R/S)	P	P	Settled 20 cm P	P(L.T.)	P(L.T.)	1 Gate damaged	P	4.5 km	0.5 km
Bhujniar Khal F.S. (used for Flush & Drg., (M:2930)	1	F.G.	G	G	P	P(L.T.)	P(L.T.)	G	P	1.6 km	0.5 km
Putimari Khal Reg., (M:32-33)	3	F.G.	P	P	G	P(L.T.)	P(L.T.)	G	P	2.0 km	0.5 km
Jhurjhuria Khal F.S. (Used for both Flush & Drg.), (M:37-38)	1	F.G.	G	G	G	P(L.T.)	P(L.T.)	G	P	3.0 km	0.5 km
Bashukhali Khal Reg., (M:42-43)	6	V.L.	G	G	G	P(L.T.)	P(L.T.)	Lifting parts missing	P	3.0 km	0.5 km
Kaibarta Sisa Khal F.S., (M:45-46)	1	F.G.	G	G	G	P(L.T.)	P(L.T.)	G	-	-	-
Madhupur Khal Reg., (Box silted and out of operation, M:46-67) Regulator	2	V.L.	P	P	6" Settled & out of operation	G	G	Not working	G	4.0 km	0.6 km
Hatiar Khal Reg., (M:48-49)	8	V.L.	G	G	G	G	G	1 is out of operation	G	1.5 km	0.5 km
Hizaltala Khal F.S., (M:50-51)	1	F.G.	G	G	G	P(L.T.)	P(L.T.)	G	P	G	G
Gazirhat (Gangusia Khal) F.S., (M:52-53)	1	F.G.	G	G	G	P(L.T.)	P(L.T.)	P leaking under sized	G	1.5 km	0.4 km
Bhumbhug Khal Reg., (M:0-1)	Under construction (Construction stopped due to foundation failure)										

Note: C/S - Country Side; R/S - River Side; V.L. - Vertical Lift; F.G. - Flap Gate; G - Good; P - Poor; L.T. - Loose Tellus; M - Embankment mileage

The access road between Gazirhat and Terokhada (constructed by BWDB) is severely damaged at several places, particularly between Barasat school and Katenga Khal culvert. The approaches to the culverts on this road are badly damaged. There is no culvert on an existing channel near Bamandanga village and on Hatiar Khal, where people presently use bamboo bridges. This road was constructed by BWDB, although it is unclear why it was built since excavation of the 'dead' Chitra river might have maintained communications (which are mainly by boat) and could have improved drainage facilities.

There is moderate to severe erosion of the river banks, which causes damage to land and property at the following locations:

- River Bhairab at Sulpur and at Laskarpur - threat to the embankment;
- River Nabaganga at Madhabpasa and at Bara Kalia; and
- River Chitra at Terokhada - for a length of 1 km and threat to the Upazila Health Centre and Upazila Chairman's office.

A retired embankment at mileage 7-8 was built in 1989 because of erosion, and there are proposals to retire the embankment at two other locations.

5.5.2 Institutional and social assessment

As detailed in the CEP O&M manual, before preventive or corrective maintenance starts the problem must be found. This inspection consists of looking at a structure, and then having the experience to identify a need for maintenance. Once the repair work is complete, it must be re-inspected, and so the cycle is repeated.

In order to ensure an orderly flow of information on the operation and maintenance of the completed polder and to keep a firm control of the O&M programme, a standard reporting system was designed (see Table 5.2). Some items follow prescribed forms and some are written or verbal.

Table 5.2 Operation and Maintenance Reporting System

Office	Reporting Item	Inspection Interval	Reporting Interval	Mode of reporting	Submitted to
P.D.(SE)	Operation and Maintenance	Annually	Annually	Written	CE(SZ)
XEN	"	Quarterly	Quarterly	Prescribed form	PD,CE(SZ)
SDE	Operation	Twice monthly	Monthly	"	XEN, PD, CE
SDE	Maintenance	"	"	"	XEN, PD
S.O.	O&M	Weekly	Twice monthly	"	SDE,XEN
Work Assistant	Maintenance	2 per week	Weekly	Written	SO
Sluice Khalashi	"	2 per week	2 per week	Verbal	WA

Source : O&M Manual of the Coastal Embankment Project

During the last few years preventive and emergency repair/replacement O&M was undertaken by the BWDB Division Office at Khulna.

However, BWDB does not practice any well defined/prescribed inspection and management system, and KBK project is not an exception to this. The reporting structure specified in the O&M manual may have been excessive given the lack of funds for field visits, but equally BWDB has manpower and resources available but has not developed a clear programme for monitoring and maintenance. Unlike operation, where the problem is of uncoordinated and conflicting local influence, public participation is not found in the maintenance of the project.

5.6 O&M COSTS

The combined O&M set-up of Kolabashukhali project has the equivalent of 52 staff, this includes the office of the Division, it has been assumed (on the advice of the XEN Khulna O&M Division 1) that KBK covers one fourth of its area of jurisdiction. This establishment costs Tk 170,000 per month or Tk 2.04 million a year (Tk 80 per ha benefited). However, this establishment includes almost 50 per cent office and miscellaneous (non-field) staff, which include an Imam and Moazzen, and a further six mechanical staff despite a lack of pumps or other machinery in the project (excluding the speedboat which is needed for access to most of the structures and embankment). It would be possible to make considerable staff savings which would help to cover routine maintenance requirements, particularly if the 11 khalashis were made part time or were retrained to provide supervision/assistance in routine maintenance.

In the last three years (1988/89-1990/91) substantial sums have been spent on major repairs and embankment resectioning. Some 57 per cent of the embankment has been resectioned under FFW programmes averaging 16.4 km a year at a cost of 624.6 metric tons of wheat a year, this implies a five year resectioning cycle for the whole embankment. Routine maintenance programmes out of the establishment budget, or even part of the FFW resources, could free resources for other investments. Particularly in 1988/89 a large sum (Tk 10.71 million) was spent on flood damage repair, however Tk 7 million went on building two regulators (Bhumbhug and Mathabhanga), neither of these structures is completed yet. The estimated cost escalation for Bhumbhag regulator in the IDA FDR submission for 1990/91 was 60 per cent due to foundation problems with the sluice. The second highest repair cost was bank protection using porcupines at a cost of Tk 1.25 million per km for 1.26 km., although building a retired embankment at the same time appeared to have a lower cost per km.

Hence the strict O&M related costs are the FFW and establishment costs, calculated at Tk 4.67 million and Tk 2.04 million a year respectively in 1991 financial prices.

5.7 LESSONS

1. Two morphological factors have important implications for management of this, and other FCD projects:

   - river bank erosion, which will require continuing investments in bank protection to avoid breaches of the embankment and maintain its effectiveness, or retirement of parts of the embankment; and

- riverbed siltation, which results in raised water levels and may require a continual process of embankment raising in the future to maintain the level of protection initially provided and to which project inhabitants become adjusted.

2. The key institutions for efficient operation of the sluices are the sluice committees, but some of these do not exist, and all the others fail to represent the full range of interests in the areas served by their respective sluices. Hence operation of the sluices, both for drainage and irrigation needs, is not well coordinated with agricultural requirements.

3. There is no project management committee to coordinate operation of the entire polder and provide a forum for consulting the elected representatives of the project population. Such a committee is needed, for example to resolve conflicting interests in sluice operation between farmers and fishermen.

4. There has been no coordination between the development institutions responsible for and active in the project area: BWDB, BRDB, BADC, DAE, Roads and Highways.

5. The extension and advisory services of the Departments of Agriculture, Livestock and Fisheries should be strengthened and reorganised to assist the population of KBK to respond to changed conditions. Preferably in new FCD/I projects such reorganisation should occur before completion and should include an integrated institutional structure for the entire project.

6. An institutional structure (project management organisation) should be created for effective liaison between BWDB and all sections of the community for planning and operation of the project. This should include, as a minimum:

   - reorganised water user groups/sluice committees representing all sections of the community with an interest in a drainage sub-basin and sluice; and

   - a project-level committee on which Upazila Chairmen and BWDB technical staff would sit to liaise over system management.

   The management structure could also contain intermediate levels (between project and sluices) if these were found necessary.

6 PROTAPPUR IRRIGATION PROJECT

6.1 PROJECT BACKGROUND

6.1.1 Project Summary Sheet

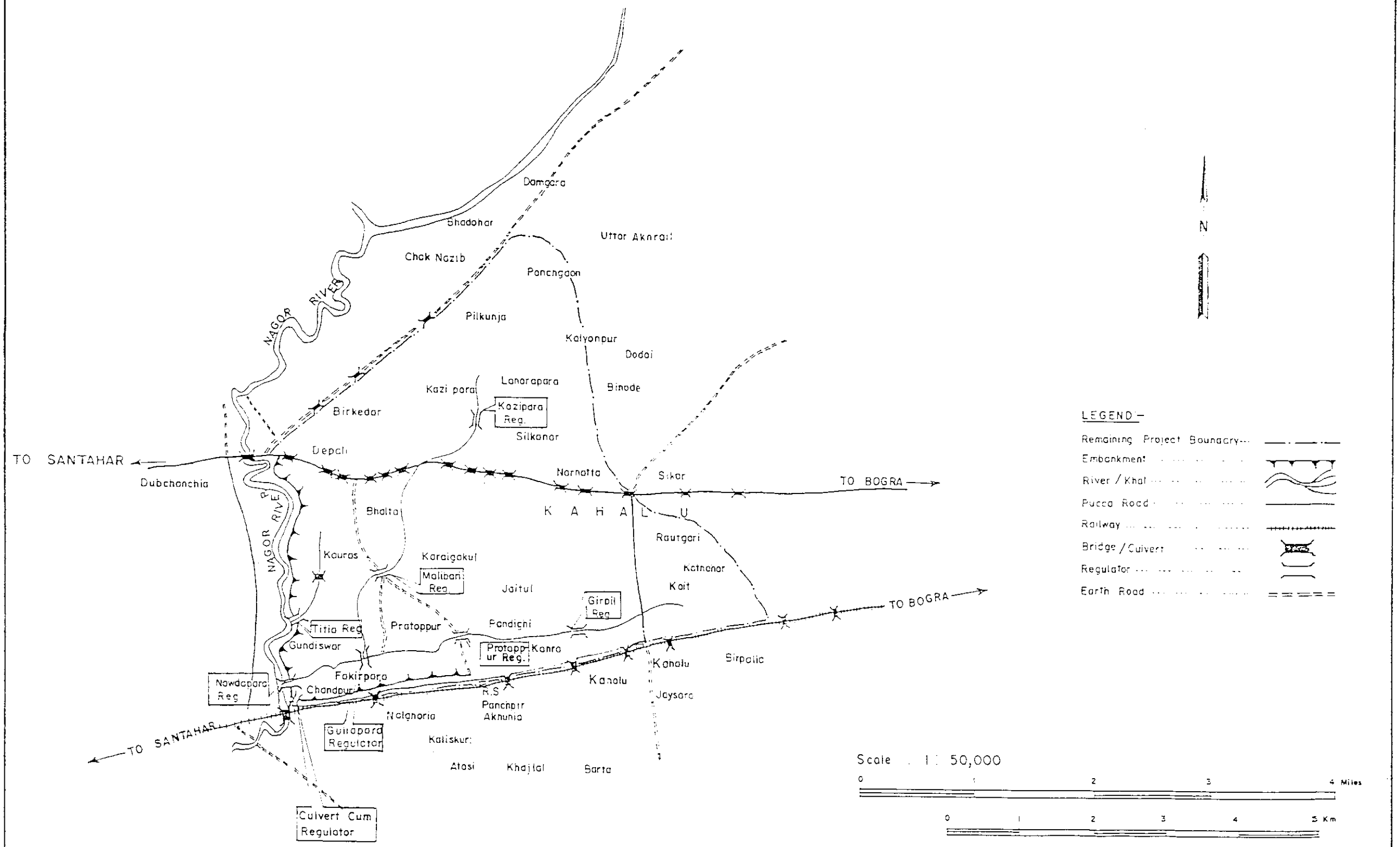
Project Name	: Protappur Irrigation Project
Project Type	: Flood Control, Drainage & Monsoon Inundation Irrigation
Location	
FAP Region	: North-West
District	: Bogra
Area (ha.)	: 5,200 ha. (gross) 4,000 ha. (cultivable)
Funding Agency	: Government of Bangladesh
Implementing Agency	: BWDB
Construction 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:	: none
Repair/rehabilitation in	: 1990 to present

Major works still required for completion/rehabilitation:

Resectioning 2 km. of embankment.
Repair of 7 regulators and 1 culvert-cum-regulator.
Re-excavation of approx. 12 km. of main drainage channels.
Rehabilitation of Khalashi sheds.

All assuming the original project design is still appropriate, which can be questioned.

Figure 6.1 Protappur Irrigation Project - Key Features



PROTAPPUR IRRIGATION PROJECT, BOGRA.

6.1.2 Project description

The Protappur Irrigation Project is a combined flood control, drainage and irrigation (FCDI) project covering a net area of 4,000 ha. in Kahaloo Upazila, some 16 km. west of Bogra in Bogra District. The construction of the project commenced in 1974-75 and was completed in 1977-78, at a cost of Tk. 4.05 million (current Taka at time of construction).

The Project area is part of the Barind tract of north-west Bangladesh, a zone of relatively high ground (14.6 m to 17.4 m in the Project area) with well defined slopes which cause rainwater to drain fairly quickly to the rivers. The climate is relatively dry, with an average of just over 1500 mm. of rain per year, but there is abundant easily accessible fresh groundwater.

The Project is bounded on the west by the Nagor River, on the south by the Bogra-Santahar railway line, and on the north by a road-cum-flood embankment paralleling the upper course of the Nagor River (Figure 6.1). The eastern boundary is indefinite, the boundary shown on the map being the limit of the area estimated as benefited at the time of construction.

The Project occupies almost flat land, having a gradual down slope from the north-eastern side towards the south-western side. The highest elevation on the northern side is 17.4 m. (57 ft.) PWD and the lowest elevation on the south-western side is 14.6 m. (48 ft.) PWD. There exist three drainage channels. One channel is about 12.5 km. (7.8 miles) long from Nawdapara to Kait via Protappur and is known as "Kahaloo Khari", another channel is about 8.1 km. (5.07 miles) long from Guliapara to Kazipara and meets with Kahaloo Khari at Guliapara and the third is about 2.28 km. (1.43 miles) long from Titia to Kauras (Figure 6.1). All of these channels slope gradually down towards the south-west side where they finally meet with the Nagor River.

The main problems the Project was intended to correct were:

- flash floods resulting from heavy rainfall in the upper catchment of the Nagor River; and

- water shortages for the Aman crop, especially at the end of the monsoon in September-October, which were caused by the combination of dry spells and rapid run-off.

Prior to the Project, there was no protection against flash floods, but local farmers had attempted to improve the security of the crop water supply by building earth cross-dams in the drainage channels. The dams are stated by Project documents to have been prone to failure, but the concept of water retention was clearly already established in the area, and indeed the construction of the Project is stated to have been due to pressure by local cooperative groups.

6.2 PROJECT AS IMPLEMENTED

Construction of the Protappur Irrigation Project started in 1974 and was completed in 1978. Under the Project, a flood protection embankment some 10 km. long was constructed along the east bank of the Nagor River from opposite Dubchanchia southwards as far as the railway line, and then parallel to the railway along the south side of the Project area as far as Panchpir station to prevent flash flood water intrusion inside the project area from the channel,

generated from the railway borrow pits, along the south side of the project boundary. Within the Project area, seven regulators with movable gates and one culvert-cum-regulator were constructed on the drainage channels to retain water in place of the previous catch dams, and at the outfall of the channels into the Nagor River (Figure 6.1). The channels themselves were deepened with the intention of discharging excess water more efficiently, and five khalashi sheds were constructed.

By the mid-1980s many of the structures were in disrepair due to poor planning and design, improper operation and lack of maintenance (see below). A Feasibility Study for the rehabilitation of the Project under the System Rehabilitation Project was undertaken by Engineering and Planning Consultants Limited (EPCL) in association with Harza Engineering International and Sir M. MacDonald and Partners in 1988, and their report was extensively consulted during the present study. Work on the rehabilitation commenced in 1990-91, but has progressed slowly and when visited for the present study the Project was essentially still in its pre-rehabilitation condition.

6.3 PROJECT PERFORMANCE AND IMPACTS

In practice this project retains water for surface irrigation in the monsoon season, and thereby has helped farmers to switch from local to HYV T Aman. It also protects against flash floods affecting this crop. Although consequent drainage congestion affects some areas, the Project has had a very positive impact, raising paddy production by 58 per cent.

These positive impacts have been overshadowed by the growth in winter groundwater irrigation for HYV Boro. It was estimated that roughly twice as much growth in paddy production occurred due to winter irrigation by STW as occurred due to FCDI provided by the project. Consequently much of the secondary economic growth which has undoubtedly occurred in the area cannot be attributed to the project.

The Project has been largely free of the negative impacts found in other FCD/I projects - there has been little or no impact on capture fisheries and incomes for most groups appear to have risen due to the general agricultural and secondary economic growth. Overall, and ignoring the growth of Boro, an EIRR of 54 per cent was estimated for the Project.

While there is a need for water, but not flash floods, during the monsoon in this relatively dry area, the main gains from the project may be protection from flash floods and water retention to recharge the ground water which is now heavily used for irrigation. In this case the rehabilitation underway appears to be inappropriate for the worthwhile objectives of continued surface-ground water management. Tubewell irrigation is probably more cost effective since it can operated during both seasons and is more flexible, while weirs might be used to retain water to recharge the aquifer without expensive gates and operating requirements.

6.4 PROJECT OPERATION

6.4.1 Technical assessment

The regulators, especially those constructed in the low lying areas, have been successful in preventing overdrainage of monsoon water. These regulators also functioned well in retaining monsoon water for irrigation so long as the khalashis operated the gates and the gate systems were in better condition.

Although the objective of the regulators was to prevent overdrainage and to retain monsoon water for irrigation, the regulator gates were not made water tight during implementation of the project which resulted in water leakage around the gates. This water leakage problem became more critical when the khalashis had left the regulator sites and the local people operated the gates incorrectly. A few years after construction of the regulators the Mechanical Equipment Unit of the BWDB provided rubber seals to some regulators, but those were not effective because there existed big gaps between the gate ends and the vent grooves, and also there were steel plates placed on the rubber seals which provided steel to steel rather than rubber to steel sliding contact surfaces.

After the regulator khalashis had left the regulator sites, the regulators were under uncontrolled operation which, together with partially or fully damaged brick pitching, have affected proper functioning of the regulators. Subsequently both irrigation and drainage have been adversely affected.

The size of the channels was not well adjusted with the actual quantity of water they will carry or retain for irrigation purposes. Inadequate discharge/storage capacity of the channels, together with siltation have reduced the capacity for retaining water for post-monsoon irrigation. This situation is more critical near to the upstream side of the regulators because the need to command a sufficiently large area floods some of the nearby lands and may damage crops.

Prevention of overdrainage and retention of monsoon water for post-monsoon irrigation may have contributed to ground water recharge in the area and hence could have had a secondary benefit for the Boro season. As such, this process may have been facilitating tube well irrigation, and may have reduced potential adverse effects on drinking water supplies from hand tubewells.

6.4.2 Institutional and social assessment

According to the Project Proforma (PP) (BWDB 1976), the Protappur Irrigation Project had its origin from a request by the Secretary, Pally Mangal Samity to the Executive Engineer, WAPDA, Rajshahi Division. The Pally Mangal Samities (Village Welfare Societies) were the fore-runners of the present day cooperative societies. The Pally Mangal Samities depended on voluntary labour and musti vikha (rice savings from cooking pot) as their capital for undertaking social welfare activities in the rural areas. It is quite possible, and also in line with their philosophy, that village people used to build cross dams in different parts of the Protappur channel for storing water to overcome the moisture loss due to over drainage in the post monsoon period in the area.

Having had this experience, and because of limited resources, the Samity submitted a petition to the then Water and Power Development Authority (WAPDA) to undertake such a project. After receiving the request, the WAPDA made a departmental feasibility study and found the request reasonable. Actual work on the scheme started in 1974 and was completed in 1978. Hence, unlike many FCD/I projects, Protappur had its origin in a local demand for this type of project.

For operation and maintenance of the sluice gates there were khalashis (caretaker cum operators) stationed at the sluices, with khalashi sheds for their accommodation. For some sluices there were local committees organized by the supervising Sub-Divisional Engineer to oversee the work of the khalashi. It is reported by the local people at Bamuza village, near regulator no.3, that the committee consisted of eleven members with one Chairman and one Secretary which supervised the work of the khalashi while the regulator

was functioning well. However, after 3-4 years the regulator developed defects and the committee became inactive. In the meantime the Secretary died and the committee was never revived.

At regulator no.4 the khalashi was absent for a long time and the doors and windows of the khalashi shed were missing from the structure. The operating handle of the sluice gate was reported to be under the possession of a local notable. This person was interviewed and he said he was only acting as the custodian of the handle as there was no khalashi to operate the sluice gate. He would welcome any initiative to form a local committee when the sluice gate gets properly repaired under the System Rehabilitation Project (SRP) and is put into operation again. However, the ordinary farmers in the area expressed their disapproval of the way he got hold of the handle of the sluice gate and thus deprived them of any say in the matter; he was reported to have stolen the handle because proper operation had benefited most farmers but flooded his fields.

6.5 MAINTENANCE OF THE PROJECT

6.5.1 Technical assessment

a) Embankment

The flood embankment was constructed with a crest width of 3m (10'), side slope of 1:2 on both sides and variable bottom width in connection to variable design crest level. It has been functioning well in preventing inundation of the low lying areas of the project since its completion.

The crest widths of the embankment have been reduced in many places due to soil erosion on one or both sides, and the crest levels have reduced in many places due to the same reason. In some places embankment sections have been badly damaged and may fail in the near future, after serving their intended purpose for more than 12 years. Some embankment sections have been badly damaged and the local people have constructed some houses and shops on one or both sides of the embankment. A pucca mosque is being built covering at least half of the crest width of the embankment at a location between regulators R-1 and R-7.

b) Regulators

Seven regulators and one culvert-cum-regulator were constructed to prevent overdrainage and to retain monsoon water for irrigation in the post-monsoon period. The regulators appear to have been well sited from both construction and operational view points. These regulators functioned well so long as the khalashis operated them.

The basic structural components of the regulators are in good condition, except for the whole gate system including seat beams, plastering on the brick masonry works, and brick pitching works on the upstream and downstream sides of each regulator.

Regulator R-1 is located at Nawdapara across the main outfall channel and by the side of the Nagor River. This outfall regulator is 4-vent of size 5'x5' each. A total of eight vertical lift gates, 4 on the river side and 4 on the country side, were provided in this regulator. Some screws connecting the gates with the vertical lift rods have been damaged. The operating wheels are not functioning well. There remains a big gap between the gate ends

and the grooves provided at both ends of the vents. After completion of the project the Mechanical Equipment Unit of the BWDB has provided rubber seals on the country side gates.

Regulator R-2 is located at Guliapara and a little downstream from the meeting point of the channel from Kazipara to Kahaloo Khari. It has 3 vents of size 5'x5' each. It was constructed just south of the original channel and the channel was closed by the north side approach to the regulator. The seat beam which had been provided for supporting the gates fell down in 1990, and hence all three gates were closed resulting in water congestion in that area. To overcome this problem the local people removed the north side approach to the regulator to make the original channel active.

Regulator R-3 is located at Protappur across the Kahaloo Khari. It has 2 vents of size 5'x5' each. The screws connecting the gates with the vertical lift rods have been damaged. The seat beam that has been supporting the gate system has been displaced from its normal position. This beam displacement has made gate operation difficult. The gate ends were not well adjusted with the grooves at both ends of the vents. After completion of the project MEU of the BWDB has provided rubber seal to the gates.

Regulators R-4 and R-6 are located at Girail and Kazipara respectively. Both regulators are 1-vent of size 5'x5' each. In both the regulators the screws connecting the gates with the vertical lift rods are in bad condition. Rubber seals were not provided in each regulator. In the regulator R-6 the joint between the seat beam and brick masonry has cracked. The road on both sides of this regulator is of low height which causes overtopping of water when the gate is closed.

Regulator R-5 is located at Malibari. It has two vents of size 5'x5' each. One gate of this regulator remains closed as the operating gear was stolen by the local people and the other gate is functional, but one of the two screws connecting the gate with the vertical-lift rod was damaged and the other one is in bad condition. The gate ends were not well adjusted with the grooves at both ends of the vents. The local people have closed this gate and sealed its ends with clayey soil to provide water to the nearby agricultural lands.

Regulator R-7 is located at Titia. It has 1-vent of size 5'x5'. It is an outfall regulator constructed on the embankment and across the channel from Titia to Kauras. The joint between the seat beam and brick masonry has cracked. The gate ends were not well adjusted with the end grooves on the both sides of the vent. Hence, continuous water leakage is a chronic problem of this regulator.

The **Culvert-cum-regulator** is located on the south-west corner of the project area and on the embankment. It has 1-vent of size 3'x3'-6" and has only fall board provision for closing the opening. The apron, curtain wall and wing walls of this structure on the outlet side have collapsed due to scouring caused by high velocity of water through the culvert. The local people have closed the inlet opening by a small ring bund to retain water for irrigation.

Brick pitching works on the upstream and downstream sides of the regulators were damaged a few years after project completion and were not maintained or repaired until 1990-1. The brick pitching works done in some regulators through the System Rehabilitation Project seem to be unstable because the bricks are loosely arranged and some bricks have already been displaced.

Five **khalashi sheds** were constructed at the regulator sites R-1, R-3, R-4, R-5 and R-7 respectively for operation of all the seven regulators by five khalashis. Only the khalashi shed at R-1 regulator site is habitable, but no khalashi is residing there. The other four

khalashi sheds were damaged in different ways: walls and floors have cracked, and the doors and windows were either damaged or stolen by the local people. As a result the khalashis are not residing there.

6.5.2 Institutional and social assessment

Despite signs of mutual good will between BWDB and the Upazila Parishad, misuse and mismanagement of regulators by influential people is resulting in social conflict causing non-operation of those regulators. The lack of regulator committees and khalashis may be one factor in the increasing maintenance problems of the project. However, there has never been any allocation of funds from outside for routine maintenance, nor was there any attempt to mobilise resources from the beneficiaries - who in the past had been responsible for managing their own cross-dams.

This is despite a minor positive impact on fisheries to the extent that more water is retained in the khals. No attempt to raise funds by intensifying use of these khals or leasing out rights to their use appears to have been made.

6.6 LESSONS

1. The project grew out of a local collective request for such an FCDI project, and appears to have been an appropriate plan.

2. The lack of a requirement on beneficiaries to maintain the project, fostered by the provision of paid kalashis, may have helped in the gradual deterioration in project facilities. The growth in private STW irrigation for which farmers have to pay may also have affected their priorities.

3. Once the whole project goes through the process of rehabilitation under SRP, the regulators and the embankment could be placed under the local Union Parishads for operation and maintenance. In which case the UPs should be authorised to mobilize local resources through taxation if necessary.

4. The embankment might be handed over to the Upazila and put under Rural Maintenance Programme to be looked after by local women groups organized by CARE.

5. The relationship between the Water Board and the Upazila Parishad should be further strengthened through frequent mutual consultation. There should be a management coordination committee consisting of representatives from BWDB, BRDB, LGEB and NGOs under the Chairmanship of the Upazila Parishad to give direction and assist in problem solving for the operation of such projects as Protappur Irrigation Scheme.

6. This project has created resources, water bodies, which could be used to help fund its O&M. The project appears to be well conceived, but irrigation water is not charged for, nor does BWDB try to (or is unable to) raise funds locally to improve the project.

7. The rehabilitation which is underway appears to have suffered from the same planning problems as many new projects. The current and future aims of water management in the project area needed to be reconsidered, in the light of current irrigation practice, ground water resources, and the reality of O&M.

7. NAGOR RIVER PROJECT

7.1 PROJECT BACKGROUND

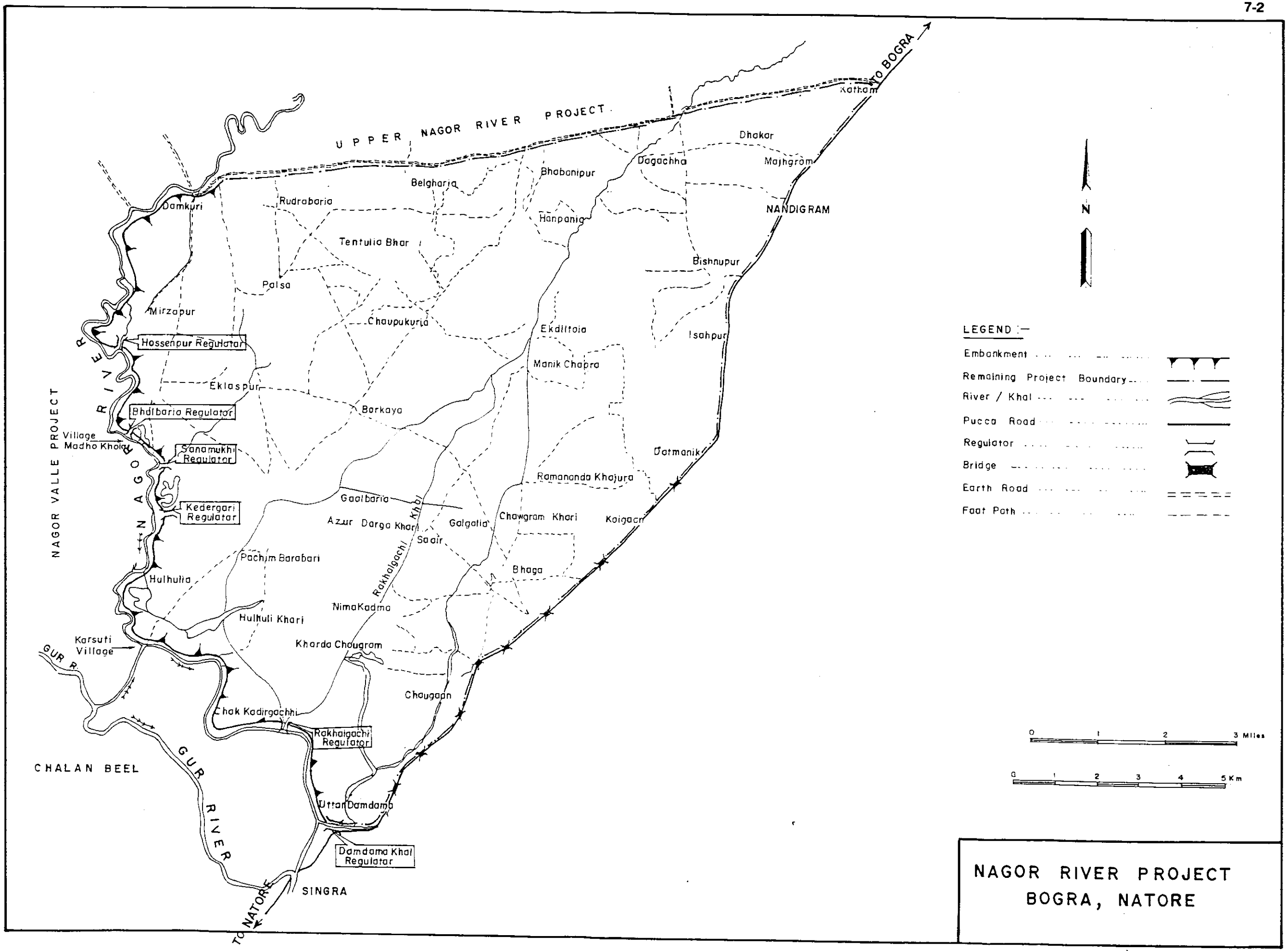
7.7.1 Project Summary Sheet

Project Name	: Nagor River Project
Project Type	: FCD
Location	
FAP Region	: North-west
District	: Bogra and Natore
Area (ha.)	: 15,400 ha (gross) 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

Major works still required for completion/rehabilitation:

Embankment is severely eroded due to continued public cut/breach and backflow in Nagor river. Project requires major replanning exercise on whole Atrai Basin before any major works are contemplated. To keep the remainder of the project in running order in the meantime excavation of the Hulhulia Khal and repair and maintenance of those regulators (except the one at Domdoma) not threatened by erosion have become urgent.

Figure 7.1 Nagor River Project - Key Features



7.1.2 Background

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 Agro-ecological Region (FAO, 1988). The south-western part of the project area differs markedly from the north-east, and forms the eastern-most part of the Chalan Beel depression.

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 the Nagor River in the west (Figure 7.1). The hydrology of the project area is mainly determined by flows from the Nagor River and water levels from the Atrai and Gur rivers.

Before the Project the area faced two flood problems:

- serious problems with early floods as well as monsoon floods, from the Nagor River; and
- acute drainage congestion in the central part of the Project area.

Before implementation of the Project, flood water could freely enter into the project area, mainly as over-land flow from the north-west to the south-east, especially through the low-lying areas between Kaliganj and the confluence of the Nagor with the Gur River, with the overland spill escaping through the bridges on the Bogra-Natore road. The flash floods of the Nagor frequently caused a rise in water level of 3'-4' (0.9-1.2m) in a day, causing huge damage to the standing crops.

The main objectives of the Project were:

- protection to the crops from early flash floods and monsoon floods;
- elimination of drainage congestion from the project area;
- reclamation of low-lying areas for cultivation; and
- ensuring irrigation by LLP and flushing through sluices from the Nagor River.

The Nagor River bed has now silted up, especially from the junction with the Gur River up to its off take on the Atrai. There have been considerable changes in the hydrological regime, resulting from the execution of this and other projects in the area.

7.2 PROJECT AS IMPLEMENTED

The project was officially completed in 1986. The major Engineering features of the project area are:

- Embankment: Length = 27 km.
  Top width = 12' (3.7m)
  Side slope: countryside = 1:2, riverside = 1:2;
- Six drainage-cum-flushing sluices:

i) Rakhalgachi Regulator on Hulhulia khari - 4 Vents
ii) Kedergari Regulator on Kedarbari Khal - 1 Vent
iii) Sonamukhi Regulator on Sonamukhi Khal - 1 Vent
iv) Bhulbaria Regulator on Bhulbaria Khal- 1 Vent
v) Hossenpur Regulator on Huseinpur khari - 1 Vent
vi) Damdama Regulator on Damdama Khal - 3 Vents (completed in 1990-1991); and

- Irrigation Pipe inlets : 14 Nos. (For LLP - 1' diameter).

The intended length of embankment was constructed. The intended re-excavation of the Hulhulia Khari was not carried out as planned. The planned regulators were built, but 30 irrigation inlets had been planned and only 14 were installed.

7.3 PROJECT PERFORMANCE AND IMPACTS

After completion, the Nagor River project operated as planned for only one year, 1986. 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.

Consequently the project at present is almost a total failure. The embankment was designed for the historical 1-in-20 year flood along this particular stretch of river, the hydrological analysis ignoring other planned and completed FCD projects in the Atrai Basin. The largely completed embanking and poldering of much of the Atrai Basin implies that the embankment at Singra would need to be at least three metres higher to protect against the 1-in-20 year flood conditions allowing for the reduced flood storage available in the basin as a whole (EIP, 1988).

Hence there are major questions over the project planning: if the adjacent projects suffer flooding and drainage problems then the Nagor River embankment is cut. If they do not then the Nagor River embankment would be overtopped in most years.

The public cuts which remain open for most of the monsoon period, despite limited annual repair, alleviate the impact on river flow by allowing some to 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 and erosion of the embankment.

This area is a traditional B. Aman zone. The project was intended to provide security from crop damage in the lower reaches, and to allow a change from B. Aman to T. Aman on higher land. In only one union, Ramananda Khajura, which is higher, has the intended cropping pattern change taken place: B. Aman has been replaced by T. Aman (local 75% and HYV 25%). 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 agriculture in the area, and a negative economic impact of the Project.

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. This is due to the fact that the project has not succeeded in cutting off the beels and other water bodies from river flooding.

The project provides intermittent improved road communications, and has not hampered boat transport (since it still floods because of the cuts). The embankment was used extensively as a shelter in the 1987 and 1988 floods.

7.4 PROJECT OPERATION

7.4.1 Technical assessment

The Nagor River project does not operate as planned and this failure can ultimately be traced to inadequate planning which did not take into account hydrological-hydraulic changes in the area. In particular no account was taken of the inadequacy of drainage and flood problems in the adjacent projects, and the consequence of the Nagor Valley and Nagor River embankments which have confined the Nagor river and thus raised its bed so changing its flood characteristics.

a) Embankment

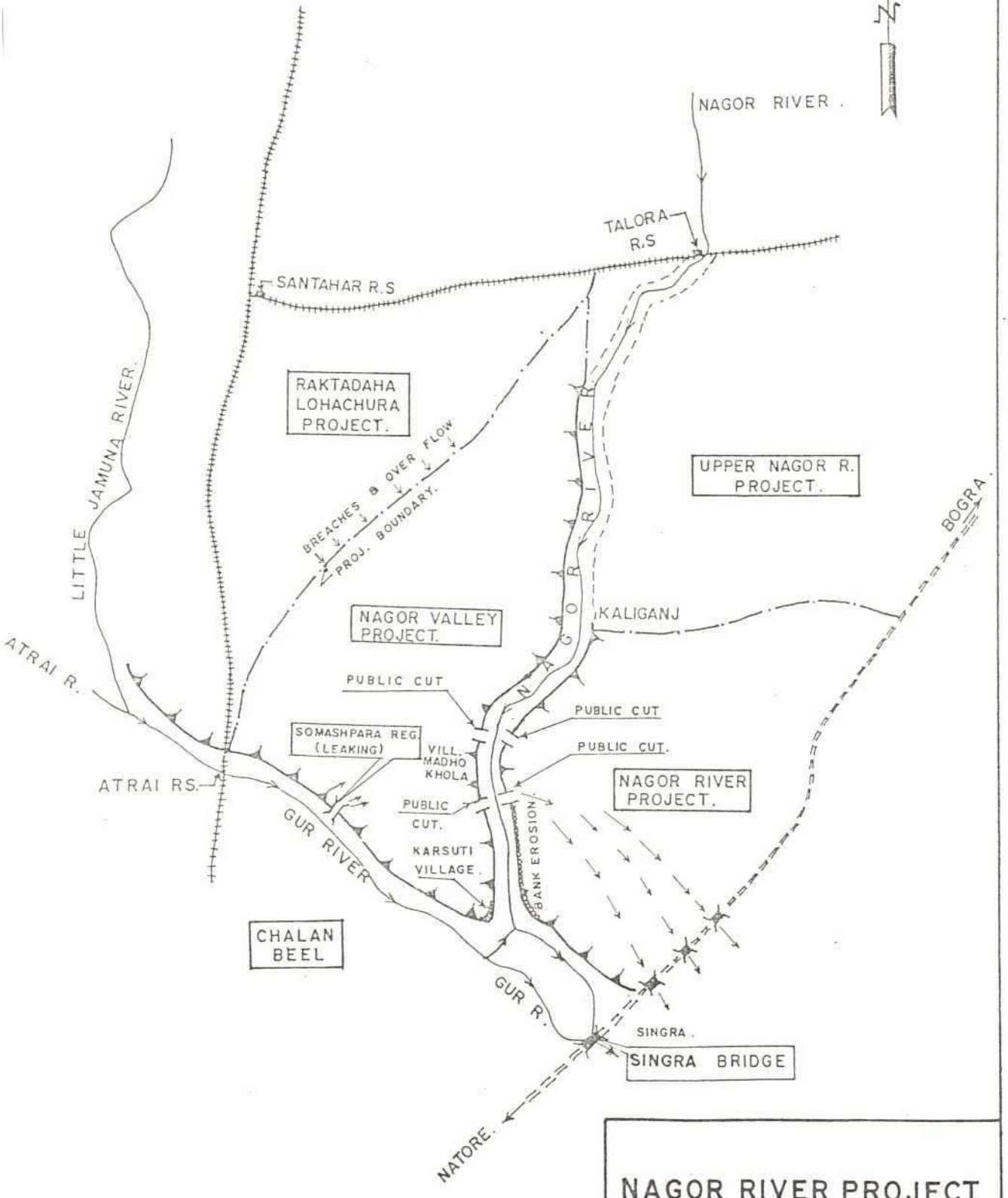
After the completion of the project the embankment functioned as planned for only one year. The embankment was overtopped at several places and was severely damaged by the 1987 flood. During this flood the neighbouring Nagor Valley Project (on the right bank of Nagor river and just opposite to the Nagor River Project) was submerged due to heavy rainfall, huge leakage through Somashpara regulator and over flow of flood water from the Raktadaha-Lohachura Project (to the north). Consequently the local people cut the Nagor Valley Project embankment at two locations near Madhokhola village to save their homesteads.

These public cuts had a great impact on the Nagor River Project as the Nagor river water level was raised by a few feet within a short time, but the Nagor River Project was not submerged due to its embankment. To enhance the drainage of Nagor Valley Project some of its inhabitants cut the embankment of Nagor River Project at two places almost opposite to the cuts in the Nagor Valley Project and the water found a direct route to the south-eastern lower flood plain through the Nagor River Project.

Since then this phenomenon of public cuts has taken place every year at these places. The public cuts both in Nagor Valley and Nagor River projects have damaged the Aman crops in Nagor River Project every year. Moreover, the public cuts in the Nagor River embankment have created a serious threat to the very existence of the project embankment, as the entire Nagor river flow is diverted into the Nagor River Project through these cuts causing a back flow of Gur river water into the Nagor river for a length of about 2 km from its confluence with the Gur. The Nagor river bed is very flat and its slope in this reach is only 4cm/km (EIP, 1988, P-9). This back flow has created a strong upstream current in Nagor river, causing severe erosion of 2 km of the project embankment. Figure 7.2 shows the now usual system of flood flows with the cuts.

The reach of the flood embankment between Karsuti and Madhokhola villages (left bank embankment) is worst affected and at several places only the country side slope of the embankment is left to be eroded. At most places in this reach more than 50 per cent of the embankment section has disappeared and it is expected to be completely eroded during the 1991 monsoon season. The remaining portion of the embankment is also in bad shape at

Figure 7.2 Nagor River Project showing typical monson water flows between projects within the Nagor river system.



many places due to wave cut and erosion during the 1987 and 1988 floods. The top width of embankment was found to be less than the designed width of 12 ft. (3.7m) and the side slopes are damaged. The embankment has practically zero set back distance from the river throughout its length.

b) Public cuts

The public cut downstream of Madhokhola village is about 200 ft. (61m) long and water from Nagor valley project and back flow from the Gur enters the project area through this opening with such a velocity that a boat can only cross it with great difficulty. The public cut upstream of Madhokhola is about 100 ft. (30m) long and water again enters the Project area at high velocity. At this location both Nagor river water and Nagor Valley water enter the project. They can be distinguished as Nagor Valley water is clearer than Nagor river water.

c) Drainage problems

No khalashi sheds or khalashis were found, except at the Damdama regulator which was completed only about a month before the RRA. In all other regulators the gates are leaking, and the Kedergari regulator gates are open even during the flood season, allowing the flood water to enter the project area at a great speed.

The project is facing acute problems of drainage congestion due to the silting up of the following khals and rivers:

i) The Hulhulia khari, which is the main drainage channel of the project area having a catchment area of about 5400 ha (21 miles^2), is silted up and has not been re-excavated as scheduled. The internal drainage network connecting to this channel is almost nonexistent.

ii) The Damdama khal drains part of the project near the Nagor-Gur confluence. A new regulator has been constructed to control the drainage and to stop the back flow from the river. The local people reported that the tail end of this khal is almost silted up causing drainage congestion in its catchment area.

iii) The Nagor River flowing from the Karatoa River at Shibganj in Bogra and ending in the Gur River at Singra is the main drainage channel of this area. This is no longer a perennial river. Since its river bed has silted up in the last few years and both banks are mostly embanked by different projects, even a minor flash flood in this river abruptly raises the water level to a much higher level than anticipated before the embankments were built. The water level in the outfall river Gur-Atrai also determines its flood level, by causing backflow up the Nagor.

d) Irrigation

The 14 irrigation inlets are not operating as intended. Most of the irrigation inlets were installed in the eroding part of the embankment and are damaged or destroyed. However, it is debatable whether this would have been a worthwhile investment had the project worked, or even if they were desired by the farmers. With low river levels in the dry season, and very rapid and widespread growth in groundwater irrigation, public investment appears unnecessary.

7.4.2 Institutional and social assessment

The operation of the regulator gates was taken up by the local public at their own will, there being no clear BWDB involvement. The people said that there were non-functioning regulator committees for each of the regulators. By 1991 most of the regulators had parts missing (Section 7.5.1) and were not in a position for proper operation. It is not clear whether the lack of operation is because the public cuts make it superfluous.

There is a very strong social conflict over the operation of the project, concerning the two public cuts. The conflict is over economic benefits for paddy growers and fishermen. The fishermen are dominant so far. During the 1987 flood, there was a severe breach of the embankment. At the breach point there developed some low pockets where many fish could be caught after the monsoon. The income from these fish amounts to Tk 3-4 lakhs annually. Since 1987 it has become an annual practice that the embankment is cut at the same points (Khorswati and Sadnagar), with the results discussed earlier. Those with a vested interest in fish are from the other side of the embankment in Atrai Upazila (Mohadevpur Mouza). They are not traditional fishermen, but are big landholders who have no land within the project.

7.5 MAINTENANCE OF THE PROJECT

7.5.1 Technical assessment

a) Embankment

The severe erosion and poor condition of the embankment, particularly in the reach where the back flow in Nagor River is taking place, has already been discussed. The remaining portions of the embankment are also in bad shape due to rain cuts, wave action and rat holes.

The two places with regular public cuts have been repaired each year with a dwarf embankment, with a crest level just sufficient to protect the project area against flash flood until the harvesting of Boro crops (submersible embankment). It is understood that EIP is studying the project, taking into consideration of the regular public cuts and all other technical and social problems, and both the SE and SDE/BWDB hinted that the embankment may be maintained as a submersible one to protect the Boro crops only (FAP 2 is also reviewing this option for the Atrai basin as a whole). Hence for the meantime BWDB is avoiding any sort of maintenance work for the whole embankment.

b) Structures

All the regulators except the recently (1991) completed Damdama khal regulator are in poor condition after only six years of operation. The fixing screws of the vertical lift gates are missing, gear boxes are also missing, and loose aprons are damaged and displaced and have become unsuitable for proper operation. The maintenance of these regulators has been practically nil since the completion of the project.

7.5.2 Institutional and social assessment

There is currently a lack of official interest in maintaining the project. While local opinions are conflicting, and it is not clear whether some of the original public investment should be preserved. The present situation worsens the livelihood of those with lowlying land,

suited before to B. Aman, which is now destroyed, while houses are also now at greater flood risk. However, the villagers from Joynagar, Bhulbulia, Sadnagar, Khorswati and surrounding villages have of their own accord formed a committee to preserve the embankment. They have raised a fund of Tk 10,000 towards this, and have filed an application to the Upazila Chairman of Singra Upazila, identifying the reason for the cuts as to catch fish by a vested interested group.

While villagers defending their interests against the adverse impacts of commercial actions of others is understandable, this ignores the likelihood of problems if the embankment is not cut. At least this indicates that potential beneficiaries are able to raise funds themselves of necessity. The question is whether they would be willing to contribute to regular maintenance if a workable FCD project could be found for the area.

7.6 LESSONS

This project raises a number of fundamental issues. It is currently not operating as planned, and is very poorly maintained. This is ultimately a planning problem.

1. The concept of protecting against early floods damaging HYV Boro seems reasonable and appropriate. Submersible embankments and the project at present can achieve this. However, the submersible embankment or regular cut strategy results in a rapid rise in water level when the embankment breaches or is cut or overtops, this is damaging in areas where Boro is not grown, since even B. Aman cannot cope with the sudden rise in water level found in Nagor River.

2. The fundamental problem is that individually the projects of the Nagor river/lower Atrai basin appear to have been poorly and individually planned, ignoring their impacts on one another. There was no modelling of the combined impacts of all the polders and embankments on the hydrology of the area, and hence on flood stages and frequencies with the polder developments, before a project such as Nagor River went ahead. The sum is greater than the parts, and it seems that even if each embankment was not cut they would most often be overtopped. To raise or repair one without considering the hydrology and flood plain management of the whole area would be futile.

3. If a project cannot hope to function as planned then it is inappropriate to consider it as constrained by O&M problems.

4. This project does, however, point to the problems of adverse impacts of the actions of one group on another, and conflicts both over land/water use and the distribution of benefits from alternative uses. It may be that Boro followed by fish is a productive land use, compared with alternative farming systems. If this is the case the local administration could give support to the inhabitants of Nagor River project to catch and market the fish themselves rather than rich outsiders taking their fish. It should not be difficult to declare the breach areas a public fishery and lease this to the local villagers, but this would need to be enforced.

5. If engineering works are adopted and adversely affect some people, there needs to be an implemented compensation procedure, otherwise people not surprisingly take the law into their own hands. In this particular case flood storage somewhere is needed, so if the quantity of water in one area is reduced storage somewhere else must be found. This means ultimately that someone will lose unless the gainers or

society as a whole pays some compensation. If compensation is cannot be realised in practice, a non-structural approach to improving the welfare of floodplain inhabitants is called for.

6. There is clearly a need for a wider water management/flood plain management plan, involving local administration, BWDB and an agency which can carry out river basin planning for its region/basin. The latter is something which this case demonstrates BWDB has been unable to do.

7. There appeared to be no systematic method for record keeping and storing of relevant project documents in the BWDB offices. All too frequently, the assessments relied on the highly personalised knowledge of individuals for critical information. Well designed monitoring of project O&M and performance is vital to improving O&M.

8. SONAMUKHI-BONMANDER BEEL DRAINAGE PROJECT

8.1 PROJECT BACKGROUND

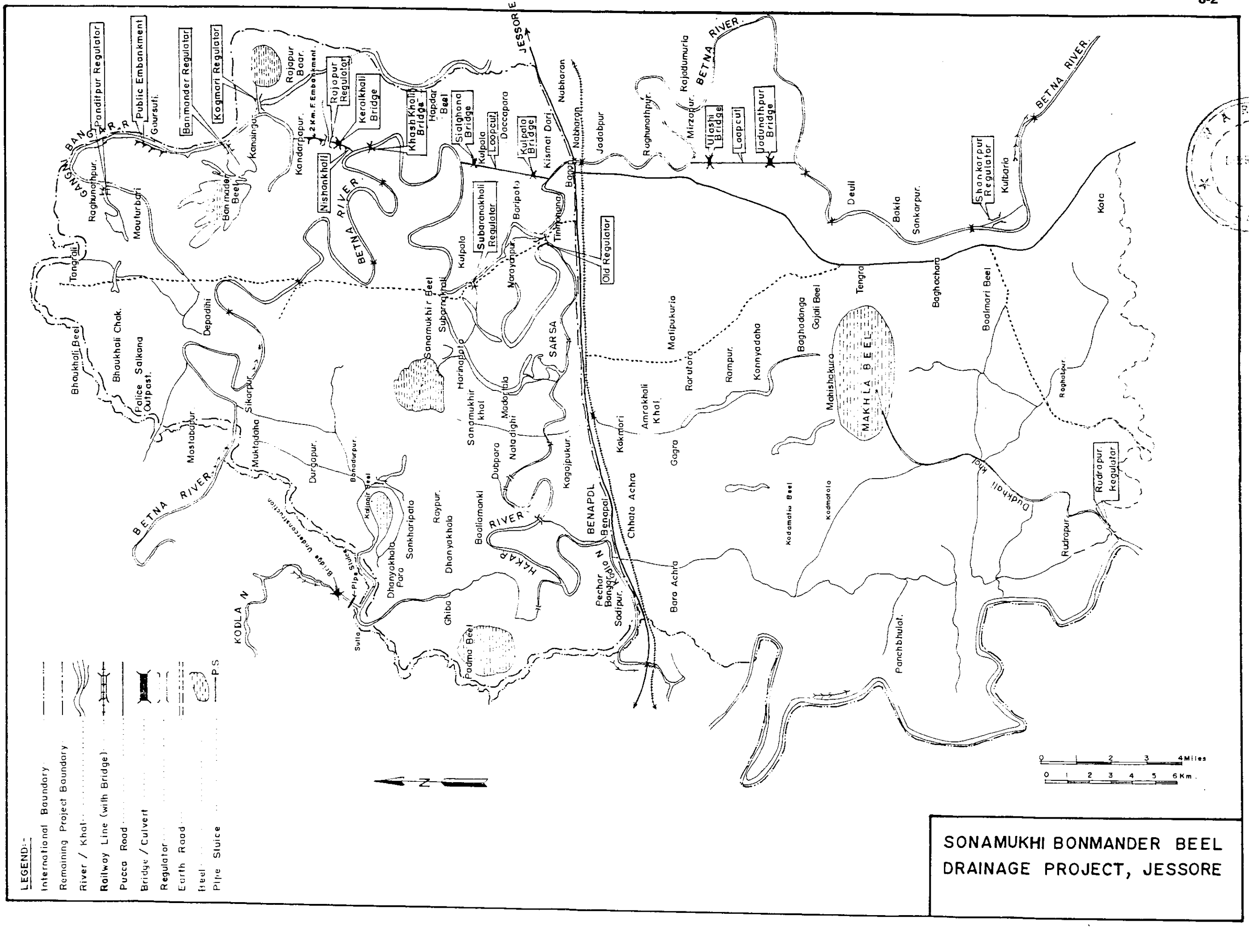
8.1.1 Project Summary Sheet

Project Name	: Sonamukhi-Bonmander 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	: Tk. ?
Final Cost Estimate	: Tk. 11.625 million (current at time of construction)
Major Flood Damage:	: ?
Repair/rehabilitation	:

Comments:

Drainage system has largely decayed, while flooding from India still causes damage. Surface water in the dry season is reduced by water retention in India and a lower ground-water table. Most agricultural development has instead come from private STW development, even so drainage benefits make it an economically successful project.

Figure 8.1 Sonamukhi Bonmander Beel Drainage Project - Key Features



8.1.2 Project Background

Sonamukhi and Bonmander are two beels in the Upazilas of Sarsha 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) in and around these two and other beels. 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 (Figure 8.1).

There are many perennial waterbodies in the project area making them natural breeding grounds for various species of fish. Quite naturally, the changing hydrology in the area is likely to have some effect on the capture fisheries. Minimal attention was paid to such issues during the planning and implementation of the project.

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' (.6-1.5m) 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 area for cultivation.

To achieve these objectives the project involved:

- eliminating drainage congestion by re-excavating Betna and Gangni Bangar rivers and the drainage channels from the beels to these rivers;
- construction of drainage sluices at the outfalls of the khals for controlled drainage and to prevent backflow to the beels;
- construction of an embankment from Radhanagar to Nishankhali on the left bank of Gangni Bangar river to prevent flooding of Rajapur baor area;
- loop cutting (straightening) of river Betna from Sialghona to Kismat Dari (3.0km) and from Ulashi to Jadunathpur (4.0km) to increase drainage efficiency; and
- excavation of Amrakhali khal (later stage).

The PP of the Project mentioned practically nothing regarding the huge volume of flood water entering the Project area from India which causes flooding in Sarsa Upazila, and as such no flood protection measure had been taken to overcome the situation. The Project seemed to be planned to drain out only the excess rainwater from the project area and thus the drainage facilities of the project are inadequate to cope with the actual situation. No irrigation facility was planned.

8.2 PROJECT AS IMPLEMENTED

The major Engineering features of the project are as follows:

a) Drainage sluices (within Project area):
   - i. Subarnakhali 3 vents
   - ii. Rajapur 1 vents
   - iii. Kagmari 3 vents
   - iv. Bonmander 1 vents
   - v. Panditpur 3 vents

Two other regulators constructed outside the project area have a great impact on the drainage system of this project:

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

b) Six bridges were constructed in connection with this project:

   - 4 bridges inside the project area: Keralkhali bridge, Khaskhali bridge, Sialghona bridge and Kulpala bridge; and
   - 2 bridges outside the project area: Ulashi bridge and Jadunathpur bridge.

c) Embankment : 2 km

d) Excavation/improvement of drainage channel:

   - 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.

8.3 PROJECT PERFORMANCE AND IMPACTS

The Project has reduced monsoon water levels in its eastern part, but drainage is impeded (partly because of cross bunds).

There has been considerable agricultural growth in the area since the Project, principally more reliable T. Aman on medium high lands as a result of the project, and very widespread irrigation of HYV Boro. The latter is almost entirely irrigated by STW, surface irrigation from the project channels and retention structures having lapsed, however reduction in drainage congestion in the eastern area benefited Boro by allowing earlier transplanting.

Overall the Project does not appear to have adversely affected fisheries, dead loops of the Betna river and ponds created by cross-bunding the rivers permit fish cultivation.

Socio-economic impacts did not appear to be large, although in-migration of labour had increased reflecting more agricultural work. The EIRR for the Project was estimated at 65 per cent, reflecting a moderate cost level and high agricultural benefits.

8.4 OPERATION OF THE PROJECT

8.4.1 Technical Assessment

Since the concept of the scheme was only to drain out the excess rainwater from the project area without considering the huge inflow of flood water from Indian territory, the drainage capacities of the rivers, channels and structures in their existing conditions are inadequate. Figures 8.2 to 8.5 show the sequence of changes in the area. Operation is handicapped by actions outside Bangladesh and by a number of problems with the complex drainage system which has evolved.

a) Indian pipe-sluice on Kodla River

The Indian government constructed a 4 vent pipe sluice on Kodla river in 1976, at Sutia, about 50m upstream of the Indo-Bangladesh border and started controlling the river water unilaterally. During the lean period all the river water is used for irrigation within Indian territory leaving a dry and silted up river bed in Bangladesh. During the monsoon season the Indians open the Sutia regulator passing a huge volume of flood water which cannot be carried by the silted up Kodla, causing flood every year in Sarsa Upazila. To mitigate the flood effect, the local affected people constructed a road-cum-embankment on the left bank of Kodla in Bangladesh and a cross dam on the Kodla river in village Ghiba inside Bangladesh about 150m from the International border which obstructed the Kodla flow, eventually causing flood in Indian territory. During the 1987 flood the affected people from India, supported by BSF of India, entered into Bangladesh and cut the cross-dam, which still remains open causing flood in Bangladesh each year subsequently. The Indian pipe sluice is now damaged.

b) Indian border road-cum-embankment

The Indian government is constructing a major road-cum-embankment along the border about 50m (160') away from this project boundary (the international border is the project boundary) with (apparently) control structures on each river entering Bangladesh from India. This embankment, after completion, may pose a great danger for Bangladesh as India will unilaterally control the flow of the rivers, depriving Bangladesh of her due share. During winter the entire river water may be utilized in India. On the other hand during monsoon sudden release of flood water can be expected to inundate Bangladesh territory damaging all standing crops. Moreover, such operation of the control structures will accelerate siltation of the downstream reaches of the rivers within Bangladesh. Another implication is that salinity intrusion may be further aggravated towards the coastal region.

c) Flood water from India

External flood water still enters the project area at Bhaukhali Beel, through river Betna at Mukundapur, at Bahadurpur through Basurtana Khal, and through numerous depressions. The Bonmander Beel area receives a large volume of Indian flood water through a number of depressions along the right bank of Gangni Bangar river between these two regulators. To

Figure : 8·2 Sonamukhi Bonmander Beel Drainage Project. 8 – 6

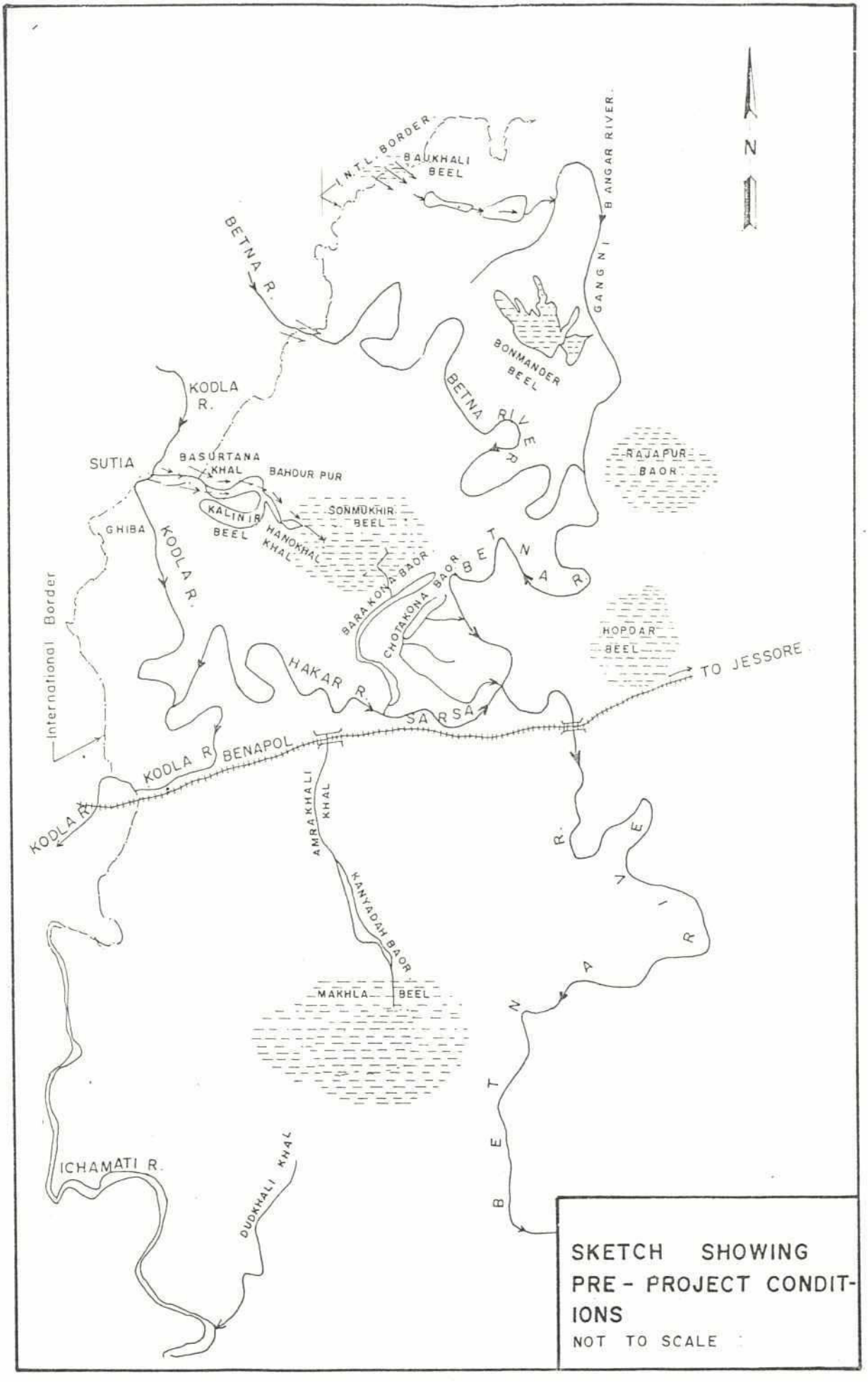


Figure : 8·3 Sonamukhi Bonmander Beel Drainage Project.

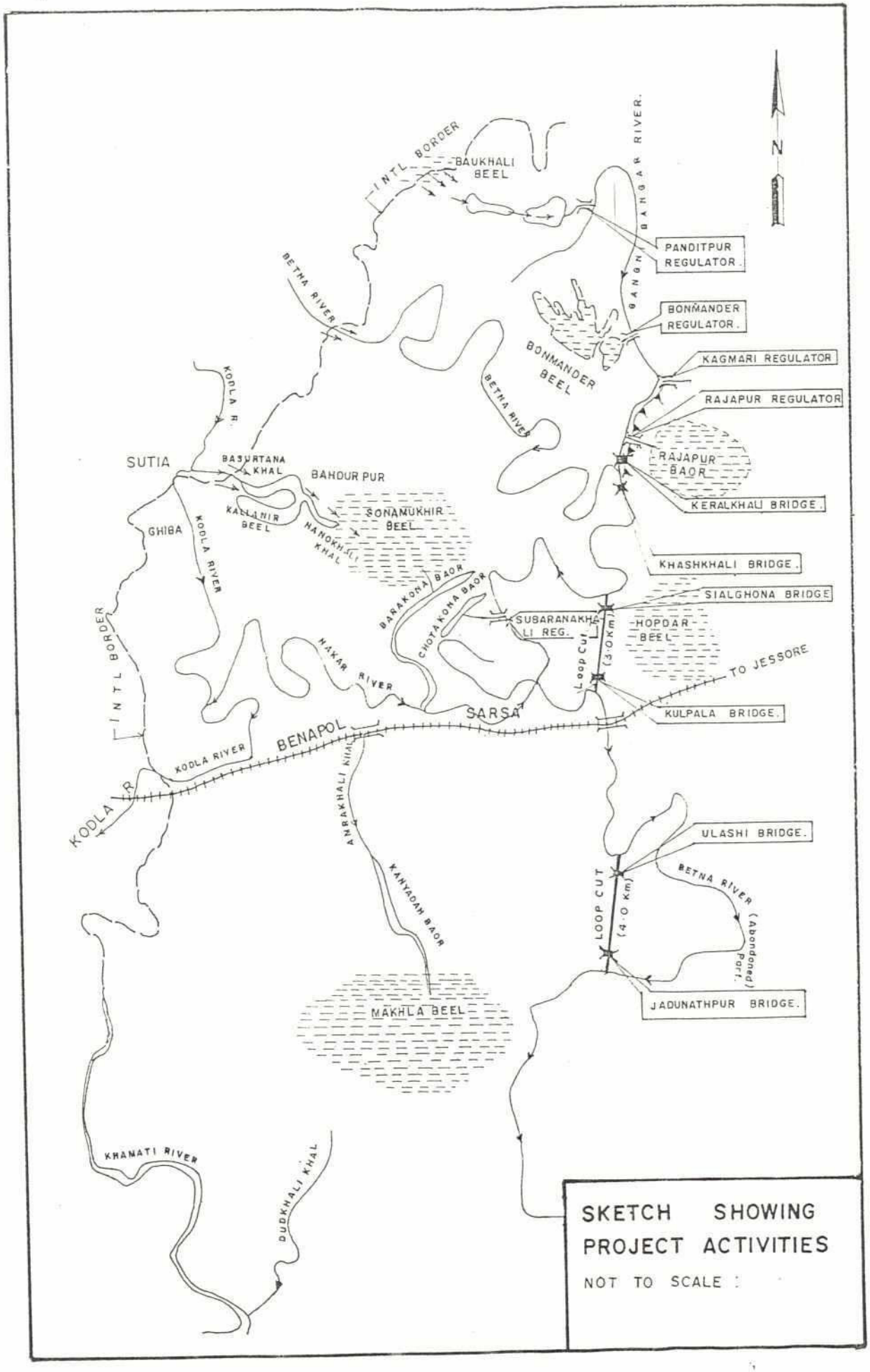


Figure 8·4 Sonamukhi Bonmander Beel Drainage Project.

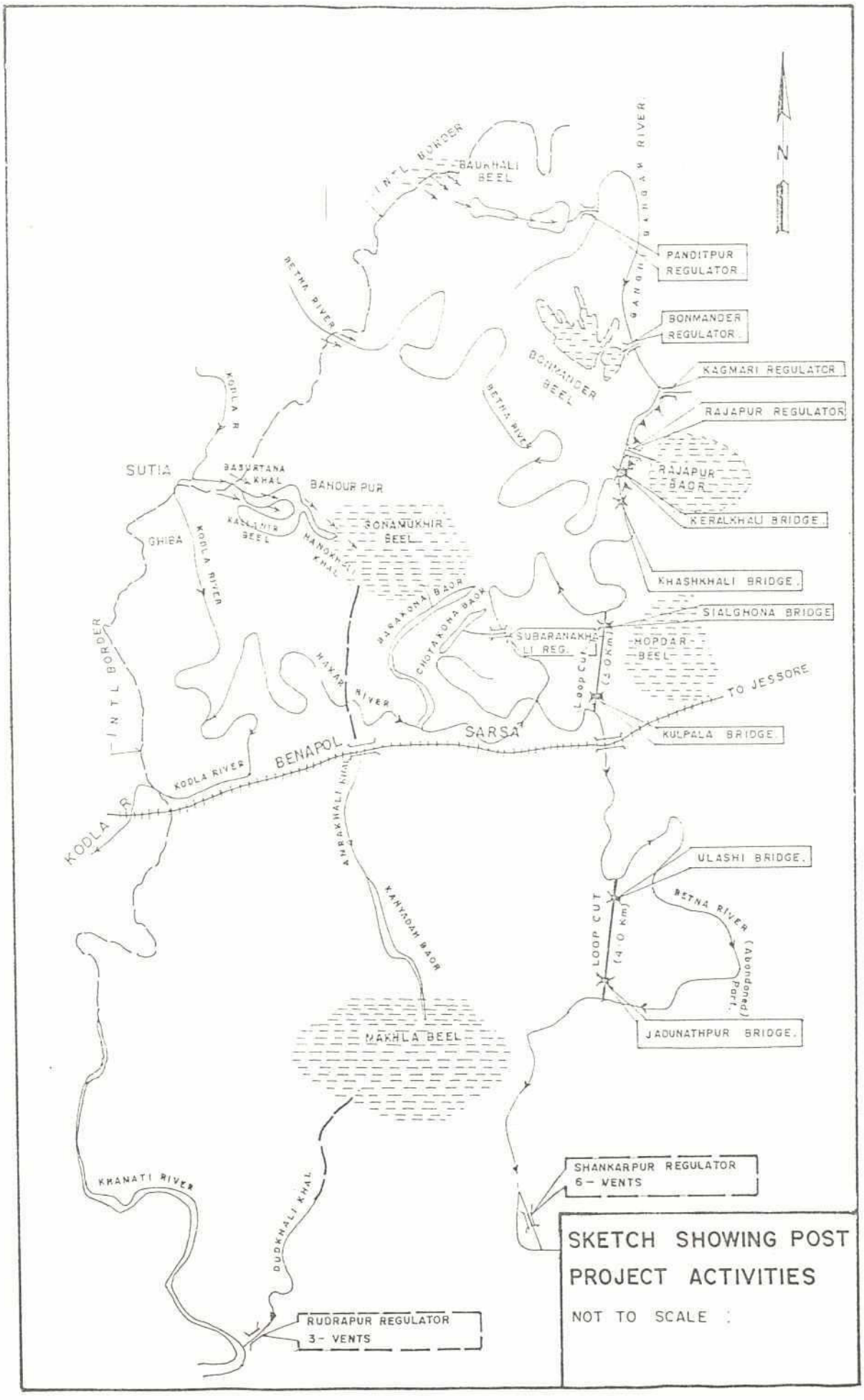
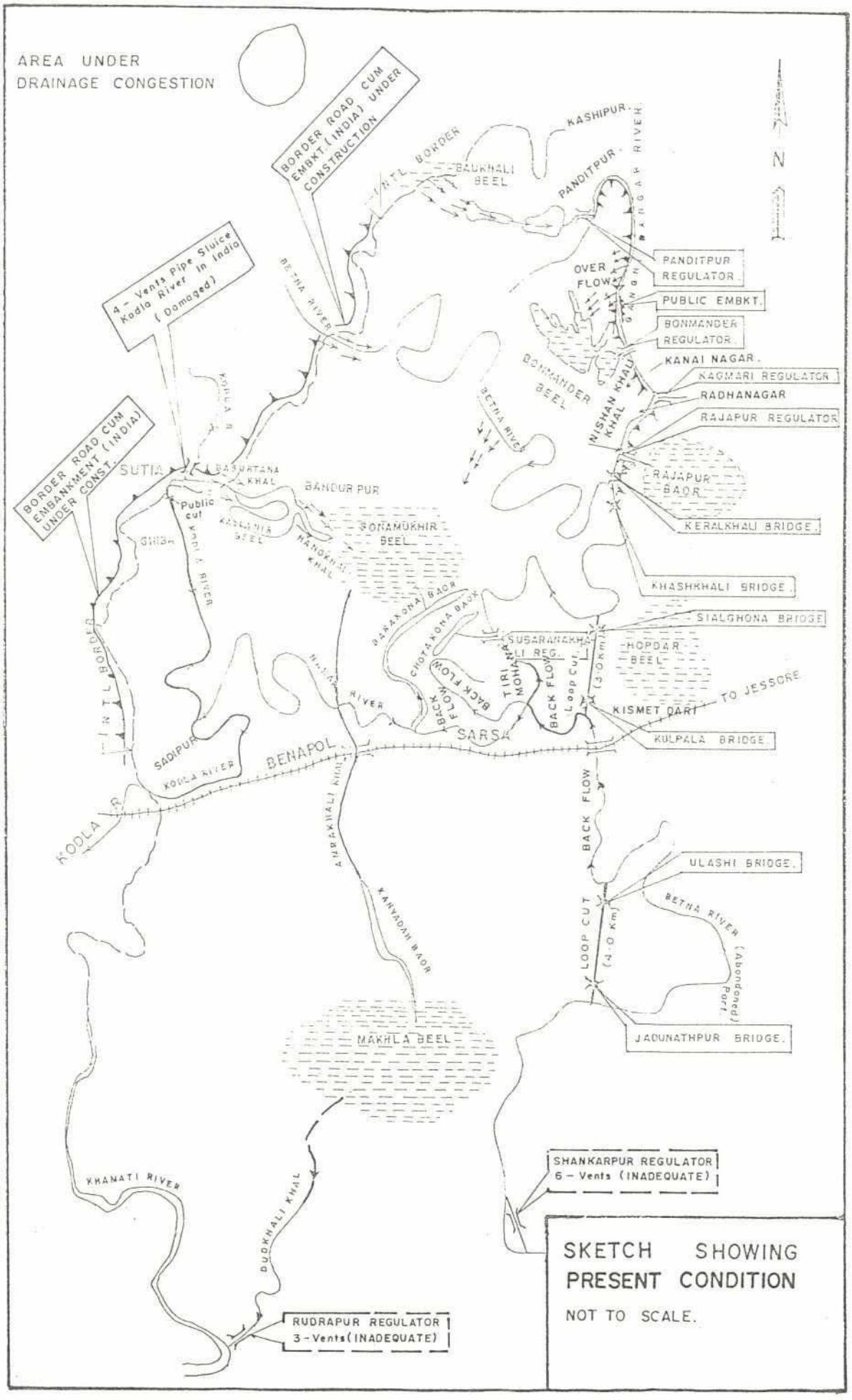


Figure 8·5 Sonamukhi Bonmander Beel Drainage Project.



overcome this situation the local people are now constructing a dwarf embankment around the main depression between village Radhanagar and Gaursuti at their own cost, to stop the entry of early monsoon water inside the beel.

d) Obstruction of Gangni Bangar River

The Gangni Bangar river, which acts as the main drainage channel of Bonmander Beel area falling into Betna through Nishan Khali, is almost silted up throughout its length and the numerous cross bunds constructed by the local people in the river bed to create fishing ponds have reduced the flow to a great extent, even during monsoon, causing acute drainage congestion in the Bonmander Beel area.

e) Flow in Betna river

The Betna river, which is the main drainage channel of the whole project area, is silted up to a great extent and is no longer a perennial river. The cross-bunds on the river bed for fish ponds have also created great additional obstructions to flows. The meandering nature of the river has increased flow time. The two loop cuts of Betna at Sialghona and Ulashi have shortened the length of the Betna by about 16 km, which has substantially decreased the flow time and thereby improved drainage efficiency and reduced the flood peaks in the area by about 0.6-0.9m. However, when the huge in flow from India is accompanied by heavy local rainfall, the Sonamukhi Beel area receives back flow through the tributary of Betna passing through Tinmohana and connected to Barakona Baor. The backflow through Subarnakhali khal is controlled by Subarna khali regulator. The Sonamukhi Beel area gets Indian flood water directly through Bahadurpur baor. It perhaps should be seen as inevitable that the beels will have volumes of standing monsoon water, but floodway obstructions may need to be regulated.

f) Silting of Hakar River

This river was a link between the Kodla and Betna rivers draining Sonamukhi Beel. However, at present the Hakar river is dead and its bed has been completely changed into fish ponds and farm plots. There is no flow even during monsoon.

d) Excavation of Amrakhali Khal

When the drainage congestion in Sonamukhi Beel became very acute, the Amrakhali Khal was excavated under FFW, connecting the southern part of Sonamukhi Beel area to the Kanyadaha Baor, which has a link with Makla Beel and the "non-project" drainage system.

e) Rudrapur Regulator

A 3 vent drainage regulator has been constructed at the end of Dudkhali Khal near village Rudrapur for controlled drainage and to stop the inflow of saline water into the beel area during high tide. The drainage capacity of this regulator is considered to be highly inadequate to cope with the present requirement, and creates acute drainage problems both in Sonamukhi and Makla Beel areas.

f) Shankarpur Regulator

A 6 vent (6'x8') drainage regulator was constructed on Betna river at Village Shankarpur to use the dry river bed of Betna from Ulashi to Shankarpur as a reservoir for conservation of water during the dry season. However, the drainage capacity of this regulator

seems to be below the actual requirement and thus causes drainage congestion in the whole of Sonamukhi-Bonmander Beel project area. To solve this problem temporarily there was an attempted public cut in the cross-dam beside the regulator and the threat of public cuts still exists during every monsoon. Moreover, the construction of this regulator has created adverse effects in the downstream areas as it has stopped the flow of the Betna just after the monsoon. This regulator has resulted in increased salinity problems downstream and also increased the rate of siltation both upstream and downstream. Discussions with local people at Ulashi and Jadunathpur revealed that the objective of conservation of water for irrigation has not been achieved as desired.

g) Loop-cutting along Betna River

The loops of Betna left after Sialghona-Kulpala and Ulashi-Jadunathpur loop cuts are now abandoned river bed and people have excavated ponds with high bunds, stopping flow through these loops. As a result all the small drainage channels falling into these reaches of the Betna are now completely obstructed, causing drainage congestion to the surrounding areas every year.

h) Groundwater

Finally the complex drainage and flood situation does not appear to be recharging ground water to keep pace with extraction by the many STWs. Integrated water management is clearly needed.

8.4.2 Institutional and Social Assessment

There is no clear assignment of regulator operating responsibilities. "Khalashi sheds" were provided on site but none are occupied. Some sluice khalashis remain but they live in their own houses 3-5 km away from their sluice. No khalashis were available to meet the FAP 12/13 team and there were strong public complaints against the absentee khalashis of Subarnakhali and Bonmander regulators. Only one regulator committee was found (Shankarpur Regulator). In general the operation is controlled by local landlords/powerful persons.

Local people on their own have not been able to resolve some operating problems. For example, the sluice in Konnyadaha is kept closed by earth-obstruction for fish culture. As a result, water from the Sonamukhi beel could not be drained out to reduce its water level for cultivation. Natadighi and Dubpara people met the people of Konnydaha and the Upazila Chairman and UNO to find a solution but the problem has not been solved. This has created a great dissatisfaction to the landowners of Natadighi and Dubpara.

8.5 MAINTENANCE OF THE PROJECT

8.5.1 Technical Assessment

There has been virtually no maintenance. A limited amount of khal re-excavation is in progress.

There has been no maintenance work for any of the regulators and as a result all the gates are leaking. The civil structures, particularly the loose aprons, are damaged. One of the gates of the Rudrapur regulator has remained non-operative for a long time for want of minor maintenance works.

The embankment from Radhanagar to Nishankhali (about 2 km) along the left bank of Gangni Bangar was completed under FFW, but is in bad shape and slope due to absence of maintenance work.

All the rivers and drainage channels of this project are silted up or obstructed by cross bunds for fishing. This year (1991) a 16 km length of Amrakhali khal and Dudkhali khal has been re-excavated under FFW programme. The 1991/92 programme includes re-excavation of 25 km of the Betna river (as informed by SDE/BWDB).

8.5.2 Institutional and Social Assessment

So far as structures are concerned, the lack of local participation in operation inevitably means there is no incentive to carry out maintenance. BWDB is unable to provide basic materials for routine maintenance.

Clearly siltation, overland flooding from India, and groundwater development, are making the intended drainage systems irrelevant or obsolete, and private use of the old channels has taken over. Although there seems to be a general lack of public collective incentive to excavate khals, local people have in some cases carried out works - construction of small embankments (for example in a village near Gaursuti) and excavating channels (Ulashi-Jadunathpur). So if a benefit is perceivable local involvement is possible.

8.6 LESSONS

1. Water resources and land uses change over time. If agricultural development in the area of such a project as Sonamukhi is to benefit from water management, then reassessment of the situation and re-planning of measures to help farmers is required.

2. Water management in the border areas requires collaboration between the intermediate level officials. The problems are not big international ones, but do require negotiation and joint planning at say the Divisional level, between the relevant parts of West Bengal Irrigation Department and BWDB, which might minimise operating conflicts.

3. The Project was imposed without local involvement. Without a strong collective interest in benefiting from the project its decay is perhaps inevitable, bringing into question the Project's original desirability.

4. It would be easy to recommend inputs of resources to rehabilitate the Project; but this should be dependent on a positive response to points 1-3 above. The Project concept still needs to be valid from a technical and international perspective, and local people need to have a say in the revised project and be helped to take up responsibilities. From the technical side the FAP 12/13 team regarded possible drainage improvements as being potentially sufficient to cope with flood flows from India, but this should be confirmed by modelling.

9. SAKUNIA BEEL

9.1 PROJECT BACKGROUND

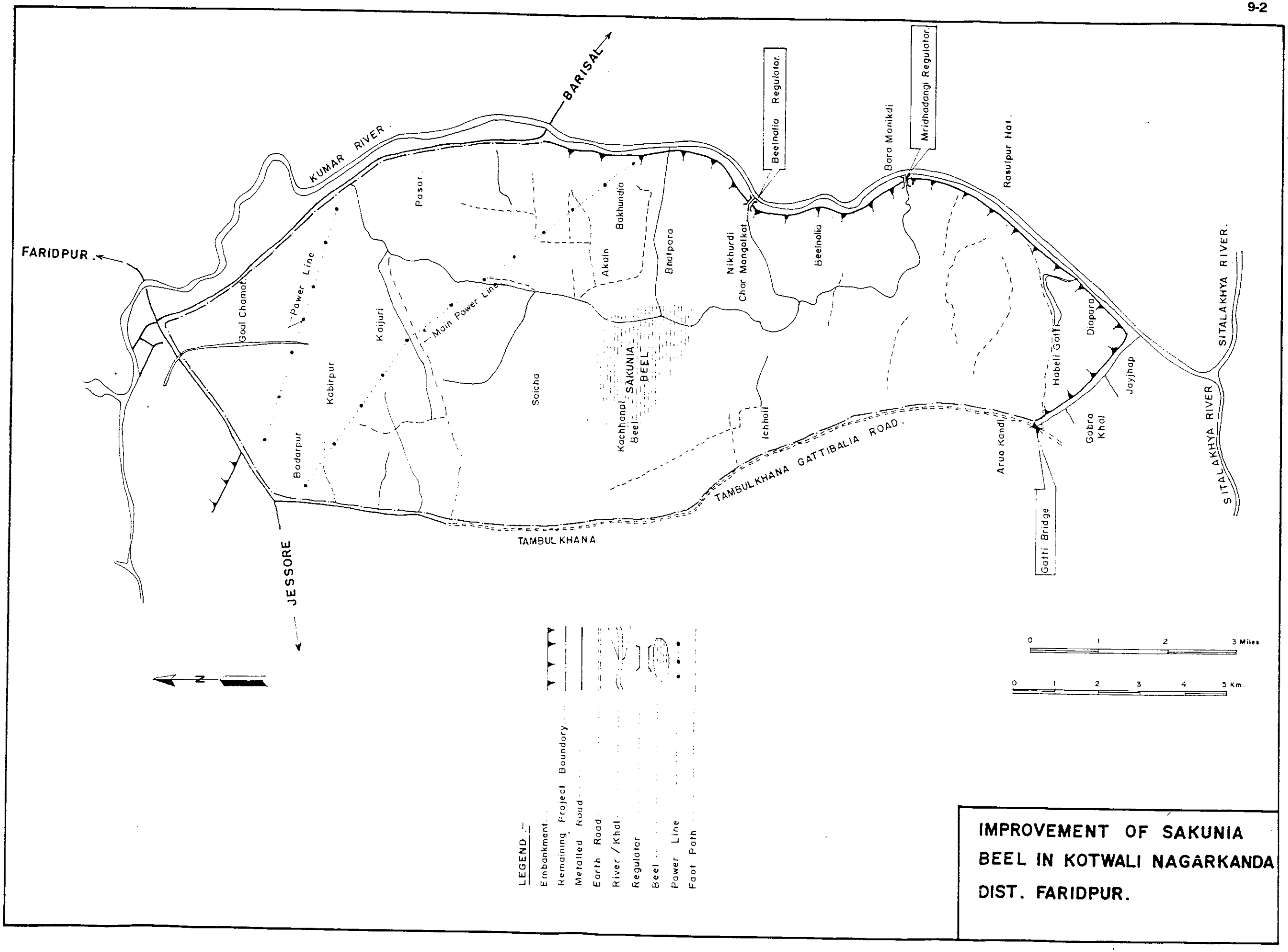
9.1.1 Project Summary Sheet

Project Name	: Improvement of Sakunia Beel in P.S. Kotwali and Nagarkanda
Project Type	: Flood Control and Drainage
Location	
FAP Region	: South-Central (in South-West Regional Study)
District	: Faridpur
Area (ha.)	: 5700 ha. (gross) 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

Major works still required for completion/rehabilitation:

Reconstruction of the embankment damaged and breached in 1988 by pressure of internal water is still required. Repair of one regulator with a cracked wing wall. Drainage congestion problems because khals need re-excavation.

Figure 9.1 Sakunia Beel Project - Key Features



9.1.2 Background

The Project, Improvement of Sakunia Beel, covers a number of small beels including Sakunia as the main one (Figure 9.1). In the pre-Project situation this area of about 5700 ha was surrounded by roads to the north-east, north-west and some portion on the south-west. There were already embankments on the south-east and southern boundaries of the project area along the Kumar River and Gobra Khal which were not adequate to withstand flood water overflowing from the Kumar River. There were minor drainage channels from Sakunia Beel to the areas of Bakhundia, Beel Nalia 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.

9.2 PROJECT AS IMPLEMENTED

Sakunia Beel Project was started in 1981-82 and completed in 1984-85. It has been mentioned in the Project Proforma (PP) that the survey, investigation and feasibility study of the project had been made departmentally, but no such document was available in the relevant BWDB office, and hence a genuine basis of the PP preparation could not be established. Major sources of information were the PP, Project Completion Report and interviews with beneficiaries and BWDB officials.

The Project Proforma proposed a series of major physical works, but these were not fully implemented and no reasons for this are given in any document available to the study. Table 9.1 shows the planned features and those implemented according to the PCR and field investigation.

Table 9.1 Planned and Implemented Components of Sakunia Beel Project

Component	Planned	Implemented
Land acquisition (acres)	252	104
Flood Protection Embankment (miles)	5	5
RCC Drainage Regulator (no.)	3	2
Re-excavation of Drainage Channel (miles)	12.5	10

Sources: Planned - PP (BWDB, 1981)
Implemented - PCR (BWDB, 1985)

After discussions with the BWDB officials, reviews of correspondence, and interviews with local knowledgeable people, it was revealed that one part of the drainage channel from Kabirpur to Sakunia Beel was dropped due to objections from the local people, and another part from Sakunia Beel to Bakhundia was dropped due to high elevation difference between Sakunia Beel and the selected drainage regulator site at Bakhundia (the others were re-excavated). Hence, due to land acquisition problems and subsequent cancellation of these two drainage channels, the total acreage of land acquired was less than originally planned.

The part of the flood embankment from Joyjhap to Gotti bridge is about 2.5 km long, but seems not to have been properly completed. The true history of its construction and/or re-construction could not be properly established because of contradictory statements made by BWDB officials and the local inhabitants. Whatever the case might be, it was revealed that this portion of the embankment, constructed by earth spoils during re-excavation of the adjacent canal, has been acting as a flood protective embankment, especially in preventing back water flow from the Kumar and Sitalakhya rivers when they are at high river stages. This work was not considered as an effective part of the flood embankment in the project feasibility study.

9.3 PROJECT PERFORMANCE AND IMPACTS

The Project has not achieved its intended impacts fully 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 many breaches since 1988.

The major agricultural and economic change in the area has been the 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 the harvest. However, there are conflicting statements that the lower parts of the beels can now grow HYV Boro due to improved drainage, and the re-excavation of two drainage channels in 1990-91 has created the opportunity for better drainage, although more channels remain to be re-excavated.

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 by low flow and water hyacinth in the river).

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

Overall the Project has brought benefits, but less than expected, and some disbenefits. There is more employment, and relative land values have increased; but the EIRR was estimated at around 10 per cent.

9.4 PROJECT OPERATION

9.4.1 Technical assessment

Drainage is the main operating activity, and this has experienced problems due to maintenance, but particularly due to variations from the intended project plan.

In the PP three drainage regulators were to be constructed, one 5-vent regulator at Mridhadangi, another 2-vent regulator at Beel Nalia, and a 1-vent regulator at Bakhundia. The regulator at Bakhundia was not constructed as the drainage channel along that direction was

dropped. The Mridhadangi regulator was reduced from 5-vent to 3-vent and no report or document in support of such a change was available. However, this regulator controls the flow of the channel that carries maximum drainage water from Sakunia Beel and has been found inadequate in ameliorating the drainage situation of the south-eastern part of the Project area. This 3-vent regulator, together with the other 2-vent Beel Nalia regulator, has been aggravating the drainage condition of a considerable part of the project area rather than improving it, especially due to the high volume of monsoon water run-off and inflow through the bridges and culverts in the road on the north-east and north-west side of the Project.

The drainage regulators at Beel Nalia and Mridhadangi have only been functioning in preventing any unwanted inflow from the nearby Kumar river at its higher stages, and this is no longer an important benefit as the normal monsoon flow of water in the river is now much less than before, reportedly because of construction of embankments and a regulator at the mouth of the river (on the Ganges).

9.4.2 Institutional and social assessment

BWDB is not involved in operation of the Project (and apparently has no field staff assigned to it, but who is responsible for regulator operation is unclear.

9.5 MAINTENANCE OF PROJECT

9.5.1 Technical assessment

a) Embankment

Out of 14.6 km (9.1 miles) of embankment, 11.4 km (7.1 miles) are along the Kumar river and the remaining 3.2 km (2 miles) are along the Gobra Khal. Almost 85 per cent of the embankment along the Kumar river is just beside the river bank without any setback distance. This might have reduced land acquisition problems, but obviously increased the risk of embankment stability. The side slope of the embankment along the Kumar river has been damaged in many places by flood water and/or by slope failure during monsoon rains.

During the 1988 flood the flood embankment was damaged at several places by water pressure from inside the project area, rather than by the nearby Kumar river. No effective measures have yet been taken up by BWDB to repair or rehabilitate the damaged portions after the 1988 flood.

At present local people are using LLPs for lifting irrigation water from the Kumar river and the placement of a few LLP discharge pipes is causing damage to the embankment as the discharge falls directly on the inside slope of the embankment.

Even though the water level in the Kumar river is being controlled by a regulator on its upstream side at Faridpur town, the existing flood embankment cannot be claimed to be adequate to withstand any further severe flood like the one in 1988.

The embankment in 1991 was still open in several places where there were breaches in the past, for example in the 1988 floods.

b) Drainage Channels

Improvement of drainage facilities in Sakunia Beel area was an important objective of the Project. It is evident from the PP that initially the drainage system consisted of five parts, a total of 20 km (12.5 miles). However, during implementation two channels, one from Kabirpur to Sakunia Beel and the other from Sakunia Beel to Bakhundia, were not implemented.

The implemented parts have been partially re-excavated by the Faridpur Sadar Upazila under the Food For Work Programme in 1991. The total length of re-excavation from Beel Nalia regulator to Mridhadangi regulator was 5.5 km (3.41 miles) and was not implemented according to the approved design. The main part of the channel that has connected Sakunia Beel with this khal was not re-excavated due to an Upazila FFW resource constraint for the Kaijuri Union.

c) Regulators

Not only has the reduced regulator ventage hindered drainage, but construction was poor. The 2-vent regulator at Beel Nalia was constructed poorly and all four wing walls have cracked, two of them have cracked severely and one failed just after completion. Although the failed wing wall has been supported by struts against the opposite wing wall, this temporary protection should be substituted by a permanent one. No effective measures in this regard have been taken up by BWDB.

9.5.2 Institutional and social assessment

There is public resentment regarding the excavation of the drainage channels, although there is no local involvement in the Project and no local initiative to excavate these channels. HYV Boro cannot be harvested in times of early excess rain in Sakunia Beel, as happened in 1990. It was observed in the field visits that the cultivation of HYV Boro in the beel had decreased to some extent in 1991 as the farmers dared not bear the risk of losing the harvest. There was, however, a general trend to reduce Boro acreage because of high diesel costs in 1991.

There is resentment about the re-excavation of drainage channels, where it has occurred, as it did not make provision for culverts or small bridges for movement of animals and children to and from the fields. It is reported that five cattle died last year when crossing the 10 to 12 feet (3.0-3.7m) deep canals in Beel Nalia and Mongolkot mouzas.

There is public resentment and confusion regarding the acquisition of land for the construction of embankments and excavation of drainage channels. Some portions were not acquired as they were constructed or excavated under the Food-For-Work Programme. In Beel Nalia area the villagers reported new acquisition, but BWDB could not clarify the situation. Although compensation money is paid, there are problems of non-payment and failure to transfer title, phenomena found in many other FCD/I projects.

All of the above problems indicate a lack of public consultation and involvement in the project, which people are not on their own prepared or able to organise to maintain. BWDB has stated it has no funds available for maintenance of the project, and appears to have abandoned it.

9.6 LESSONS FOR O&M

The project was completed on 30.06.1985. It seems it is completed once and for all. There is no provision for the maintenance of the project. The present BWDB authority are not concerned with its performance. They would be concerned only if there were a budget for it. None of the present (1991) engineers of the Division had visited the project on a single occasion. There are several natural breaches, and perhaps public cuts, which remain open. The drainage channels were silted up by the 1988 flood. Part of the Boro crops are lost just before harvesting due to heavy rain and drainage congestion. It is better not to speak of technical loopholes but only to mention that the regulator at Beel Nalia cracked at installation. The authority blamed the construction firm, the construction firm told a different story. There is also a gap between the planned work and actual work in respect of the length of drainage channel and number of regulators and vents, both of which are insufficient.

Very little O&M has taken place in this project and yet it could be perceived as the main "problem" in this project. The project concept appeared appropriate, although it is unclear whether it was economically desirable, but omissions in implementation and substandard construction have reduced the potential benefit. Moreover, damage to the embankments and silting of the khals have continued with a lack of routine maintenance or rehabilitation. Only in 1990/91 had some khals been re-excavated, and than not by BWDB.

The problems could be put down to a lack of funds, but this renews emphasis on external funding, and ignores the BWDB O&M Division staff available to assist and advise in project management and operation. There was no attempt to involve local people in the project management or to mobilise resources in any way from the area. Clearly given the performance in this project of BWDB to date, a project management organisation involving not just BWDB is called for.

10 SILIMPUR-KARATIA BRIDGE-CUM-REGULATORS

10.1 PROJECT BACKGROUND

10.1.1 Project Summary Sheet

Project Name	: Silimpur-Karatia Bridge-cum-Regulators
Project Type	: Flood Control, Drainage, and Irrigation (intended)
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

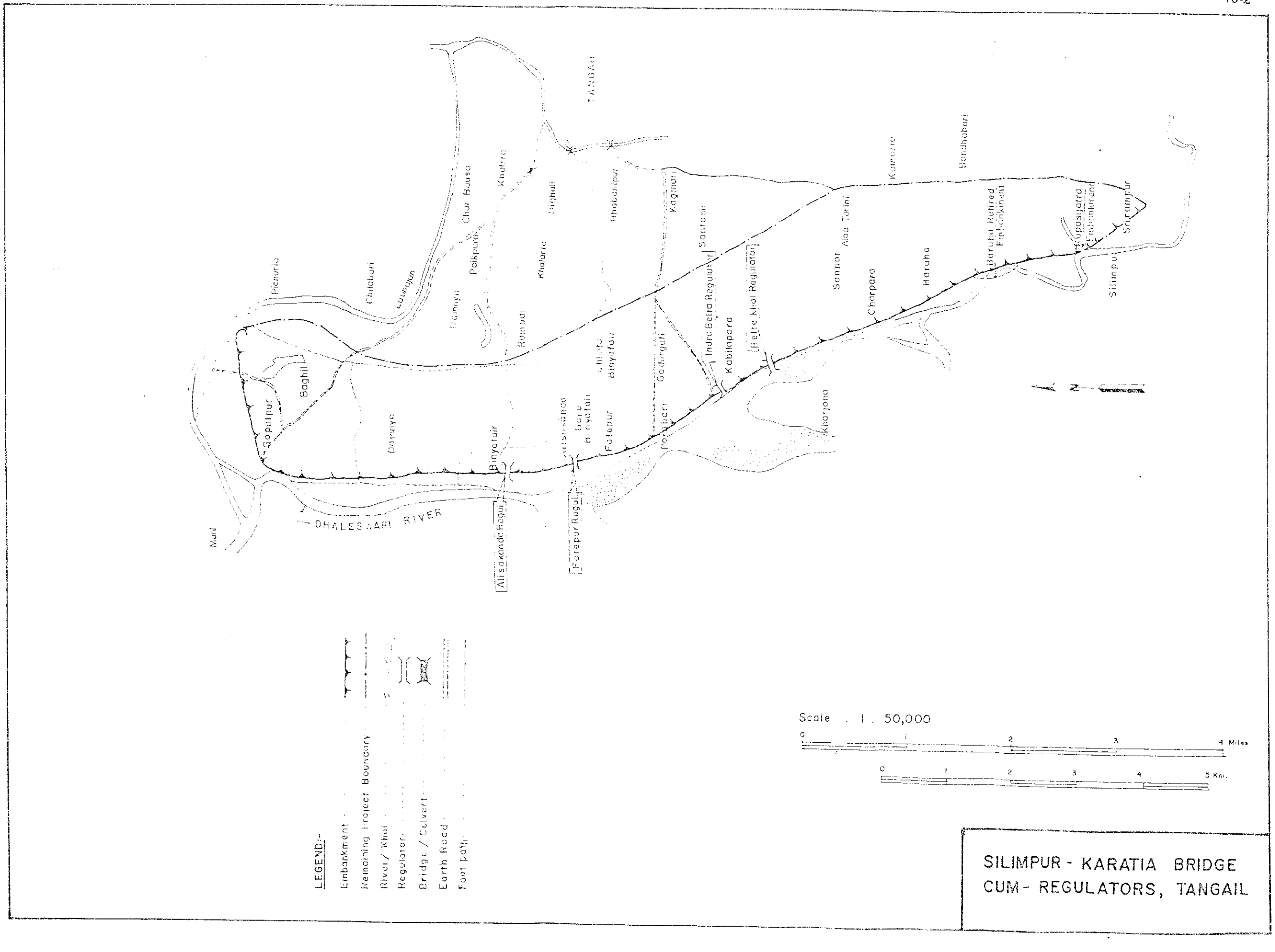
Major Flood Damage : 1988 area flooded, embankment washed away in places.

Repair-rehabilitation: maintenance comprises periodic resectioning of embankment.

Comments

A poorly conceived project which has provided limited agricultural benefits 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.

Figure 10.1 Silimpur-Karatia Bridge-cum-Regulator Project - Key Features



10.1.2 Project background information

The Silimpur-Karatia embankment forms a horseshoe around Tangail town, it was originally constructed in 1964-65 by Tangail Thana Council at a cost of Rs one lakh. Construction was with voluntary labour and contributions of crops after harvest for several years, however the embankment was eventually taken over by BWDB. The rivers and khals remained (and still remain) open. The area forms part of the "Tangail pilot compartment" under FAP 20.

Under the SSDFC project (IDA credit 955-BD) the construction of four small regulators was taken up to close off four khals running from the Dhaleswari river into the Project area (Figure 10.1). The stated aims were to let in and retain water for irrigation and to close off the khals to exclude flood water. These four structures are the investment which was being evaluated in the RRA, although the O&M comments have some relevance to the Project as a whole.

Both low and higher land exist in the Project area. In pre-Project conditions higher land grew T.L. Aman, while lower land was under deep-water B. Aman with flood depth in excess of six feet. However, irrigation was already developing using DTWs and later STWs.

Flood water enters the Tangail area from the Lauhajan river which originates from the Dhaleswari, which also brings flood water to the area.

10.2 PROJECT AS IMPLEMENTED

The "Project" comprises four small brick masonry sluices titled "regulator cum bridge" of one vent capacity (3'x4') operated with fallboards, located on four khals which linked from the Dhaleswari and its distributary into the Project area and the Lauhajan river.

The embankment around Tangail is a mixture of locally built embankment and roads which has been taken up by BWDB. The land was not acquired by BWDB. However, the Lauhajan remains open to flood water and is itself a distributary of the Dhaleswari. The sluices were built under IDA credit 955-BD (SSDFCP), but this investment was subject to minimal pre-appraisal. The sluices were claimed to be flushing inlets to provide water for irrigation, although ground water irrigation has been able to cover almost the whole area.

10.3 PROJECT PERFORMANCE AND IMPACTS

The "project" has had a minimal impact. The four sluices have remained open ever since 1983 (when constructed), with the exception of one sluice in 1991 (see Section 10.4.1); while water has still entered the area more or less as normal (although the inflow from the khals is slower as their entrances are constricted by the sluices).

Higher land in the project area has experienced little relevant agricultural change: T. Aman could be grown before the sluices, as it is now. However, there has been a major growth in HYV Boro cultivation, starting with DTWs **before** the sluices were built. Flood control (if effective) would have no impact on this crop, as evidenced by its adoption despite the ineffectiveness of the "project". On lower land HYV Boro has displaced B. Aman which can no longer be broadcast in time. There has been a decline in monsoon season cultivation. However, farmers try transplanting the same deep water Aman varieties on some of this area. The embankment helps to reduce flooding, but there is still a high risk of loss from flood water

rising too quickly in the early stages of the crop. So reduced monsoon water levels could help, given the change to Boro, by enabling an Aman crop to be securely grown, but farmers are already much better off from small scale irrigation.

Since the waterways are still open there have been few adverse impacts (it was not a major fishery, but fish have apparently not declined in the area), and the sluices facilitate catching fish. However, the sluices do not allow passage of boats. During the monsoon small country boats were able to move goods cheaply from the outer char areas direct to Tangail, now they are transhipped to rickshaw/vans and trucks at the sluices and embankment. Although the village road has been improved by the sluices, they were just an expensive and inappropriate response when small bridges would have done the same job and permitted boat traffic to continue.

10.4 OPERATION OF THE PROJECT

10.4.1 Technical Assessment

There has been virtually no operation of the Project. It was reported that the fall boards in some of the sluices were used initially but did not fit well, were difficult to remove once used, and then were distorted after soaking and could not be reused; they had long remained idle/lost. However, while showing visitors around the Project in 1991 the XEN discovered the sluices were not being operated and succeeded in locating fallboards for two sluices. Although the fallboards were in July 1991 in place in one sluice, they still leak profusely. Fallboards clearly raise some technical problems and are easily removed permanently. The lack of operation essentially reflects the inappropriateness during the 1980's of sluices - a planning problem, and institutional problems. However, this may change with FAP 20, the Compartmentalisation Pilot Project, which will experiment with improved monsoon water management in the area.

10.4.2 Institutional

Despite an earlier involvement in the embankment, there was no involvement of local people in the regulator project from the start. No doubt someone brought their influence to bear on the authorities to build structures there (under whatever project funding was available), but the local people thought that bridges were being built. They would have welcomed bridges, whereas the sluices were of little use.

BWDB is supposed to hand over small projects to the local administration, and under the most recent small-scale project (SSSFCDIP) there is a provision for local project committees to be established from the planning stage. It is reported that the BWDB Work Assistant for this project was entrusted with forming sluice committees and he designated a chairman and four members per sluice. However, having built the structures and provided fallboards BWDB took no real interest in them, nor did it have any clearly defined handing over of operating responsibilities. It is hardly surprising that local operating involvement did not develop when people had not wanted that type of structure, and people had negligible incentive (benefit) or training for taking responsibility.

Furthermore the people living near the sluices mostly farm outside the embankment. They believe that closing the sluices would raise the water level outside in floods (although this is unlikely, it could have been modelled in project planning). The people with lower land, who might sometimes gain by closing the sluices, live further from the embankment. In such

circumstances the fallboards left behind by the contractors naturally fell into the hands of people with land outside the project.

In any case there has been no serious conflict over closing the regulators - had there been any clear gain to be had from closing them attempts by local people to block the sluices off with earth and wood might have been expected.

10.5 MAINTENANCE OF THE PROJECT

10.5.1 Technical Assessment

The sluices were well built and remain in good condition without any maintenance work since 1983 (apart from a few missing bricks in the aprons). The embankment is not regularly maintained by BWDB, instead it is resectioned under FFW schemes and "flood damage rehabilitation". This amounts to periodic repair on an approximately five year cycle. For example, in 1988-89 15.1 km were repaired with 763 metric tonnes of wheat and 4.5 km with Tk 3.2 million (Flood Damage Repair), while in 1989-90 8.9 km were repaired with 407 metric tonnes of wheat.

Damage to the northern section of the embankment, dating back to 1988, remains to be resectioned, and has allowed in flood water in 1991. However, some routine maintenance is carried out by women's work crews under CARE's rural maintenance programme. This is without the knowledge of BWDB and arises because the embankment is effectively a village road. The resectioned parts are in relatively good shape.

10.5.2 Institutional and Social Assessment

Maintenance at present is dependent on external resources (FFW). This work has a limited effect since the annual program of resectioning appears not to be prioritised on the basis of gaps in the embankment or poor sections. Perhaps this is because water can still enter the area through the Lauhajan river. Local resources are not mobilised for maintenance work, as there is an expectation that FFW wheat will eventually be available for such work.

10.6 LESSONS

1. Operation and maintenance become irrelevant when a 'FCD project' is incomplete and does not change monsoon water conditions.

2. The concept of the investment being considered here was unclear, and the actual work carried out inappropriate to the circumstances.

3. Local consultation involving a series of public meetings to discus the pros and cons of possible projects, and to actively decide what to build would have made the needs of local people clearer to the implementing agencies, and open up an avenue for local involvement from the outset.

4. Had the project been a worthwhile concept, the attempt to involve local people in the project was insufficient. It is unreasonable to imagine that the local people would work out an operating regime without institutional support. The social problems of helping people to organise their own management structure and overcome the differences of interest between insiders and outsiders (for example) were completely ignored.

11. KATAKHALI KHAL PROJECT

11.1 PROJECT BACKGROUND

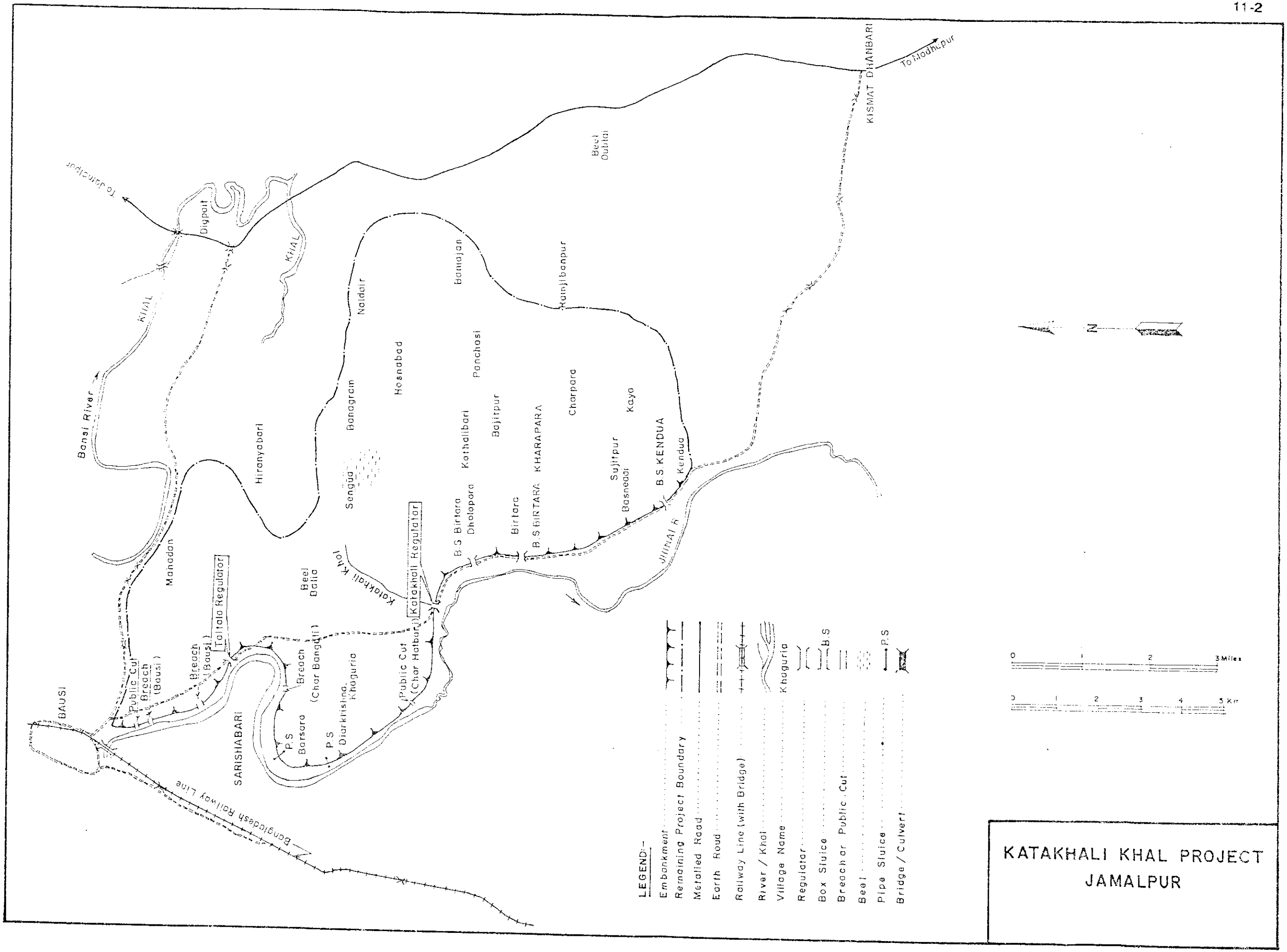
11.1.1 Project Summary Sheet

Project Name	: Construction of bridge-cum-regulator on 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	: not to date

Major works still required for completion/rehabilitation:

Repair of breaches dating back to 1988 and of public cuts made in 1991 to drain out early rainwater. Resectioning of northern part of embankment where there are many raincuts. Maintenance of earthworks around regulators and box sluices.

Figure 11.1 Katakhali Khal Project - Key Features



11.1.2 Background

Katakhali Khal Project is located about 25 miles (40 km) south of Jamalpur, and comprises the larger parts of one Union (Mahadan) of Sarishabari Upazila (Jamalpur District) and one Union (Birtara) of Modhupur Upazila (Tangail District). The Project is bounded by the Jhinai river, which is connected to the Jamuna system, along its western side. The general area comprises a mixture of low lying depressions and beels interspersed with slightly higher land (Figure 11.1).

Existing roads and embankments have now protected much of the general area from smaller floods, although the general area was badly affected in the 1988 floods. There has been widespread development of groundwater for HYV Boro cultivation in the region, initially with deep tubewells (DTW) since about 1980, but mostly during the last few years with shallow tubewells (STW). At the same time the rivers were silting up and siltation of beels has made more land available for cultivation during the dry season. Hence the experience of Katakhali Khal should be seen in the light of an agro-environment where changes were in any case happening.

Katakhali Khal itself drained much of the project area and flows into the Jhinai river. Before the Project the drainage channels and part of the project area were open to water from outside so flooding was reportedly a frequent event. The Project was subject to a short appraisal (EIP, 1980) and to a socio-economic baseline study (Naqi, 1980). These indicated a small area of HYV Boro at the time, with the main crops: Aus, jute, B Aman and T Aman. The assessment (EIP, 1980) did not estimate flood losses, but claimed that the proposed project would bring two benefits:

- the monsoon water levels would be reduced - the maximum 1-in-5 year level inside the project would be reduced by 5 feet (1.5 m); and

- the rate of rise in water during June/July would be slower - with a maximum of 4" (10 cm) per day.

Hence the project was not expected to eliminate monsoon season flooding from internal runoff (since water could not be drained out during high river stages). Even so two benefits were predicted, one respectively for each of the above targets:

- there would be an increased area under T. Aman, and higher yields; and

- there would be reduced flood damage and so higher average yields for the other monsoon season crops. It was also argued that Aus and jute areas would increase in response to this lower risk.

The works planned to achieve these aims were primarily structures. Much of the inflow of flood water came through Katakhali Khal so a 3 or 4 vent regulator and closure were to be built there. Additionally a smaller bridge opening at Taltala allowed in water to a smaller beel system which connects in to the main beel (Beel Balia) during high floods so a 1 vent regulator was to be built here (since the drainage is independent from the main Khal), and 8.8 miles (14 km) of embankment were to be built to prevent overbank flooding.

11.2 PROJECT AS IMPLEMENTED

The Katakhali Khal Project was included in the EIP 1980-81 construction programme. The project was intended to be completed within one season, but although work started on schedule it was in fact only completed by June 1983. The engineering features of the Project, as depicted in the PCR, are as follows:

i) Length of embankment = 14.16 km. (8.8 miles)

Embankment crest elevation +54.6 ft. PWD
Embankment crest width 14 ft. (4.3m)
Cross dam width 14 ft. (4.3m) and crest elevation +57.2 ft. PWD
Side slopes 1:2 (embankment) both sides
1:3 (cross dam) both sides

[4.5 miles (7.2 km) of new embankment, the rest being "resectioned", presumably the existing road]

ii) Flushing cum drainage regulator = 2 Nos.

Regulator at Taltala Beel = 1 vent
Regulator at Katakhali Khal = 3 vents

iii) 3 Box sluices and 2 pipe sluices are situated at the following locations:

Box sluice at Kendua
Box sluice at Birtara Kharapara
Box sluice at Birtara Dholapara
Pipe sluice at Barsara of Mahadan union
Pipe sluice at Diarkrishna of Satpoa union

The two main flushing-cum-drainage regulators at Katakhali Khal and Taltala Beel have been constructed to cover catchment areas of 12.6 square miles (3263 ha) and 1.3 square miles (337 ha) respectively. However, a difference was found in ventage of the Katakhali Khal regulator from the completion (recast) PP, which originally was 4 vents and was not corrected to reflect the actual structure constructed. Moreover there are actually three box sluices instead of two in the original proposal, there is no written record available of the reasons for changes in project planning. As no detailed design drawings or "as built" drawings were available for the structures, it is not possible to verify the construction or understand the reasons for any change in the structures during execution.

The box sluices appear to have been well constructed, which is to be hoped for since the original cost estimate was Tk. 3 lakh for two (EIP, 1980), but the final cost was Tk. 20.66 lakh (BWDB, 1986; Planning Commission, 1988) for three. Even allowing for annual inflation of about 10 per cent, this implies a construction cost 3.7 times higher than estimated and higher than the cost of the three vent regulator, even though the box sluices serve a much smaller area.

11.3 PROJECT PERFORMANCE AND IMPACTS

The project has had limited success in excluding floods from the area. EIP (1990) reported that during three of the first six years after completion the project had been

completely flooded. This was not reported during the RRA fieldwork, but may be because 1988 was so much worse, and in the two years since then floods have not been so severe. Even so monsoon water levels have been reduced on most land levels.

As a result of the Project B Aman has disappeared and short stemmed HYV Aman has been introduced on 49 per cent of the Aman area. However, much of the agricultural growth in the area has resulted from growth in HYV Boro cultivation (86 per cent of winter cultivation) with groundwater irrigation. This has also occurred in nearby non-Project areas, and has happened despite flood and drainage problems inside the Project, although the drying of the beels may have been accelerated by the Project. The regulators and sluices have helped locally to improve drainage, but the change mainly results from the introduction of irrigation. Overall paddy production has trebled, but has only increased by 50 per cent in the monsoon season (due to the Project).

Open-water fish production has been decimated with the separation of the beels from the rivers during the early flood period (perhaps an 80 per cent loss of the previous fishery). However, fish cultivation in ponds, and even the beels, has been facilitated, although the latter requires improved operation, and organisation of fishermen.

Normal flood flows have been excluded from a larger area than that claimed to be affected by the project, even though the drainage from, for example, Beel Dublai does not flow through the project structures. Some flood security has been provided although the area was badly affected in 1988, and employment has increased. Despite the problems encountered the Project had modest costs and substantial agricultural benefits, giving an EIRR estimate of about 27 per cent.

11.4 PROJECT OPERATION

11.4.1 Technical assessment

The construction and closing of 14.16 km. (8.8 mile) embankment has prevented natural drainage in most parts of the area, except where sluices were installed. Natural drainage appeared to be partly improved as part of the Project. However, during the late 1970s canal digging programme a khal from Beel Balia to Bangsi river was excavated through which water could flow into the Bangsi river. This khal has now silted up, creating a local drainage problem and damaging the standing crops. It is notable that this channel was dug away from the Project structures. There appears to have been a lack of coordination between Project and programme, and a lack of local consultation.

Drainage efficiency, even with the regulators, is reportedly limited, partly due to the condition of the regulators and partly due to khals silting up. The drainage channels (14 km.) leading to the drainage structures are now partly silted up and need to be re-excavated to augment their capacity so that the local drainage can be enhanced. Perhaps the real reasons why this is seen as a problem are that the beels and khals have silted up, altering drainage conditions and putting in question the use of expensive structures with long lives. Also HYV Boro is now widely grown, hence broadcast deep water Aman cannot be grown because the fields are still under Boro when it should be broadcast. Yet rainwater flooding means that the water sometimes rises too much for T. Aman. The project was expected to leave relatively deep flooding from rainwater (EIP, 1980), but this was probably never explained and discussed with local people, and at the planning stage the area of HYV Boro was much less.

The other leading causes of local drainage congestion are the kutcha roads constructed under FFW programmes without any drainage facility or with insufficient culverts. To this extent farmers have a valid complaint and proper coordinated planning of all earthworks in the drainage system/project is required.

Two public cuts in 1991 illustrate the operating problems, and also inadequacies in project planning.

a) Public cut at Bausi

This occurred in May 1991, due to drainage congestion caused by heavy precipitation over a short span of time. The embankment was cut, therefore, to protect the standing jute crops. A very low bund of sandy soil has been built across this cut.

b) Public cut at Char Hatbari

In May 1991 this cut was made to protect HYV Boro and jute crops and homesteads from flooding by drainage congestion caused by intense rainfall. This was to relieve drainage in an area bounded by the embankment and by an older earth road (the road which further south forms the project embankment). There is no drainage structure in the southern part of this pocket of the project and the culvert in the road is small. Project planning for this area appears to have been faulty. Even in early July water was still flowing out through the cut.

The water control structures (Regulators/Sluices) control the outflow of water from the project so it is possible to cultivate fish seasonally in the beels to compensate for loss of wild fish. This already happens in some beels in the Project.

11.4.2 Institutional and social assessment

There was no special O&M Manual for this Project, nor was any manual for operation and maintenance found to have been prepared for the Project. No specific formal institutional arrangement for the project operation and maintenance was made. The BWDB officer in immediate charge of the embankment in Katakhali Khal project is the Sub-Divisional Engineer (Jamalpur). He may delegate his authority to the Sectional Officer (SO). The next immediate charge is with the Work Assistant who is authorised to operate the regulator. The regulators are actually operated by local committees, and only the SO appeared to be well informed about the project. There appears to be minimal, if any, liaison between BWDB and the two Upazilas (and Unions) covering the project. The Upazila engineers appeared unaware of the project, yet they have plans for roads, culverts and drains in the project area. Both sides need to plan for the area keeping in mind the issues of water management (floods and drainage).

There are sluice committees for almost every regulator sluice. The committees are functioning but not without disputes. The Taltala regulator is reported to have a committee of 7-9 members (their names are lodged with the BWDB SDE's office). The chairman is the largest landowner in the area. There is no BWDB involvement in operation. Originally the sluice was reported to have only been fitted with fallboards, but some four years ago a vertical lift gate was installed. However, the regulator is reportedly rarely operated as cuts and breaches make it ineffective. The operator-secretary reported that he was unpaid and landless. It was unclear for what reasons he continued in this capacity.

The Katakhali Khal regulator operator is reportedly also unpaid and acts at the behest of influential members of the committee. There appears to be a khalashi shed by this

regulator, although none is mentioned in the PCR (BWDB, 1986) and it is now a medicine store. There is no BWDB involvement in operation, which is determined by larger landowners in the northern part of the regulator's catchment.

11.5 MAINTENANCE OF THE PROJECT

11.5.1 Technical assessment

A significant part of the top of the regulator at Taltala Beel was found to be exposed due to soil erosion, urgent maintenance of the embankment is needed to ensure its stability around the structure. The wooden-fall boards of this regulator need to be replaced by new ones because the existing ones are rotten.

The regulator at Katakhali Khal is in a defective condition as one gate is completely inoperative. Another can only be lifted half way, and the third is in full operation. According to BWDB the two defective gates were tested by the local technicians but they could not identify the problem. The concerned authority therefore requested repair by the technicians from the central mechanical workshop of BWDB. However, according to the regulator operator, the two defective gates have been partly out of order for three years and the sluice committee is still awaiting a response from BWDB to its request for repair. In practice the gates can be closed, but this is reportedly much more difficult than it should be. Certainly efficient operation is hampered.

The design crest of the embankment was fixed at El +54.6 ft PWD to protect the project area from both early floods and the main monsoon flood. The embankment could withstand the catastrophic flood of 1988 despite it being closer to a 1-in-100 year event in this area, and hence higher than the design standard. There were some natural breaches but these were influenced by public activity such as digging the embankment down to ground level [totalling 6 ft. (1.83 m)] for using as an irrigation inlet which was not closed properly later on. This caused the embankment to breach naturally at the weak section. During the field visit by the RRA team it was understood from group discussion with the local people that the majority of the embankment was not overtopped even in the 1988 flood, and they were able to take shelter on it.

However, the most northern part of the embankment at Banshi appeared not to have been constructed to the design level. Erosion, breaching and overtopping in 1988 all appeared to have occurred, based on the depths of water reported in houses and their floors relative to the river bank level. Water from this northern end of the Project flooded the whole area, despite the effort of people along the southern road-embankment to raise its level (successfully preventing local overtopping).

The whole embankment was found, during this survey, to be in a critical condition due to lack of maintenance since it's construction and also due to damage by the 1988 flood. If it is not repaired and maintained immediately then it will risk lives and damage to crops in the ensuing monsoon seasons.

Two public cuts and three "natural breaches" were found to be open in the embankment. The public cuts are detailed under operation (Section 11.4.1).

a) Natural breach at Bausi

This took place in the 1988 flood due to removal of an old bridge by the local people, weakening this part of the embankment. It appears that an old bridge existed here before the embankment was adopted by BWDB, the openings were sealed off by local people with earth to prevent flooding during the monsoon. When the embankment was taken up by BWDB they built the embankment around the bridge, without providing any drainage structure (Taltala regulator being intended to serve this area). However, two local powerful persons had the bricks removed (there were about 60,000 bricks) to build their houses. This loosened the earth, and in the floods the embankment remains were washed away. Sand was locally deposited up to waist deep on land behind this breach.

b) Natural breaches at Char Bangali and Kalibari

In the 1988 flood breaches occurred at two weak points in the embankment where it had been dug down to ground level to allow irrigation water to pass from the river by LLP, and had not been closed properly.

These cuts and breaches remained unclosed during the visit by the RRA team. There was no evidence of BWDB or local initiative to close the embankment.

11.5.2 Institutional and social assessment

Public participation is not found in the maintenance of the Project. There has been no maintenance of the embankment since construction. BWDB does not practice any well defined/prescribed inspection and management system, and Katakhali Khal project is not an exception to this.

However, in 1988 local people were mobilised voluntarily by the Birtara Union Parishad to protect part of the embankment when it was threatened by overtopping. Unfortunately, although they were able to raise the crest level in this emergency, the efforts were not coordinated between unions and flood water entered from the northern part of the Project and flowed through the rest of the project.

11.6 LESSONS

Katakhali Khal project highlights problems of poor maintenance. There has been no maintenance by BWDB, although where the embankment is a village road there is some routine maintenance by female maintenance crews organised under CARE's rural maintenance programme. There is some local initiative in O&M but only when an immediate need is clear. A number of means of fostering this, and of mitigating adverse project impacts, are possible.

1. The instruments to achieve effective **liaison** between BWDB, Upazila officials, appropriate members of line ministries (principally agriculture, fisheries, livestock, and LGEB engineers), Union Parishads and local people need to be established and put into practice. This would be for project planning, the continued operation of the Project, and to coordinate earthworks which change drainage. For example the Unions and Upazilas might be able to acquire wheat under FFW to repair damaged embankments (breaches and cuts) if they thought this a sufficiently high priority, and might combine earth roads and embankments to reduce drainage problems (earthwork to dismantle or move an earth road should also qualify for FFW wheat).

2. To improve the state of **embankments**, which are currently poorly maintained and under used, the following could be attempted:

   i) if embankments are given feeder road status at the outset, and are planned with this in mind, compaction could be improved (even if they have no surfacing), and they might be better maintained;

   ii) regular maintenance is needed rather than periodic or non-existent maintenance, particularly where soils are very prone to rain cutting as in Katakhali Khal. This should be through maintenance crews, preferably of landless women for distributional reasons and following the approach adopted in rural roads and the Delta Development Project. This is already happening on CARE roads within Katakhali Khal project;

   iii) to improve productive use of the embankment, compensate for the loss of trees in the area, and reduce raincuts on the embankments, greater use should be made of this resource through:

   - tree planting by handing over long term rights to use the embankment to local people (this will probably require long term leasing direct to individuals or NGOs, or BWDB could have its own revenue earning tree planting programme); and

   - shorter duration use of the embankment could be undertaken by local landless groups: zero tillage crops with good ground cover could be grown (such as country bean). Alternatively grasses could be grown to protect the slopes and be cut (not grazed) for fodder.

3. **Drainage** committees should be responsible for maintenance and operation (for example the maintenance of the embankment around structures, since rain cuts may eventually threaten the long term operation of a structure). This could also extend to public cuts: these may be necessary at times for drainage (even in a fairly well planned project), but BWDB should inform local people that this is permissable **only if**:

   - approved by their local drainage committee and UP;

   - BWDB is informed (this may not be possible in advance given the lack of visits to projects by BWDB staff);

   - there is an agreement (backed up by the local administration) that the local people will repair the cut when it is no longer needed so that flood protection is restored in time to prevent flood damage. This would create a liability for preventable damages consequent on public cuts made for drainage and minimise public expenditure on repairs; and

   - O&M could be improved by replacing the wooden fallboards used in the box sluices. The economic viability of gates should be considered. There is also a need for proper irrigation inlets to avoid embankment damage. Irrigation groups or pump owners might be persuaded to invest in these provisions.

4. Although in this project area the capture **fishery** has been largely destroyed and this loss has now to be accepted, there are some compensating measures which could be taken.

   i) In new projects the possibility of modifying structure designs and operating practice to help the movement of fish should be considered. Although an effective solution to the problem of migratory fish passage appears unlikely and would require very active participation from a fishery regulatory agency.

   ii) Semi-intensive fish culture is possible in the beels within a project, to encourage this the lower parts of the beel could be re-excavated to provide a reservoir area. Genuine fishermen's cooperatives would need to be established and given longer leases and institutional support in organising themselves against outside interests. This could be assisted by a better extension service for fish culture in beels. This would need resources to enable field visits, but might also be supported by sale of advisory services since fish cultivation can be a highly commercial enterprise. This might help to make the service accountable for giving appropriate advice.

12. HALIR HAOR

12.1 PROJECT BACKGROUND

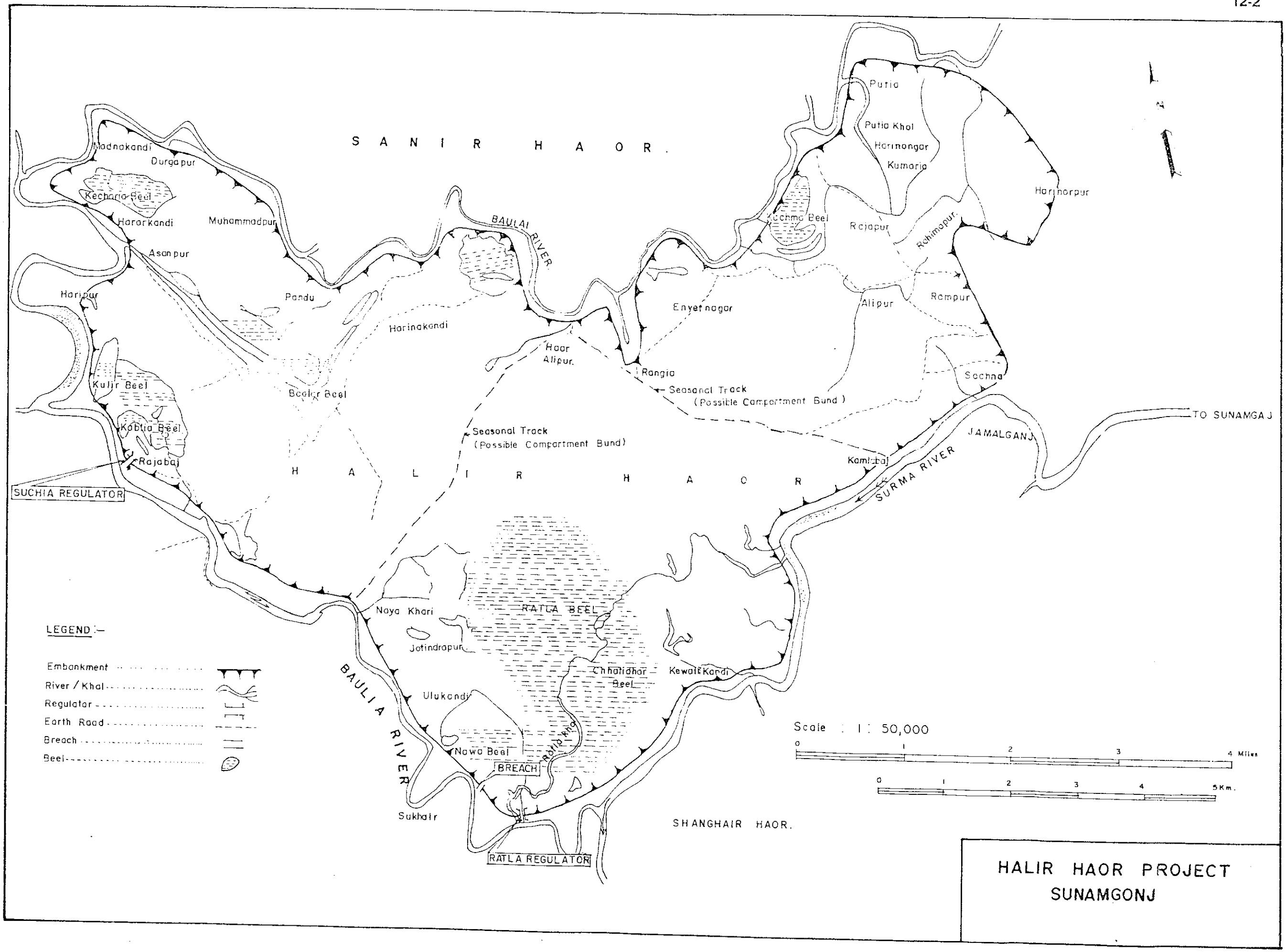
12.1.1 Project Summary Sheet

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

Key points

A partially effective submersible embankment project with a high rate of return estimated. Major benefits are from protecting the local Boro crop, and the disbenefits are minor. Maintenance problems and the need to make cuts for drainage each year limit the benefits. The Project does not help in coping with high floods.

Figure 12.1 Halir Haor Project - Key Features



12.1.2 Project area description

Halir Haor is located in Jamalganj Upazila (apart from a very small part in Tahirpur Upazila) in Sunamganj District, and is bounded by the Surma river to the south-east and the Baulia river to the north-west and south-west. The project area takes its name from the main haor in its area but includes a number of smaller beels (Figure 12.1).

The region comprises a series of haors - depressions which flood deeply (often to depths of 4m or more) for at least half of the year, and separated from one another by rivers and the slightly higher land of natural levees along the river banks. Under these conditions only one crop is possible in the winter period when flood water recedes - this is almost exclusively Boro paddy. The main limiting factor on its cultivation is the short period of flood free conditions and in particular the risk of early flooding just before harvest which can destroy the crop. Water depths are too deep for too long, and rise too quickly, for a monsoon crop to be possible.

A locally constructed submersible or dwarf embankment had been constructed for some time around at least part of Halir Haor, during the 1960's. This was to protect the area from early flash floods in April/May, and to ensure a safe harvest of the only crop - Boro paddy. To overcome the drainage congestion problems created by this embankment the people used to cut the existing embankment each year at some particular khal closures during the post-monsoon period to release the water, and then closed those khals before the next early floods. However, this arrangement did not give satisfactory results to the farmers as the rate of overtopping of the dwarf embankment was very frequent, and the closing of the cut portions every year before the early floods could not be achieved properly, causing partial or full damage to the crops of the area.

12.2 PROJECT AS IMPLEMENTED

Eighteen out of 29 miles (29 out of 46 km) of embankment were reported by IDA to have been rebuilt under a WFP Food-For-Work (FFW) programme in 1976-77. Unfortunately the engineers responsible for the Project were unable to confirm this construction date and only have records of FFW maintenance carried out from 1984. Moreover the official length of embankment according to the responsible BWDB sub-division is 53 km. What is clear is that as part of IDA credit no 955-BD (Small Scale Drainage and Flood Control Project) Halir Haor was taken up as a sub-project and two regulators were built between 1984 and 1987 and have been operational from 1988.

The engineering features of the project in 1991 comprise the following:

- Length of submersible embankment = 53 km.

  Embankment crest elevation + 20' PWD
  Embankment crest width 8' (2.4m)
  Closure crest width 14' (4.3m)
  Side slopes + 1:2 (embankment) both sides
  1:3 (closure) both sides

- Flushing-cum-drainage regulator = 2 nos.

Regulator at Ratla khal = 5 vents
Regulator at Suchia khal = 3 vents

The structures appear to have been constructed to a satisfactory standard and have not yet silted up. However, there seems to be some variance from the sub-project summary prepared prior to implementation of the structures. The latter refers to the approval of an unspecified number of pipe sluices, yet none have yet been constructed. Additionally both structures are marked as 5'x18', yet as noted above the regulators inspected are of different dimensions and capacities. Unfortunately no detailed design drawings or as built drawings could be obtained for the structures in order to verify the construction or understand the reasons for any change in design.

12.3 PROJECT PERFORMANCE AND IMPACTS

Despite some problems the project is low cost, although it entails recurrent maintenance costs, and has been relatively successful.

There is one crop per year, mostly local Boro. Following the Project the cultivated area has increased by 6 per cent of the total area, and now 5 per cent 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 L. Boro yields are 19 per cent higher with the Project because of somewhat better flood protection. Overall these changes result in about one third more paddy being produced on average. However, 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.

Other impacts of the Project have been small. The cattle population has declined with reduced areas of grazing, loss of animals during high floods, and continued crop failures resulting in sale of cattle. Fish catches are apparently unchanged, but there has possibly been a change in catch composition with delayed onset of flooding affecting fish migration. Availability of fish to casual and small scale fishermen has declined as the main Jalmohal is now controlled by outside interests. There is no benefit to pond cultivation.

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.

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.

Limited data on Project costs was available, but an estimate of the economic rate of return for the whole project was made of about 65 per cent. The incremental return on investing in the two regulators may well have been even higher.

12.4 PROJECT OPERATION

12.4.1 Technical assessment

The two regulators have fallboards to close the vents. While the fallboards are available they are difficult to operate. During the fieldwork the boards in the Ratla Khal regulator were leaking profusely. There was still at least a 40cm head difference flowing into the project and it was reported by local people that "Boail" fish could pass through the gaps.

More importantly the operating objectives of the project cannot be effectively achieved with this design. One of the general concepts behind operation of structures in submersible embankment projects is that, after the Boro crop has been safely harvested, water should be let into the project in a controlled way before the embankment is overtopped to equalise the inside and outside water levels and thus reduce damage to the embankment during overtopping. This is not possible with wooden fallboards since it is impossible to remove more than a few boards by hand with a large head difference at the regulator.

It is understood from Sunamganj BWDB Division that this design is no longer used in new projects. The adjacent submersible embankment projects built at about the same time are reported to use vertical lift gates which are clearly better suited to this type of operation. It should be possible to fit these to the regulators of Halir Haor, although the design and current condition of the inside aprons and spillways could not be assessed by FAP 13 as they were underwater. The cost implications in terms of direct investment cost relative to reduced maintenance costs (of boards and embankment) and increased potential efficiency in operation have not been assessed. While the operating efficiency and annual maintenance costs of the Project might be improved, it is just as likely that the current controlling interests of the local elite over the regulators would be strengthened without an improvement in institutional arrangements at the same time (see Section 12.4.2).

The submersible embankment crest is in fact lower than planned in several places and does not ensure a safe harvest of Boro in all years. This is largely due to less annual maintenance work than is necessary (Section 12.5.1), but it was not possible to assess whether the design standard of the embankment crest is now lower than was originally intended.

The embankment has closed all the drainage khals/channels of the area except the Ratla khal and Suchia khal, where regulators were later constructed. There are several other low beels of different sizes within the Project area which were drained out through a number of khals and are facing acute drainage congestion during the post-monsoon period. The lack of an internal drainage network to connect these low pockets to the Ratla/Suchia drainage khals results in continued drainage congestion. Environmentally this may be a blessing in disguise: if drainage improvements are considered these should not aim to maximise drainage of the entire area given the importance of fisheries and the natural environment. However, if areas are not to have more efficient drainage there is likely to be continued pressure or conflict from landowners who see their neighbours benefiting more from the Project.

The existing low level village roads (one between Haor Alipur and Naya Khari (near Ulukandi) and the other between village Rongia and Kamlabaj) provide dry season access for harvesting, as well as helping in soil moisture retention for the higher regions of the project area. It is not sure that they will be above early flood levels. There appears to be widespread support for raising these roads and higher land areas slightly to provide compartments within the project area, so that even if part of the embankment overtops before harvest it may not affect all the project area.

12.4.2 Institutional and social assessment

The SSDFC project had an objective that O&M should be organised (and funded) on a voluntary basis by "local councils" and if this was not possible then under FFW or directly from BWDB. There was no specific O&M Manual prepared for the SSDFC project, nor has any manual for operation and maintenance been prepared by the O&M division for Halir Haor project. The institutional arrangement for the project operation and maintenance is thus dependent on the BWDB O&M division, and on ad hoc local involvement.

The actual informal "institutional" arrangements and issues in public participation in operation involve three regular sites of "public cuts", although cuts are also made at other sites. These cuts are "planned" to the extent that the BWDB division agrees that they are needed for post-monsoon drainage and would like to build regulators there. However, in only one of these locations does a local person request permission each year to make the cut - he also arranges for the cut to be filled in each year before the risk of early floods (it is not clear whether this is at his expense or at the cost of local farmers). Cuts are not made to let in water after harvest to safeguard the embankment during overtopping. By this time the embankment is already close to overtopping or breaching.

Only a casual assignment of operating responsibilities seems to have been made for the regulators. Project committees for operation have not been formed and the two regulators are each operated by a single member of the local elite (respectively Chairman of the Union Parishad and ex-Chairman of the Upazila). This means that there is no direct representation of local interests in the management of the regulators, and BWDB has little influence over operation of the structures. BWDB has provided neither gauge marks nor instructions on recommended water levels or actions at different times of year.

On the whole regulator operation is relatively simple and benefits the vast majority of farmers. However it was reported that the regulators are sometimes operated to catch fish for the benefit of the operators and not the farmers, creating a social conflict between the poorer farmers on the one hand and local leaders and fishermen on the other hand.

12.5 MAINTENANCE OF THE PROJECT

12.5.1 Technical assessment

The design crest of the embankment was fixed at El.+20' PWD to protect the project area from the early flash floods up to 15th May, the target date for the completion of Boro harvest. The actual crest level was found to be inadequate as the embankment was submerged on 17th April, 1990 about 1 month before the target date and almost 100 per cent of the standing crops were damaged. The existing embankment crest is not maintained to the design elevation of + 20' PWD at several reaches totalling a length of about 14km. These reaches are about 2 - 2.5 ft. (0.6 - 0.76 m) below the design crest level (as mentioned by the BWDB SDE responsible for this project) due to inadequate availability of wheat.

Observations by the RRA team confirmed that those sections of Halir Haor embankment still visible in mid-May had a lower crest elevation (by about 30cm) than embankments on adjacent haor projects.

All routine annual maintenance/repair of the embankment is undertaken through the Food-For-Work (FFW) programme. Table 12.1 shows the quantity of maintenance work under FFW requested and achieved/provided for each year on record with the SDE. It is not clear

Table 12.1 Food For Work maintenance (requested and actual) for Halir Haor project, Sunamganj District

Financial year	Programmed work			Actual work			Percentage of plan achieved	
	Embankment (km)	Wheat (mt)	Earth (m^3)	Embankment (km)	Wheat (mt)	Earth (m^3)	length	wheat
1984-85	19.2	256.30	-	11.2	203.80	-	58%	80%
1985-86	-	195.798	-	-	187.254	-	-	96%
1986-87	7.55	174.235	-	6.97	170.174	-	92%	98%
1987-88	8.29	295.402	120048.2	6.6	235.881	96034.6	80%	80%
1988-89	5.32	203.418	73961.0	5.32	203.418	78014.0	100%	100%
1989-90	12.48	280.273	106012.0	12.48	222.601	84708.69	100%	79%
1990-91	7.29	217.552	82493.0	6.27	137.954	-	85%	63%
Mean	10.02	231.6		8.14	194.4		81%	84%

Note: means for volumes of earth not calculated as number of years with available data is small

Source: BWDB Sunamganj O&M Division

whether the project had actually been adopted by BWDB before these records. The quality of embankment maintenance is poor under the FFW programme due to lack of compaction and lack of quality control.

The existing embankment was submerged almost everywhere except for a few short reaches during the RRA visit (May 1991), but it was known from the SDE (BWDB) that the majority of the embankment will need to be repaired after the flood. The actual annual maintenance work will depend on availability of funds under the FFW programme. He also believed that if the whole embankment was once repaired to the design section and crest level in one season the maintenance cost in subsequent years would be reduced to a great extent. At present limited resources mean that only the worst portions of embankment are repaired each year, this invariably involves repairing the public cuts to close off the khals, due to limited resources.

So far there has been no maintenance work on the structures themselves since completion in 1987. However, both use wooden fallboards to close the vents. The boards are vulnerable to warping, rotting, and damage during operation. Some have to be replaced every year, and the SDE reported that in 1990/91 winter 25 out of 75 boards had been replaced - a significant maintenance cost.

12.5.2 Institutional and social assessment

The embankment overtops each year with a head difference causing erosion of its country side. Local involvement at this time is limited to some people patrolling the embankment in the pre-harvest period. They may take action, or request the Upazila to help if there is a risk of overtopping/failure before harvest. Hence the responsibility for maintenance at the critical time falls on the beneficiaries, otherwise they lose their entire crops, but there is no assistance in forming local responses and organisations for flood-fighting and emergency repairs.

Maintenance of earthworks, both the embankment and the closures, is carried out under the FFW programme through BWDB, which contracts local UP members to enrol labourers for the earthwork, with supervision by BWDB Work Assistants and Section Officers.

12.6 LESSONS

1. Effective consultation between BWDB, the Upazila, and the local people concerning operation and maintenance of the Project is virtually nonexistent. Although the Project is effective, better use of limited resources, and additional direct resource mobilisation might be achieved by local prioritisation of work, for example.

2. Local people, at least in some areas, have proved capable of developing their own arrangements for cutting and repairing the embankment. This has not been as a direct result of any initiative by BWDB. In fact there is circumstantial evidence that, by BWDB taking over the submersible embankment, previous local initiatives to maintain the embankments have declined with increased dependence on FFW.

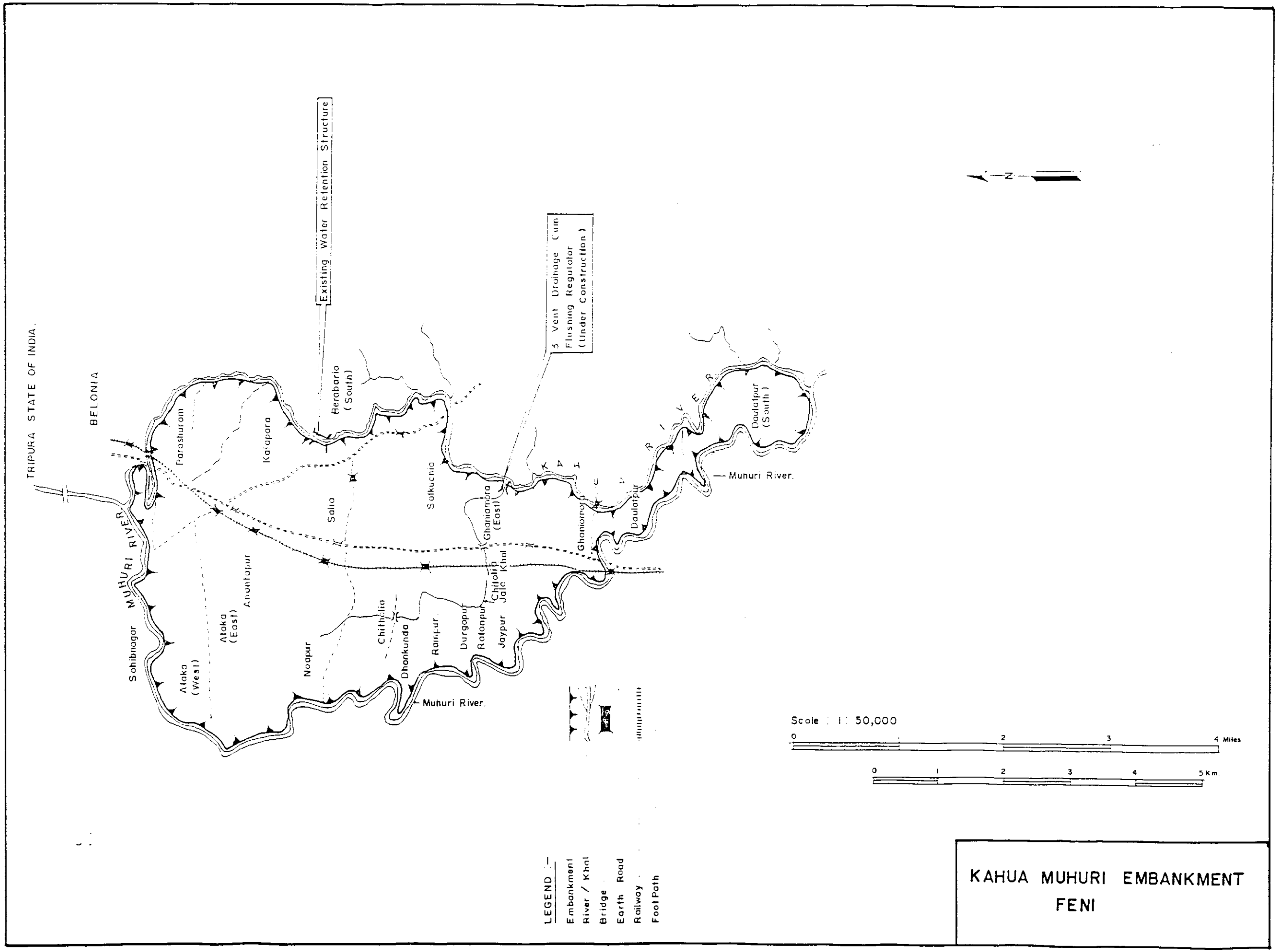
3. FFW means that the Project is continually dependent on external resources. Attempts at local resource mobilisation through taxation would most likely meet resistance since the land taxes paid at present are not related to the value or productivity of land. The local people believe their land taxes are too high compared with more productive areas. It would also be difficult to gain acceptance of voluntary labour inputs given the

availability of FFW. However, a matching commitment from local landowners above some minimum holding (say 1 ha) might gain the extra work needed to achieve the design embankment, and could be promoted as securing the still uncertain harvest. Because of the public good nature of the embankment some regulation to enforce such contributions, once agreed by the local community, would be needed. This might take the form of a project management committee which would be able to raise taxes, and the normal FFW being withdrawn if local contributions are not made.

4. Compartmentalisation of the haor with similar internal submersible embankments based on existing dry season village roads would provide an additional safeguard if embankments breach, would be of help in retaining soil moisture, and could improve communications at harvest time.

5. Even a well maintained and operated submersible embankment project only protects against early floods. A project development/management organisation could have wider scope to experiment with agricultural systems to reduce potential losses (on the basis that maintenance is never perfect and an even earlier flood always possible). It could also invest in improving peoples resilience to and ability to cope with high floods which will persist. Thus effective operation of the project includes getting the harvest to safe storage places and facilitating drying, otherwise safeguarding the harvest from floods is of limited use.

Figure 13.1 Kahua Muhuri Embankment - Key Features



13. KAHUA - MUHURI EMBANKMENT PROJECT

13.1 PROJECT BACKGROUND

13.1.1 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.)	: 2638 ha (gross) 2024 ha (net cultivable)
Funding Agency	: GOB?, FFW, IDA (SSSFCDIP)
Implementing Agency	: EPWAPDA, BWDB
Construction Started	: Not available
Scheduled Completion	: Not available
Actual Completion	: 1980-81 to 1985-86, and ongoing
Original Cost	: Not available
Final Cost Estimate	: Not available
Major Flood Damage	: Not available

Repair/rehabilitation:

Repair of public cuts and breaches, and resectioning of embankment is necessary in most years.

13.1.2 Background information

The Kahua-Muhuri River Project is located in Parsuram Upazila in Feni District in part of the Muhuri floodplain. The Upazila is a valley wedged inside the hills of the State of Tripura of India. The Muhuri defines the boundary of the project on three sides - north, south and west (Figure 13.1). 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 low embankments had been constructed by the local people to protect their crops and property. Earthen cross-dams were also built across the Kahua to retain irrigation water. To assist this local endeavour, the then government, in 1965, connected the Kahua to the Muhuri river and also re-excavated 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. Subsequent works, which form the bulk of the FCD system assessed here, include flood protection embankments on both sides of the Kahua river (major work reportedly in 1980-81), and a weir across the Kahua (1985-86). The only drainage canal within the project area is the Chithalia Jala Khal which drains into the Kahua. At present a regulator is being built at their meeting point.

The land elevation is 21.5-36.5 ft (6.5-11.1m) 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 vegetables are 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.

13.2 PROJECT AS IMPLEMENTED

The project was implemented in different phases according to the local needs. Relevant documents were not available, and the concerned officials could not offer much background information. For details of the historical works, 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. There are three aspects to the project:

i. diversion of water during peak flows from the Muhuri to the Kahua to reduce overbank flows;

ii. embankments to protect against flash floods; and

iii. structures to retain and divert water and so facilitate irrigation for HYV Boro cultivation.

There appear to be no BWDB documents giving the embankment length, despite regular FFW repairs to it, however based on the 1:50,000 Survey of Bangladesh map (which is out of data and since which the rivers have moved locally) the embankment along the Muhuri is around 20 km long, while that along the Kahua is about 16 km long (see Figure

13.1). The embankments encircle a project area reportedly of 2638 ha, but these were constructed in different phases. Resectioning of different reaches is carried out virtually every year.

Later under the SSDFC project (IDA credit 955-BD) a six opening weir was constructed during 1983-87 at Berabaria to retain water for gravity irrigation of the project area.

Currently under the SSSFCDIP there is a Kahua River Sub-project which aims to provide flood protection, drainage improvement and some irrigation facilities to an area of about 740 ha in and around the Chithalia Jala Khal. In order to fulfil these objectives the sub-project includes the implementation of: a drainage-cum-flushing regulator, re-excavation of Chithalia Jala Khal, construction and re-construction of 10 km of embankment along the Kahua river, construction of ten irrigation flushing inlets along the Kahua river embankment and five such inlets along the Muhuri river embankment. This project is ongoing.

At present some of the re-sectioning on the Kahua river embankment, and re-excavation of Chithalia Jala Khal have been completed. However, most of the re-excavated portions of the khal have silted up after intrusion of flood water through the embankment breach at Ratanpur in 1991. Construction of the 3-vent drainage-cum-flushing regulator at the outfall of Chithalia Jala Khal has been progressing slowly. It appears that the construction work stopped for a long time due to a low construction bid and higher material and transportation costs. Construction of the 15 irrigation-flushing inlets along the embankments of the Muhuri and Kahua rivers has yet to start.

13.3 PROJECT PERFORMANCE AND IMPACTS

The system as a whole has benefited agriculture and the local economy considerably by providing protection against flash floods. Unfortunately the full potential benefit is often not achieved because of frequent embankment breaches and public cuts. Irrigation has, however, benefited from the weir, and from local cutting of the embankment.

The most important environmental processes in the project area are regular bank erosion and sedimentation. The sediment load of the two rivers, particularly of the Muhuri when it overspills, results in the raising of land elevation, deposition of sand, reduction in the area of habitat for wild fish, and creation of pockets of waterlogging and moisture stress adversely affecting agriculture.

Agriculture in the project area is dominated by HYV Boro during the rabi season; except that on higher land sweet potato, potato, chili and vegetables are cultivated. In these areas irrigation may be needed due to soil moisture stress. The increased area under HYV Boro might have happened without the project, but the weir on the Kahua river facilitates gravity irrigation and farmers are able to cultivate HYV Boro and winter vegetables at a lower production cost. However, embankment breaches mean there is still a risk in Boro cultivation.

Impacts in the Aman season are less clear. Silt deposition from the Muhuri is almost annual as breaches are a common phenomenon. This leads to changes in the locations of land devoted to T. HYV Aman. The general pattern is that, wherever waterlogging does not prevent it, T. Aman is cultivated and the area under HYVs appears to have increased over time. Yields of T. Aman are high as farmers have now switched to HYVs.

As in many areas, the combination of cultivation replacing seasonal fallow land, a switch to HYV paddy (with reduced straw production), and loss of straw and income when the

embankment fails, all mean that the cattle population has declined, although power tillers are increasing in use. These trends might have occurred without the Project.

Inside the Project area, the Chithalia Jala Khal remains the major open fishery. The construction of the embankments, in general, would be expected to have had an adverse impact on this fishing ground, 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 during embankment breaches is raising the beds of the water bodies and hence adversely affecting production from the open water fishery in the area. However, this might have happened in any case since sand and silt deposition from the hills is a natural phenomenon.

Pond fish culture is common in the Project area. It has increased to a great extent and new ponds have been excavated. 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. Hence fish cultivation may not have been induced by the Project.

Employment has increased both directly in maintaining the embankment, and indirectly with increased cultivation. Migrant labour comes into the area during both Boro and Aman seasons.

Despite the problems mentioned, there has been a considerable expansion in agricultural production and the Project has been assumed to be a low cost one, giving an estimated EIRR of 96 per cent.

13.4 PROJECT OPERATION

13.4.1 Technical assessment

Informal operation of surface irrigation in the project area, by cutting the embankment, causes serious maintenance problems for the embankments. This is discussed in detail in Section 13.5.1.

The local people on the Kahua river side used to construct earth cross dams across the Kahua river to retain water for irrigation. To improve this local irrigation practice, BWDB constructed a weir during 1985-86 across the Kahua river at Berabaria in order to retain and to control the discharge through the upper reaches of this river. This structure functioned well as long as the stoplogs (fallboards) were in good condition. By 1991 most of the stoplogs have been damaged and the vents are closed by wooden planks and corrugated iron sheets which cannot effectively impound water behind them.

The Kahua river banks immediately downstream of this structure have been severely damaged, especially the left bank. This might have happened due to asymmetrical placement or removal of the stoplogs (suggesting a need for an assessment of operation problems and training in operation), and/or temporary constrictions created by the right bank slope failure immediately downstream of this structure. Upstream the water retained is allowed into the project by cutting the embankment. This creates weak points which are loosely filled in with sandy soil and consequently often fail during floods. Moreover the overland flow of irrigation water inside the Project can cause drainage congestion in the downstream fields.

13.4.2 Institutional and social assessment

It appears that a committee for operation of the weir was formed. However, one particular individual has usurped the function of the irrigation committee and collects rent at a high rate from the farmers. The weir does appear to be operated effectively, but public property has been taken over for private gain, and there is a potential conflict regarding water retention with the downstream users. There is a lack of coordinated irrigation in the project, and BWDB takes no part in managing the project.

13.5 MAINTENANCE OF THE PROJECT

13.5.1 Technical assessment

The embankment has been reconstructed and resectioned several times. Due to the meandering nature of the Muhuri and occasional high flash floods, severe scouring has been taking place in the concave sides of the meanders eroding the set back distance and even the embankment. The embankment in some parts of East Alaka, Rampur, Durgapur, Ratanpur and Joypur has been repeatedly damaged by flash floods. During the RRA (July 1991) two openings of about 150m in the embankment were found. At some places in the above-mentioned areas local people have constructed spurs and temporary protection using bamboos. Unfortunately all these attempts have failed due to high water pressure during flash floods and due to inadequate construction.

During the post-monsoon period local people install low-lift pumps near the Muhuri embankment to collect irrigation water from the Muhuri river. While the water level in the Muhuri river is low the local people cut the embankment at the pump locations to reduce the relative elevation of the discharge pipes and get a better discharge. After the irrigation season they just loosely fill up the embankment cuts. This fill ultimately gets washed away by the subsequent flash floods and sometimes causes severe damage to the standing field crops, and siltation on the fields. Such damages were especially notable in the Muhuri river embankment in 1989 and 1990 at East Alaka and in 1991 at Ratanpur and Joypur.

The Kahua river, on the other hand, follows a less meandering course and has been more stable than the Muhuri river. However, there have been public cuts along the embankment for flushing irrigation water into the nearby agricultural lands. These cuts have not been restored properly before the onset of the monsoon resulting in severe breaches to the embankment during floods. One such embankment breach at Kolapara has resulted in serious damage to the nearby agricultural lands. There are two public cuts in the embankment at Ghaniamara made by the local people for drainage of stagnant flood water. Sometimes these cuts cause unwanted inundation of that area due to back flow of water from the Kahua river at its higher stages of flash flood discharge.

The only drainage canal, the Chithalia Jala Khal, was re-excavated in 1990, but still appears to be silted up for much of its length. Poor drainage due to the silted up canal causes water congestion in the low-lying areas.

13.5.2 Institutional and social assessment

There are a number of 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. There is no inter-agency cooperation between state agencies in the area concerning water management.

The only evidence of state intervention in O&M is the resectioning of the embankment. Resectioning of the embankment goes on at one place or another almost every year under the Food for Work programme. This creates seasonal opportunities for labour employment.

13.6 LESSONS

1. This project is an example where investment in inlets to replace irrigation cuts would appear well justified in terms of reducing cuts and subsequent breaches and flood losses. If there were stricter regulation of cutting of the embankment it would be easier to encourage private investment in pipes, but this could also benefit from credit arrangements. It should not be provided free, but low cost pipe inlets should be permitted.

2. Coordinated operation of the gravity flow irrigation system is required. At present there is no formal or informal coordination and private irrigators are not responsible for the public costs of their actions. Currently a potential source of revenue for the project (weir operation) has been usurped by the private sector without any handover or responsibility for maintenance. However, it is clear that farmers are willing to pay for irrigation services.

3. The Kahua-Muhuri embankment project has undergone many repairs, rehabilitation, re-construction and renovation in different periods. However, there is a lack of documentation of past works. The only available information refers to the weir and the current "Kahua River Sub-project" of SSSFCDI project, and is held with the consultants rather than the O&M Division. Improved management requires better record keeping. The annual maintenance costs of the project are unclear.

4. Due to some rearrangement of the organizational structure of BWDB in the area, the project has been and will continue to remain under the Noakhali O&M division even though there exists a similar official setup in Feni district where the project is situated. This complicates O&M by distancing the project from the responsible officers. There is even a lack of awareness of the project among some of the concerned officers, BWDB cannot claim to be managing this system.

14. KONAPARA EMBANKMENT PROJECT

14.1 PROJECT BACKGROUND

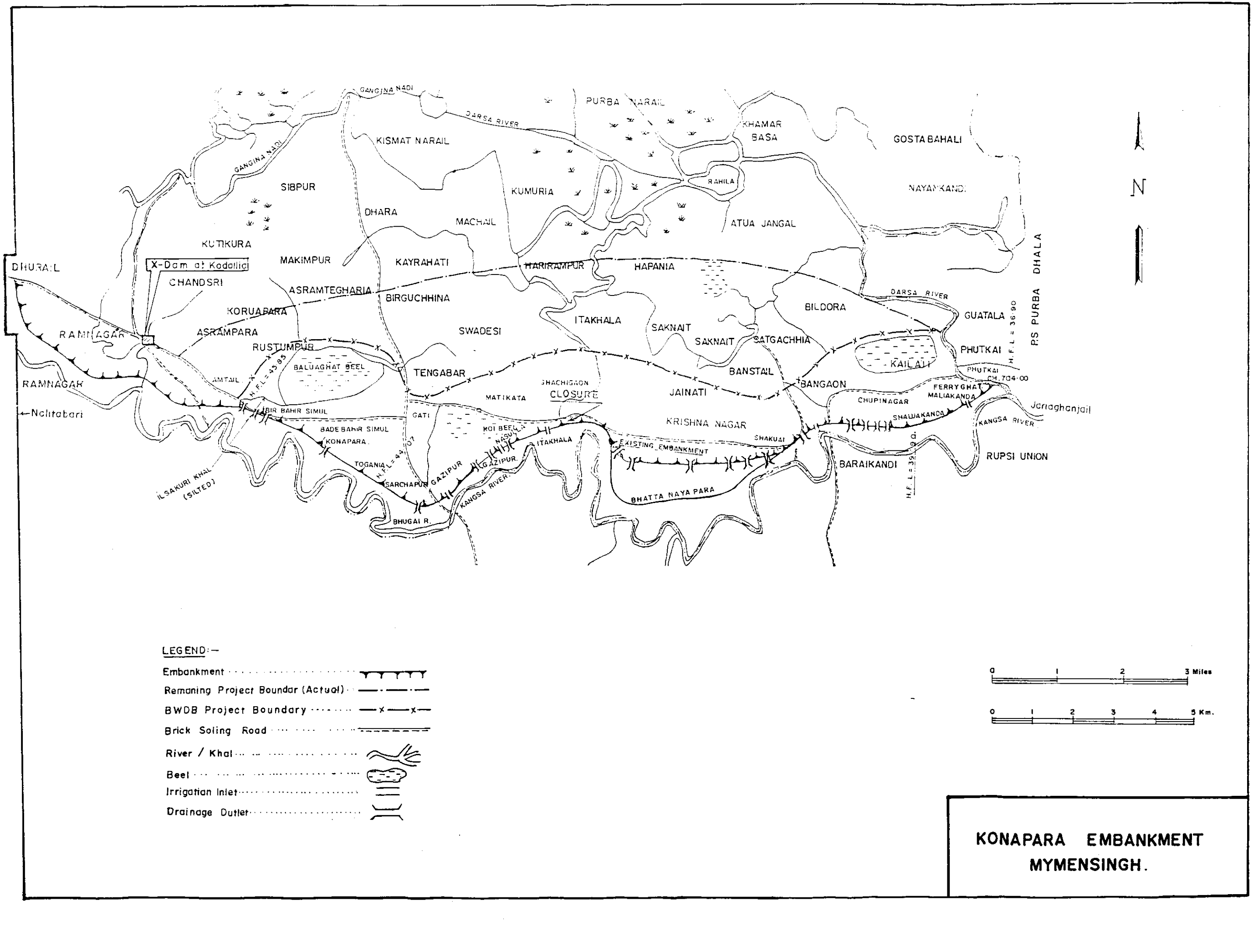
14.1.1 Project Summary Sheet

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 3480 ha (gross), 4251 ha or 3116 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

Major works still required for completion/rehabilitation:

Despite complete resectioning in 1989 much of the embankment is in poor shape and still requires extensive work.

Figure 14.1 Konapara Embankment - Key Features



LEGEND:—

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

KONAPARA EMBANKMENT
MYMENSINGH.

14.1.2 Background information

The Project area lies along the left bank of the Kangsa River, from Bahirshimul to Phutkai ferry ghat, in Haluaghat Upazila, Mymensingh District (40 km north of Mymensingh town).

The ground elevation of the project area is quite flat, with homesteads and roads situated on relatively higher ground. Almost the entire project area used to be submerged by flood water, to a depth of 1-5 feet (0.3-1.5m), during the monsoon.

There are two rivers, namely the Kangsa and the Darsa in the area. The Kangsa flows parallel to the project area. It originates in the Garo Hills in India and drains into the Dhanu River. The river almost dries up in the winter. The Darsa also originates in the Garo Hills and drains into the Kangsa, after passing through the haors. This river also virtually dries up in winter.

The pre-project flooding situation was characterised by flash floods in July-August and gradual monsoon floods later on in September-October.

Three crops were grown: Aus, T.Aman and jute. About 26 per cent of the area was devoted to Aus and ten per cent to jute. During the Aman season, the entire cultivable area was under T. Aman. Yields were very poor, ranging from 10-15 maunds per acre (0.9-1.4 mt./ha) for paddy and 15 maunds per acre (1.4 mt./ha) for jute. The cropping intensity was 135.7 (Project report, undated). According to Naqi (1980b), however, the pre-Project cropping intensity in the Project area was 188, and the RRA indicated higher pre-Project yields.

14.2 PROJECT AS IMPLEMENTED

The Project objective was to prevent early ingress of flood water and so prevent damage to standing crops.

An embankment of 21.6 km along the Kangsa River was built, stretching from Bahirshimul to the ferry ghat at Phutkai. The PP included installing 11 drainage outlets/irrigation inlets, but BWDB reported that there were, in 1991, 21 drainage outlets and five irrigation inlets. It is impossible to check if these were constructed as planned since no details of design or intended location were available.

14.3 PROJECT PERFORMANCE AND IMPACTS

The Project has protected Aus/jute and Aman crops from flooding in most years, and the RRA suggests that this benefit extends over a **larger** area than that claimed by BWDB. HYV Boro has expanded rapidly during the life of the Project, but this would have happened without the Project, since HYV Boro has expanded in nearby unprotected areas. However, the embankment provides flood protection for Boro when early floods occur, and hence average annual yields are higher in the protected area.

Communications have also been improved, and pond fish cultivation and tree planting have been encouraged by flood protection. However, capture fisheries inside the project have declined, and the Project has had serious negative external impacts by worsening flooding outside the Project. Due to improper placing of the drainage outlets relative to ground level, drainage problems are aggravated.

There are problems that have led to aggravated social tensions and large crop losses. The project planning seems unclear, the embankment does not tie in to well defined starting and end points, and was not implemented as planned due to the influence of local people.

The Project cannot be treated as complete. Downstream, where the Godaria (Darsa) river meets with the Kangsa, when the river rises during high flood this results in back flow of water into the Project area by overtopping the bank of Godaria (there is no embankment here). This damages crops in the lower part of the project area every year.

The upstream end of the embankment ends at Bahirshimul without taking into consideration the fact that there are lots of villages in the area which can be adversely affected by flood water backing up. People outside the project area complain bitterly about the increased water level and consequent flooding of homesteads during the flood season. There was a cross-dam at Kodallia which is outside the embankment. During the severe floods of 1988, the embankment was badly damaged at several points, and a number of public cuts were made. The people outside the embankment cut the cross-dam, hoping this would ameliorate their condition somewhat. This resulted in serious damage to crops in the project area. This led to social conflicts between the people of the project area and the people of Kodallia, and the conflict came to an extreme form when two persons were killed. The public cut at Kodallia has now been open for the last three years, and remains a bone of contention in the area.

It would be ideal if the embankment could be extended from Bahirshimul to Dorail via Bishumpur, Amtail, and Kodallia (8 km). This could solve the problems of both parties. Upstream, the local demand is for extension of the embankment from Bahirshimul to Dorail via Kodallia. The downstream demand is for an embankment on the bank of the river Godaria at Phutkai, with a sluice gate.

Despite these problems, the Project is simple and had very low construction costs. It has brought substantial agricultural benefits to a larger area than expected, and even after deducting fisheries losses an EIRR of 62 per cent was estimated.

14.4 PROJECT OPERATION

14.4.1 Technical assessment

During the severe floods of 1988 the Konapara embankment was submerged under flood water. It may be noted that during this flood the river stage at the gauging stations of Nalitabari, Sarchapur and Jariaghanjail on the river Kangsa exceeded the stage considered at design to be a 1-in-20 years flood (where the observations were within the 95 per cent confidence limits of the Gumbel-I distribution). It was reported to the RRA team by the local people and also by concerned BWDB staff that many natural breaches occurred along the entire embankment. The biggest breach (of about 91m or 300 ft) occurred at a weak section due to huge hydraulic pressure imposed against that portion of the embankment situated between Gazipur and Nasullah.

Since it failed in a greater than design event, the embankment can be regarded as having operated as intended in the past. This may no longer be true in the near future, because of maintenance problems (Section 14.5.1). The embankment is no longer intact, nor is its crest level as designed.

The Project was provided with minimal drainage facilities, and drainage problems have been worsened by construction of earth roads since the embankment was built. The borrow pits at Bahirsimul, Gazipur and Nasullah have silted up. During the flood season, water flows through these borrow pits at high speed, causing the riverside areas to erode.

14.4.2 Institutional and social assessment

Generally, where there are no major structures, operation requirements are minimal, and no institutional development has occurred for O&M. However, a number of issues directly influence the way in which the affected population perceive the project.

i. The villagers whose lands were acquired for borrow pits and the embankment were partly compensated in terms of money. The final instalment has not been paid and this has created dissatisfaction among the landowners.

ii. There is also a legal problem in paying land revenue. The landowners who lost their land ten years ago due to acquisition continue to pay land revenue because the BWDB has not yet transferred ownership of the land.

iii. The section of the embankment at Bhatta was not constructed according to the original plan, because of the intervention of the ex-Chairman of Shakoi Union, and thus about 1500 families with about 1620 ha (4,000 acres) of land (about 10 mauzas) remained unprotected. This area is strongly disbenefitted, in terms of damage to houses and livestock, by annual flooding. Before the embankment homesteads were not inundated, but they are now. During the 1987 floods, a baby fell from its bed into the water and died. Villagers grew angry and cut the embankment at Bhatta Nayapara. The people cut the same spot successively for several years after this incident.

iv. The public cut at Kodallia cross-dam (outside the embankment) has already been discussed (Section 14.3). This created acute social conflicts, resulting in the death of two persons.

14.5 MAINTENANCE OF THE PROJECT

14.5.1 Technical assessment

a) Embankment

The embankment construction and resectioning have been carried out without any compaction. This has made breaches and cuts easier.

As the whole embankment was partly damaged during the flood of 1988, it was repaired and resectioned in 1988/89 under the EIP Flood Damage Restoration (FDR) programme, at a cost of Tk 3.39 million. Discussion with BWDB staff, interviews with local people, and on site observations indicated that the entire embankment was severely damaged at several points by 1991. The embankment at Bahirsimul, Gazipur and Nasullah needs urgent repair otherwise it will be badly damaged in the 1991 monsoon season, and is certain to cause damage to crops and other infrastructure. Moreover, the entire embankment (except 6km which has been reconstructed by LGEB for use as a road-cum-embankment) needs resectioning for its stability, as two years after the rehabilitation and resectioning work it is already damaged by raincuts. The present condition of the embankment is such that its ability

to survive the next onslaught of rain and flood is questionable if no preventive maintenance programme is undertaken immediately.

b) Inlets and outlets

One irrigation inlet at Gazipur needs protective work on the river side as the supporting soil is eroded beneath and around it. Two drainage outlets, at Gazipur and Nasullah respectively, need to be provided with protective works on the river side as the supporting soil has eroded. However, in general the inlets are in an acceptable state of repair.

14.5.2 Institutional and social assessment

There is no direct involvement of local people in maintaining the embankment. The section which has been adopted as a village road receives regular maintenance, but not the remainder of the embankment. At present maintenance depends on external resources which have been available after major flood damage. However, opportunities exist, in particular the use of the embankment, and possibly borrow pits, for trees and fish respectively, which could help to fund maintenance and give people a direct interest in the infrastructure. Because of the negative external impacts continued effective maintenance is likely to depend on revisions to the Project.

14.6 LESSONS

1. Benefits to farmers behind the embankment are threatened because of the negative impact of increased flood losses outside. The O&M problems largely relate to public cuts and conflicts over the embankment because of this conflict of interest.

2. Public involvement in project planning is essential so that insiders and outsiders, and different interest groups in each area, can have a fair chance of expressing their opinions and fears.

3. The technical feasibility study should also have identified potential changes in flood conditions and adverse impacts due to the proposed project.

4. Consultation is of no use if measures, both in design and management stages, are not taken to mitigate these adverse impacts and potential conflicts. If adverse impacts cannot be avoided there needs to be some real compensation or mitigatory measure.

5. It is clear from this case that the project planning authority, implementing agency, system management, and majority of farmers need to be strong enough to overcome pressure from vested interests in modifying projects to the detriment of other interests.

6. Public involvement may be hampered when greater than design standard floods occur and damages result. People protected by a project need to know to what extent they are protected, and as part of project management provisions for warning of impending flooding and planned emergency responses are called for.

15. POLDER 17/2

15.1 PROJECT BACKGROUND

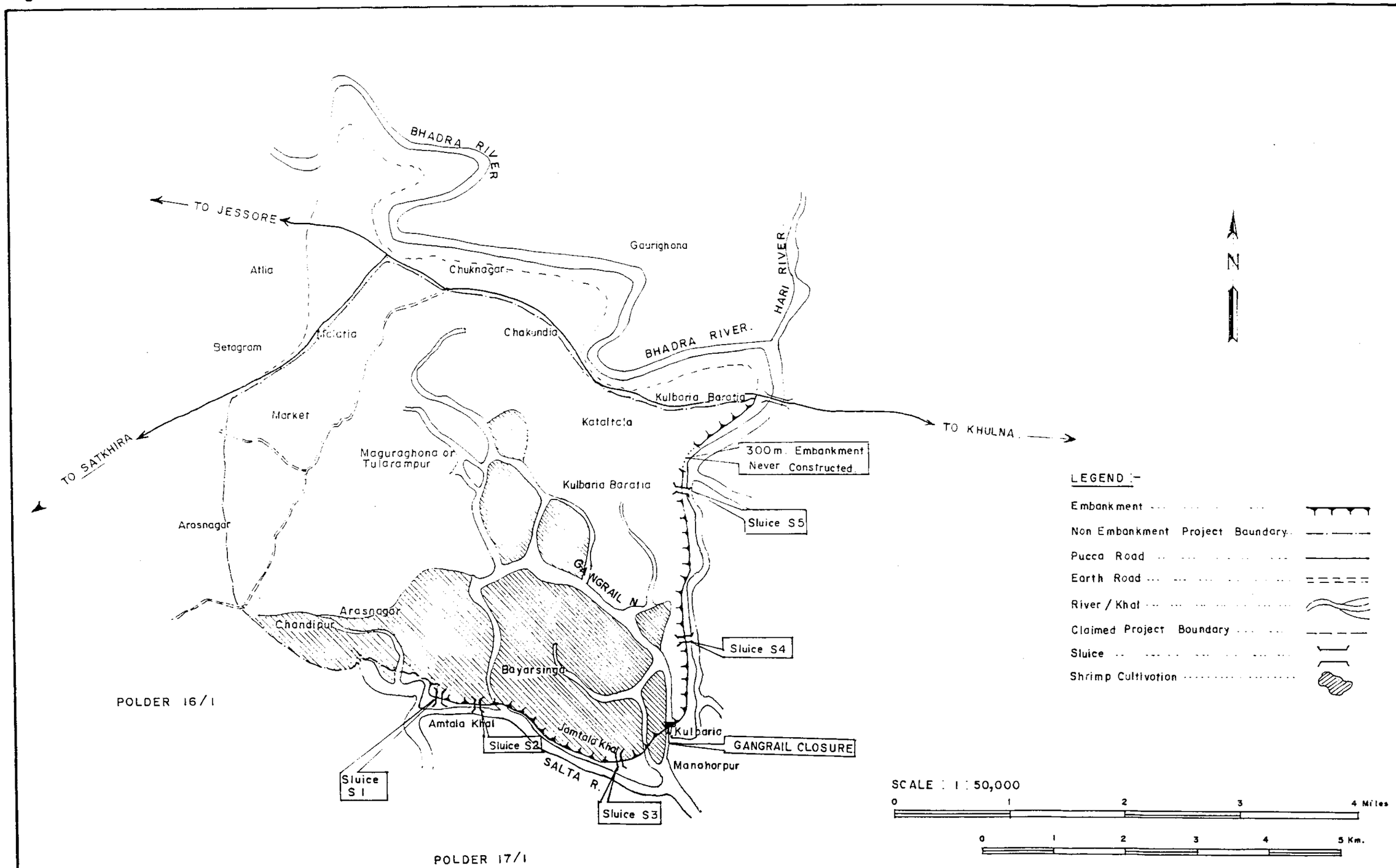
15.1.1 Project Summary Sheet

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 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) Tk 9.0 million (closure, 1980 estimate)
Final Cost Estimate	: Tk 11.837 million (initial investment costs, 1970s) Tk 10.64 million (closure, 1982/3 prices), ignores costs of two closure failures in mid-1970s
Major Flood Damage:	: none
Repair/rehabilitation in	: embankment/sluices: c.1985, also nominally in 1988/9

Comments:

Project works completed, after three failures to close Gangrail river, in 1983/4. However, numerous private inlets for controlling saline water used in shrimp cultivation mean the intention of excluding saline water was not achieved, although saline water is now managed by private entrepreneurs.

Figure 15.1 Polder 17/2 - Key Features



POLDER 17/2, KHULNA

15.1.2 Project area description

Polder 17/2 was selected for study as a representative polder of relatively recent completion in the "semi-saline" zone of Bangladesh. It is located 23-30 km west of Khulna city on the Khulna-Satkhira road. The polder is bounded by this road to the north and by roads to Paikgacha to the west (in both cases the limits comprise naturally higher land). Immediately to the north, and forming part of the north-east boundary is the Bhadra river, while the remaining boundaries are embankments which form the polder running along link channels from the Bhadra to Gangrail to Salta rivers. To the south is Polder 17/1, while contiguous with Polder 17/2 is Polder 16/1 to the west (see Figure 15.1).

All of the polder lies within Dumuria Upazila, Khulna District. It forms one of the many polders constructed under the Coastal Embankment Project in the late 1960's and early 1970's. Polder 17/2 is located towards the northern limit of the zone of saline water intrusion. Much of the land in the region is low lying and is crossed by numerous tidal creeks. During the dry season these carried saline water with the tidal cycle and in the absence of embankments the land was frequently inundated with saline water, even higher land being affected by spring tides. In pre-project conditions, therefore, crops could not be grown in much of the area during the winter because of salinity levels.

However, both pre-project and at present during the monsoon the large volume of rainfall and flow in the rivers from further north result in the water in the khal-river network being fresh, although the level still fluctuates with the tides. Hence the main crop was transplanted Aman which could be grown during the fresh water period but at the risk of being flooded by unusual tides. At the same time homesteads and village roads were quite frequently affected by flooding.

The majority of the land in the region is now behind embankments designed primarily to exclude saline water, but also intended to prevent flooding in extreme events. Hence the projects offer full flood protection, and have provision of structures for improved drainage. However, the main benefits were expected to be from exclusion of saline water and from securing the Aman harvest.

15.2 PROJECT AS IMPLEMENTED

Polder 17/2 comprised, at the time of evaluation, 6.5 miles (10.5 km) of embankment under the responsibility of BWDB. There are five drainage sluices: one 1-vent sluice (S-5) and another 2-vent sluice (S-4) of vent size 5'x6' each, have been constructed along the Bhadra river side, and two 1-vent sluices (S-3 and S-2), and a 2-vent sluice (S-1) of the same vent size have been constructed along the Salta river side. There area a number of closures of channels which flowed into the polder, particularly the Gangrail closure. Because the polder effectively comprises two projects a brief history of the works is necessary.

The embankment and structures were completed in 1970-71 (local information and dates inscribed in sluices). About 300m length of the embankment was never constructed along the distributary of the Bhadra river on the north-eastern side of the project area (see Figure 15.1). This area was under homesteads and the residents argued that the land was high enough to be above flood risks, and that they did not wish to lose their homes. The land dispute raised by the households there appeared to have been overcome by a compromise between them and the then BWDB officials for the Project. Water level at high tide remains 0.3-0.6m (1-2 ft) lower than the river bank at that site, but the natural levee might be overtopped by an unusually high tide during the monsoon.

However, severe problems were encountered in closing the Gangrail: the initial attempt at the time of independence failed. Two later attempts in 1975 and 1977 also failed for technical reasons: commencement of work too late in the construction season (almost during the rainy season), selection of an inefficient contractor, and lack of proper organization of works. In both cases major slips in the earth dam occurred leading to the work being abandoned, the problem being unsuitable subsoil conditions (EIP, 1980b).

Finally the Gangrail closure was taken up as an EIP scheme in 1980-81 and was completed in 1982-83. Hence for over half of the period since embankment completion up to 1991 the project was not complete in terms of the original design and so it was not fully effective. During the same first ten years of the Project commercial shrimp cultivation expanded rapidly in the Project area, changing radically the water management aims of land users.

15.3 PROJECT PERFORMANCE AND IMPACTS

The EIP recommendation summary (EIP, 1980b) discussed the technical standard of the original embankment and that proposed for the (successful) closure. This appraisal noted that the aim of the closure was to exclude saline water and this explicitly meant "the end of the shrimp culture and salt water fishing in the area" (EIP, 1980b). This report discusses the problem of the distribution of profits from shrimp cultivation and notes that "It is our impression that the profits of the shrimp business do not flow to the rightful owners of the land, but into the pockets of a few big entrepreneurs ... Further investigations by the EIP Sociologist will be necessary if the project is considered for execution" (EIP, 1980b, p8-7). Although EIP (1980b) noted that the capture fishery in the Gangrail would be lost with a closure, the loss was regarded as more than counter balanced by the gain to small farmers (who would gain increased agricultural production and not be exploited by shrimp farmers), although no distributional policy to effect compensation was proposed.

The actual impacts have been that saline water was still available naturally in the polder until the closure, but the embankment helped shrimp farmers build their own bund systems which meant that saline water was managed in the project from the early 1970's. The closure failed to end shrimp farming. Although it reduced the area under shrimp ghers, the shrimp farmers simply installed their own water control structures in the embankment and made the ghers larger. The social objectives on which the closure was justified, failed to be achieved. Meanwhile the, previously very productive, capture fishery in the area has been decimated by the closure.

Agricultural benefits were slow to materialise, but since the closure salinity levels on higher land have fallen and areas and yields of Aus, jute and especially vegetables have increased. HYV Boro has now started to expand because of reduced salinity levels and the availability of ground water. Aman production and yields have increased where shrimp farming ended. The increased potential for cultivation round the year and for higher yields has heightened conflicts between farmers and shrimp cultivators.

The polder has created slack water at high tide and hence channels adjacent to it have silted up, there has also been a loss of natural seasonal wetlands which have been replaced by managed shrimp ponds and agriculture.

The long delay before any benefits were achieved, the severe adverse effects on fisheries, and the lack of a major economic gain where shrimp farming is displaced, all mean that both for the Project as a whole and the Gangrail closure the EIRR is negative.

15.4 PROJECT OPERATION

15.4.1 Technical assessment

a) Project as planned

Construction of the Gangrail closure has increased efficient use of agricultural land, as internal dykes around the agricultural lands are less necessary. It has also reduced the flood risk to shrimp farm dykes so that dykes of smaller cross-section serve the intended purpose, resulting in a corresponding increase in farming areas. The portion of the Gangrail river outside the Polder area which has been silted up due to the closure is now being used for shrimp and other fish culture.

Ignoring shrimp farming, the sluices have been moderately efficient at reducing saline intrusion, and in draining out rain water. However, none of the sluices are functioning perfectly, because there remains in most cases a gap between the upper end of the flap gate and the sluice opening. Most of the flap gate rubber seals have been damaged. Consequently tidal water flows into the Polder area at a considerable rate. Some sluices were repaired, and flap gates were replaced, under the IDA flood rehabilitation programme around 1988-89, although the structures had not been damaged during the severe flood years of 1987 and 1988 but had suffered from a lack of routine maintenance. All of the sluices have additional fallboard systems (in keeping with the CEP sluice design), but in sluice 4 this system has been replaced by vertical lift gates. It was observed that the flap gate, together with the vertical gate, in sluice 4 is unable to prevent leakage causing saline water intrusion.

b) Private water management

There is extensive and complex water management taking place in the polder, but BWDB has no involvement in it. A total of 14 temporary water control structures of different kinds have been installed by the local people. Eleven are long wooden boxes with small cross-sections and gates on both sides. These are used by the shrimp farmers to introduce saline water, to drain it out, and to flush fresh water into the ghers.

Another two are small arch-like brick structures used for drainage and for intrusion of sweet water during the monsoon for agriculture. The other inlet is a long reinforced concrete pipe used only for collection of water in a domestic pond during drought periods.

In the northern part of the Project, near the Kataltala bazar, there exists a permanent sluice constructed by a group of farmers for shrimp culture. This sluice was constructed five years ago on the bank of Bhadra river and lies on the same channel as a Roads and Highways Department (RHD) culvert in the road. It had been facilitating saline water intrusion into the lands inside the polder on the other side of the RHD road. However, this farmer group has dropped shrimp culture in the last 2 years, and in 1991 reportedly achieved good Boro yields. The locally constructed wooden flap gate of the sluice and the opening of the RHD culvert have temporarily been closed by that farmer group to exclude saline water.

c) Status of shrimp culture

There is a GOB notification concerning shrimp culture, which is to be enforced through the Divisional and Upazila Shrimp Culture Regulation Committees. These committees have an outline procedure for taking approval for shrimp culture, but no strict legally enforceable procedure has been mentioned for preventing unauthorised embankment cuts being made by the shrimp farmers. Whether or not shrimp cultivation has been disfavouring the polder

objectives and overall welfare of the polder inhabitants, it has been hampering an important facility of continuous road communication around the area by damaging the embankment sections. According to BWDB officials, no such embankment cuts for shrimp culture have ever been approved by BWDB.

d) Siltation

In the pre-Project situation the portion of Salta river along the southern boundary of this Polder had a few live branch channels projecting inside the Polder area, together with other branch channels of the Gangrail river these channels appeared to be in an equilibrium and were kept open naturally by the tidal cycle. Closure of the Salta river branch channels during embankment construction, and the closure of the Gangrail river, have ended the ebb-tide pressure on the Salta river.

This portion of the Salta river, through the Bhangaria and Gangrail rivers on both sides of Polder 17/1, has a common source of tidal water on the southern side of Polder 17/1. Consequently, with no additional flows into and out of the branch channels in Polder 17/2 (because of the sluices), there is stagnation of tidal water in the reach of Salta river from sluice 1 to 3. As a result high siltation has taken place in this portion of the Salta river which is causing serious drainage problems to sluices 1 (in particular) and 2.

15.4.2 Institutional and social assessment

Prior to 1970 the risk of tidal flooding (saline or non-saline depending on the season), which in particular threatened Aman cultivation resulted in a local response of dyke building. While these local bunds appear to have been less effective than the polder, they did represent direct local resource mobilisation to address flood risks. No doubt the organisation of the bunds was dominated by larger landowners, but there appeared to be a fair system of labour inputs proportional to the area owned within a bund system.

Hence there was an informal system for channelling local resources (labour) into building, repairing, and daily maintenance of these bunds. Voluntary contributions to this appeared to be widely accepted, along with the loss of land to the bunds. There were no structures in the bunds, and it is not clear to what extent there were conflicts over draining out and cutting the bunds. However the smaller command areas (of around 60 ha) may have resulted in fewer conflicts.

By 1980, prior to the final Gangrail closure, the economic and institutional setting for water management had changed radically (even ignoring the project embankment). Shrimp cultivation was widespread in the area. Shrimp ghers also required bunds to keep in shrimps and saline water, and keep out high tides. However, the management model which developed was for the gher to be managed by one or a few entrepreneurs, who might even be outsiders without land in the gher.

Commercialisation resulted in labour for bund maintenance being hired, but there was no longer a clear coincidence of interests in water management in the gher - small landowners had little say in the decision to cultivate shrimp or in the division of profits. Consequently agriculture appeared to have less importance in gher management. Additionally there was greater control over water management in the ghers since sluices to permit inflow and outflow of saline water were built. Naturally control of these lay in the hands of the gher managers.

So far as water management in much of the polder is concerned, the ghers are little changed. Inflow and flushing of saline water are under the effective control of the shrimp

farms. However, the BWDB embankment and sluices have altered the institutional setting. There is now a public embankment, and public sluices. The polder means that BWDB could, if it were interested and had enforceable means, regulate the management of the polder and arbitrate between private land uses since shrimp farms can have adverse impacts on other land uses (leaking saline water for example).

The general organisational structure for CEP polders was clearly stated (Leedshill de Leuw, 1967): large polders or groups of polders with 80-120 miles of embankment were envisaged under the charge of a Sub-Divisional Officer (SDO). Tiered below the SDO were to be Section Officers (SO), Work Assistants, and khalashis - both embankment guards and sluice khalashis. This overall administrative/operational structure is in place, with the exception that there are no embankment guards. The later posts would appear to have been superfluous anyway, to the extent that they replace local participation and vigilance with employees who lack incentives and are not locally accountable.

The CEP sluices were each to have a khalashi and were to have sluice committees comprising the SO, UP chairman, and Union agricultural assistant (Block Supervisor). Hence the committee was one of local technical functionaries who were supposed to listen to farmers' demands and make decisions and judgements accordingly. This was to extend to mobilising local works to overcome problems, for example in local drainage channels, and not just to opening and closing gates, as it was recognised that the basic project planning and design would not cope with all problems. Moreover unspecified contacts with local farmers, joint inspections of water levels and problems, and operating criteria based on experience were all to be part of sluice operation (Leedshill de Leuw, 1967, p404.02).

While laudable in principle these intentions were not realised. The sluice committees referred to were not formed. Although recently committees have been formed for the sluices in Polder 17/2 these are of a more informal nature: for example the committee of sluice 4 has 9 or 10 members and is chaired by the UP chairman (or in 1990 by his relative), the members are mostly shrimp cultivators, and it issues written or verbal instructions to the khalashi on when to open or close the sluice (flap and vertical lift gates). There are similar arrangements for the other sluices. These committees would appear to function adequately, which is hardly surprising given dominance by a strong interest group (shrimp farmers). This means that there is little say for small farmers or for those in upstream areas, and no direct involvement by BWDB engineering staff who appear to have abandoned any attempt to manage water within the project. The Government funding of sluice khalashis in these circumstances is a waste of public money as the gher managers could easily pay the khalashis for the service they render.

There was apparently no provision for funding and supporting the proposed operation system, nor for training or encouraging farmer participation in management of parts of the polder area. There was also no provision for local involvement in coordination at the polder level, which was presumably intended to be done by the SDE and Executive Engineer. Without a continuing commitment to supporting local involvement in polder management, at least during the early years of the polder, it is not surprising that the concepts in the O&M manual have largely not been put into practice.

15.5 PROJECT MAINTENANCE

15.5.1 Technical assessment

The embankment generally has a good section which compares well with the design standard. The crest is also higher than the sluice tops. Thus the last resectioning in 1988/89 appears to have been well done, and to have a useful life of at least 3 years. However, the embankment still needs some periodic maintenance work, due to inadequate earth-filling done by the shrimp farmers during placement or removal of their water control structures, and due to rat holes which are damaging the embankment and hampering its stability and serviceability as a continuous road. No routine embankment maintenance works are being done by BWDB or local people, especially the shrimp farmers, on their own initiative.

The state of the project sluices has already been discussed. There is no public involvement in maintaining these structures. However, the private gher box sluices are not infrequently moved or replaced. They are relatively cheap but deteriorate. Hence the gher operators dig the wooden boxes out and replace them. This has implications for the structural integrity of the embankment, but because the gher operators do not want their high annual investment in shrimps to be lost by embankment breaches or flooding with external water, the standard of work is not bad. A more serious problem arises where private sluices are abandoned, as in one of the arch-culverts. Here the embankment collapsed above the culvert during the RRA fieldwork in June 1991, although it had been repaired by August.

Khalashi sheds were constructed for each sluice, and at the initial stage each khalashi shed had one khalashi residing there. About three years after construction, two sheds became uninhabitable because they subsided. At present khalashi sheds at sluices 4 and 5 are being used, and the other at sluice 1 is being used by the khalashis of sluices 1 and 2. Sluice 3 has no khalashi and is being overseen by the khalashis of sluices 2 and 4 alternately.

15.5.2 Institutional and social assessment

Maintenance of the embankment is the responsibility of BWDB. This means that no regular maintenance is done, but periodically, when external funds become available, the embankment is resectioned. This has apparently happened twice since the embankment was built. There is no local involvement in maintenance, and while gher operators do rebuild the embankment after cutting to place their box sluices, the local people did not appear interested in repairing the embankment failure which developed during the RRA fieldwork.

The resectioning generates irregular paid employment for labourers but from external sources. There is no regular employment and no local resource input. However, there is a saving in bund construction for the shrimp ghers because of the BWDB embankment. They could easily pay an embankment tax if a proper licensing and regulating procedure were implemented by a polder management organisation.

15.6 LESSONS

1. There is little point in building a **polder** if there is no effective institutional framework for its management. This means a management organisation or committee is required which is both locally accountable and reflects fairly the interests of polder inhabitants and activities, and has enforceable authority to implement its decisions.

2. To achieve effective management, technical expertise is required along with adequate resources. While some external funding (funding external to the polder) may be necessary, if it is bringing real financial benefits (and the profitability of shrimps seems clear) there is no reason why direct funding of O&M from beneficiaries could not be realised if the polder authority were given such powers. The main limitation is the lack of representative local participation in management.

3. The institutional arrangements achieved by this polder show some promise: unlike many projects there are khalashis in post and sluice committees exist. Unfortunately this is just the type of project where public funding (rather than local funding) of such arrangements is not necessary, given the major commercial interests (shrimp farms) in water management in the project. Instead strong regulation of an agreed water management plan (which would define and protect fairly the interests of all concerned) was required of BWDB but is lacking.

4. Prevention of saline water intrusion inside the Polder area was a major objective, but this aim has been contradicted through intrusion of saline water inside the Polder area for shrimp culture. The BWDB needed to be flexible and to adjust its management objectives to changing economic circumstances. This shrimp culture has been legalized through a GOB notification which also enables regulation (Polder 17/2 was one of 15 out of 28 polders where continuation of shrimp cultivation was regarded as acceptable). However, there is still no provision for taking any strict legislative and enforceable action against unauthorised shrimp farming.

   There also exist both Divisional and Upazila Shrimp Culture Regulation Committees, and a procedure for taking licenses for shrimp culture and for placement of BWDB approved sluices and bunds to support such practices. This approval system does not work in practice and the shrimp farmers have been using temporary, inadequate and low strength wooden boxes, together with insufficient earth filling during their installation or removal. This uncontrolled activity not only hampers stability of the affected embankment sections, but also hampers the serviceability of the embankment as a continuous road. It should be noted, however, that the BWDB approved control structure was reported to cost Tk. 1.5 lakh to build, whereas wooden boxes have material costs of perhaps Tk. 5000. There appears to have been no attempt to find or invent a compromise low cost but adequate design which would be financially acceptable to shrimp farmers and would not place the embankment structure at risk.

5. Extensive O&M manuals prepared by external consultants are of little use (however appropriate the procedures and institutions they recommend, and many of the details in the CEP O&M manual seem still to be valid and appropriate) if there is no interest in, or funding to set up and run, the management systems they entail.

6. The external impacts of this and other polders affect its long term operation because the lack of through flow of water results in siltation of the drainage channels. A management plan, which might include allowing in saline water through the main sluices to supply the ghers, might help to keep the channels open. The sluices also need to be operated in both directions, although this was recognised in the CEP O&M manual (which gave instructions for propping up flap gates and using fall boards to break the flow of water flowing in). The design used does not facilitate this, while the failure to provide simple instructions to this end, and an overall plan of operation, means that the blame does not rest with the operators.

16. BRAHMAPUTRA RIGHT EMBANKMENT

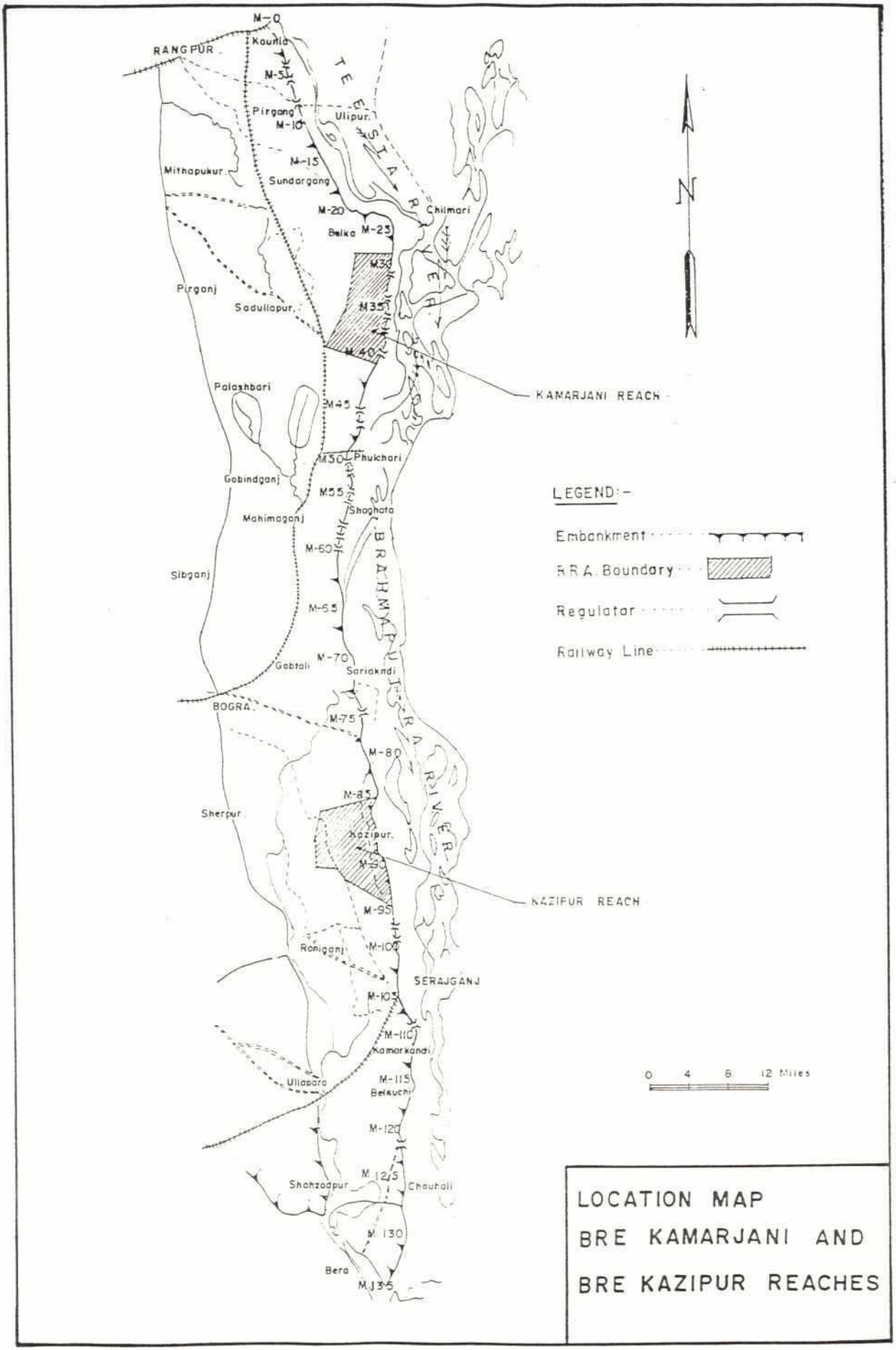
16.1 PROJECT BACKGROUND

16.1.1 Project Summary Sheet

Project Name	: Brahmaputra Right Embankment
Project Type	: Flood Control and Drainage
Location	
FAP Region	: North-West
District	: Gaibandha, Bogra, Sirajganj Districts
Area (ha.)	: 240,000 ha.(gross), but c. 73,000 ha for rehabilitation
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) entire BRE
Final Cost Estimate	: Tk. 395.8 million (1974-85) entire BRE
Major Flood Damage	: Annual
Repair/rehabilitation	: Frequent

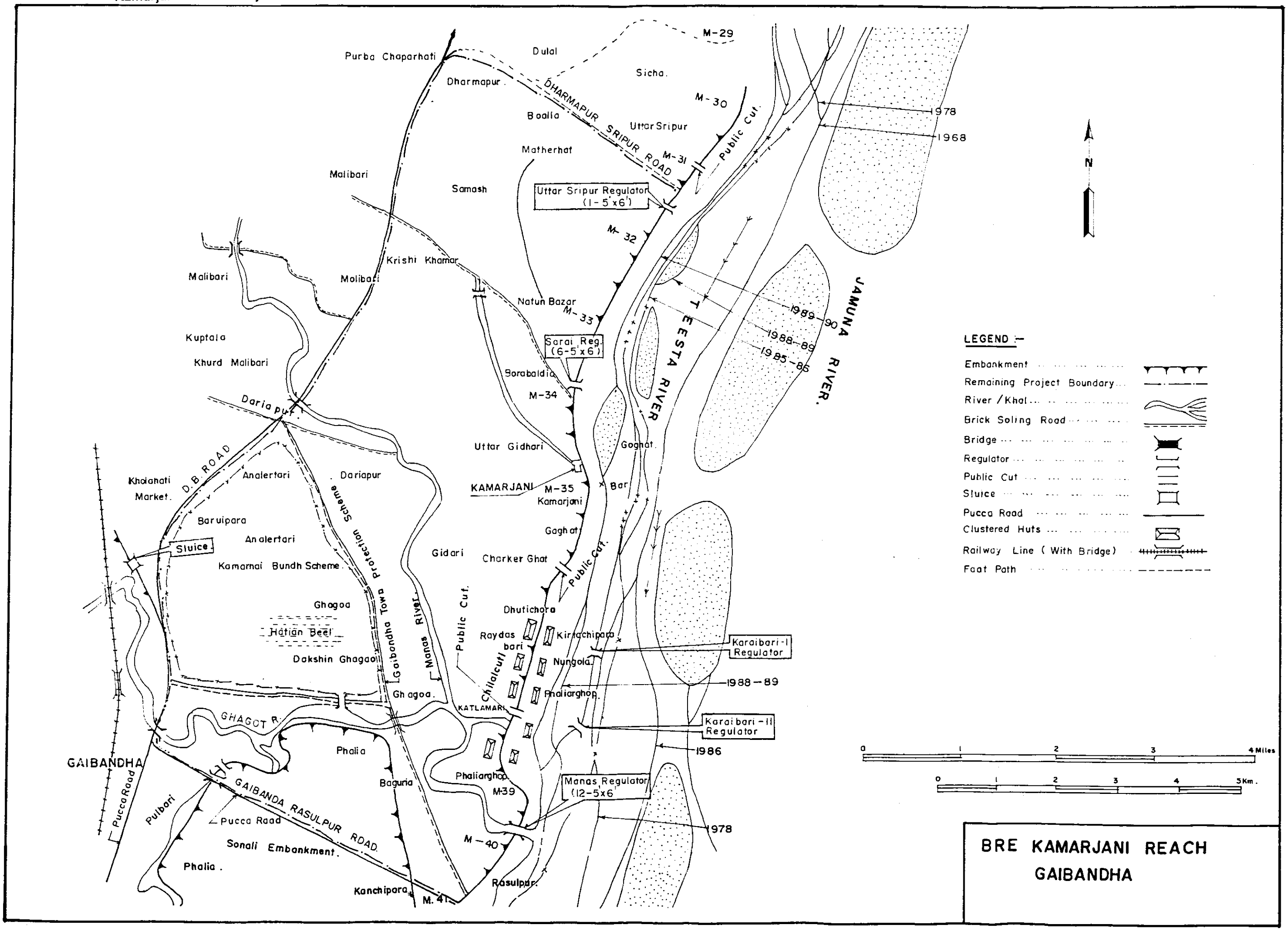
Major work in 1974-85 period, frequent erosion and construction of retired (fallback) embankments, particularly since rehabilitation.

Figure : 16.1



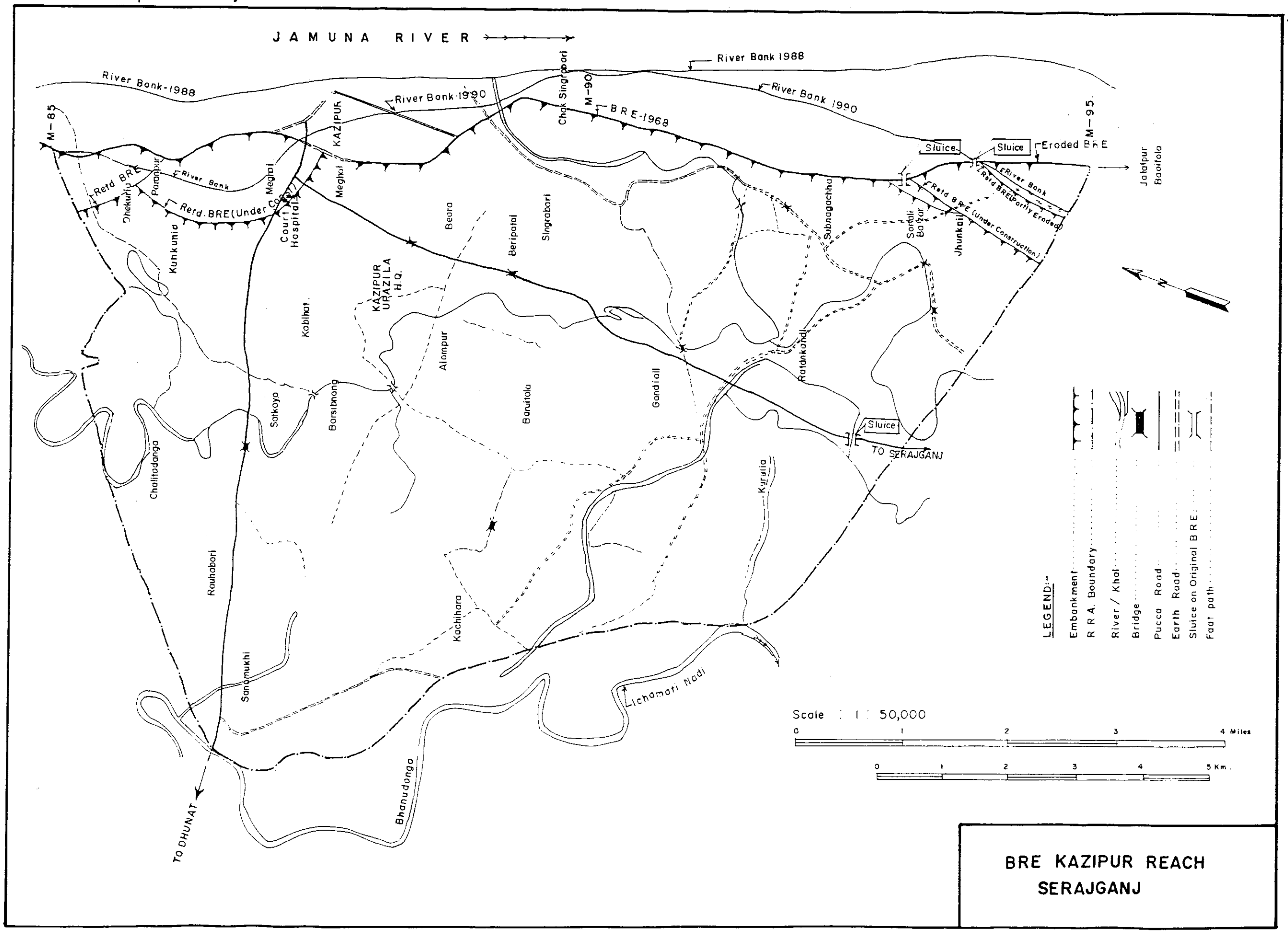
LOCATION MAP
BRE KAMARJANI AND
BRE KAZIPUR REACHES

Figure 16.2 **Brahmaputra Right Embankment, Kamarjani Reach - Key Features**



BRE KAMARJANI REACH
GAIBANDHA

Figure 16.3 Brahmaputra Right Embankment, Kazipur Reach - Key Features



16.1.2 Background Information

The BRE is one of the oldest FCD projects in Bangladesh. It was originally started in 1963 (BRE-I) to build 225 km of embankment to protect about 240,000 ha from flooding of the Brahmaputra. Funding was by the World Bank. Major rehabilitation was carried out from 1975 onwards (BRE-II) again funded by World Bank, but with the recognition that its useful life would be much less (about 15 years) than the nominal 50 year life assessed in 1963, and that retirements in the face of erosion would be frequent. Hence the BRE as it currently stands might be expected to be nearing the end of its useful life.

It was not feasible to evaluate the entire Project, either for impacts or O&M. Instead two sections of the embankment were selected to assess a representative range of O&M experience and problems. These were around Kamarjani (Gaibandha District), where the drainage pattern is towards the Brahmaputra, and at Kazipur (Sirajganj District) where drainage runs away from the Brahmaputra towards the Ichimati river, Figure 16.1 shows the locations of the study reaches in relation to the whole BRE.

16.1.3 Kamarjani Reach

This reach extends from Mileage - 29 at Sripur in the upstream (north) direction to Mileage - 41 at Rasulpur in the downstream (south) direction, and lying between longitude 89° 3'11" to 89°8'56" and latitude 25°3'33" to 25°12'40". The area covered by the RRA team is shown in Figure 16.2 and is about 10,100 ha. This area is bounded by the Gaibandha-Sundargonj road in the west, the BRE in east, the Gaibandha-Rasulpur Road in the south, and the Dharampur-Sripur Road in the north. The western edge of the impacted area is unclear.

The Project area is a gently sloping alluvial plain which varies in elevation from about 73 feet PWD in the north at Dharampur to about 62 feet PWD in the south at Rasulpur, with a slope of 1:7,500 from north to south side. The land can be sub-divided into three levels: high, medium and low under which there are 2,020 ha, 4,949 ha and 3,131 ha respectively. During the pre-project period the entire area used to submerge due to onrush of flood water from the Brahmaputra river and remained inundated for about 2 to 3 days after which water started to recede. The Manas and Ghagot rivers drain the protected area into the Brahmaputra.

16.1.4 Kazipur Reach

The Kazipur reach of the BRE studied by FAP 12/13 covers about 10,500 ha. between mileage - 85 (near Dhekuria and mileage - 95 (near Jhunkalia) in Kazipur and Sirajganj Upazilas. The BRE here dates to the original 1960's project, and was intact up to 1983. However, in 1984 this reach of embankment suffered its first breaches due to erosion. Since then this has been an annual event. The location is given in Figure 16.3 and lies between Mileages 85 and 95 - the area studied covered about 12,200 ha of which 1,700 ha are on the Brahmaputra side of the embankment (the actual area has declined with erosion since this 1988 estimate).

The land slopes gently towards the south and more steeply westwards away from the Brahmaputra, with the embankment built on a "saddle" in the floodplain cross-section. Hence this reach could be expected to be less stable, and before the BRE flooding involved surface flows from the Brahmaputra into the Ichamati and Karotoya rivers.

16.2 PROJECT AS IMPLEMENTED

16.2.1 Kamarjani

The original embankment of this reach was 19.3 km long (Mileage 29-41), although the actual length will differ due to retirement, there are three regulators (functional), and two abandoned regulators (eroded) built to permit drainage into the Brahmaputra.

16.2.2 Kazipur Reach

The original embankment of this reach was 16 km long (Mileage 85-95), although the length is now different due to numerous retirements. No drainage regulators were needed (or built) in this reach of the BRE since the drainage was not impeded by the embankment, but a few one vent flushing sluices were constructed. These sluices were intended to bring irrigation water into the area but river levels were invariably too low when irrigation water was required, so the sluices were rarely used.

16.3 PROJECT PERFORMANCE AND IMPACTS

16.3.1 Kamarjani Reach

The BRE in this reach has been largely successful in excluding normal river floods from the area, except that in 1988 breaches along the Teesta right embankment inundated the area. There have been a number of retirements. Aman paddy production on medium and high land has increased considerably as T. local and HYV Aman has replaced B. Aman and mixed Aus+Aman.

However, the drainage facility is aggravated due to siltation of the internal drainage channels, low lying areas and also by the intervention of other polder constructions like the Sonali Embankment (EIP), the so called "house bund" of a local M.P. Now the waterway of the Manas river is confined between the sides of Sonali and Komarnai bund schemes and water flowing towards the Manas regulator is constricted, significantly raising the internal water level. Consequently on lower land T. Aman (grown now because of the spread of HYV Boro) and Jute are mostly damaged by drainage congestion

Since project completion irrigation by shallow tubewell (STW) has developed rapidly and 93 per cent of irrigation in this reach is by STW. It seems unlikely that the BRE has facilitated this major agricultural growth, since Brahmaputra flood peaks normally occur after the harvest of HYV Boro.

The BRE has helped road communications, and is very important as a shelter for people and livestock during floods. It has also prevented sand (and silt) deposition. Retirement of the embankment has generated employment, but has also meant further loss of land. Open water fish production has decreased as fish migration has been interrupted and beel water levels are lower over the year as a whole. Overall the agricultural gains have been modest and an EIRR of 3 per cent was estimated

16.3.2 Kazipur reach

Up until 1984 the BRE had considerable success in this reach: much of the land switched from B Aus+Aman to T. Aman (resulting in 10 per cent higher monsoon paddy production than before the Project); and later with irrigation Aus and rabi crops were replaced

by HYV Boro. From 1984 cultivation has been uncertain. Embankment breaches and consequent serious floods have occurred during 3-in-5 years making Aman cultivation very risky. Early floods have also damaged HYV Boro (10-15 per cent lost in 1990, for example). The only certain crop in the area now is HYV Boro, except for higher areas where oilseeds can be grown when the flood recedes, but farmers still try a T. Aman crop and may be lucky depending on the timing of floods and breaches. In areas which have suffered sand deposition due to embankment breaches cultivation is shifting towards sugarcane, after one or two years lying fallow because of the sand.

Frequent embankment retirement, plus inspecting and repairing embankments, has created employment, but ultimately this has not been productive. Moreover open water capture fish production has declined, as in other reaches. As at Kamarjani the embankment is important as a place of shelter during floods.

Had the embankment not been there the annual floods would be damaging, but they would not involve sudden embankment breaches, and people could be sure that risking T Aman would not be worthwhile, in some places B Aman or transplanted deepwater Aman might again be possible. However, since 1984 the embankment has provided a less secure environment (partly because of the low standard of embankment retirements), consequently it does not offer an economic rate of return in this reach.

16.4 KAMARJANI REACH ASSESSMENT

16.4.1 Technical Assessment of Operation

Drainage provisions and responses to erosion and cuts are the main operational activities. In the Kamarjani Reach only three drainage regulators are now in operative condition, at: Uttar Sripur, Sarai river outlet at Natunbazar, and Manas river outlet at Rasulpur.

The one vent regulator at Uttar Sripur is insufficient to drain out water rapidly as it was installed at a relatively higher elevation than required invert level, it appears to be a flushing sluice which is now acting as a drainage regulator. The downstream side apron, wing wall and gate are severely damaged and need urgent repair for their stability.

The six vent regulator at Natunbazar over the spill channel of the Sarai is in good condition, except that some minor preventive repair works are needed.

The largest regulator, the twelve vent regulator at Rasulpur over the spill channel of Manas river, drains out water from the upstream and western areas of the study reach. The operating systems of three gates were found to be in defective condition and require repair. The khalashi has been operating this regulator for over 20 years - opening it to drain out water whenever possible in the monsoon season, and closing it to retain water for the remainder of the year, it is now threatened by erosion (see Section 16.4.3). All these structures were constructed according to the design criteria with minor modifications in keeping with the site requirements.

In this reach there were two more regulators (Karaibari I and Karaibari II), in addition to the three discussed above. However, when a retired embankment was built in 1986 these two regulators were abandoned (a large capital loss). Hence the drainage congestion problem in the monsoon is being aggravated through the reduction of drainage provision/outlets in the retired embankments, and through silting up of khals and rivers (such as the khal 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 Aman production.

The BRE is a unique project from the viewpoint of river bank erosion which has resulted in up to seven retirements along the BRE at some places, such as Jalalpur downstream of the study area. Although a maximum of three retirements are shown for the Kamarjani reach area in Figure 16.4, local information indicated that the embankment just north of Manas regulator has been retired five times since 1978 (between mileages 35 and 40. The general history of retirement is given in Table 16.1.

In the 1984 flood, from July to September, there were several breaches in the embankment at a number of places throughout the length of 135 miles (216 km). For Kamarjani, there were breaches between M-23.65 to M-25.00.

In the 1985 flood, from July to October, about 90 miles of the embankment out of 135 miles of BRE in the Upazilas Kaunia, Pirgacha, Sundarganj, Phulchari, Saghata, Sariakandi, Dhunat, Sirajganj, Belkuchi and Shahjatpur were more or less affected by natural breaches. The Kamarjani reach was not affected.

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

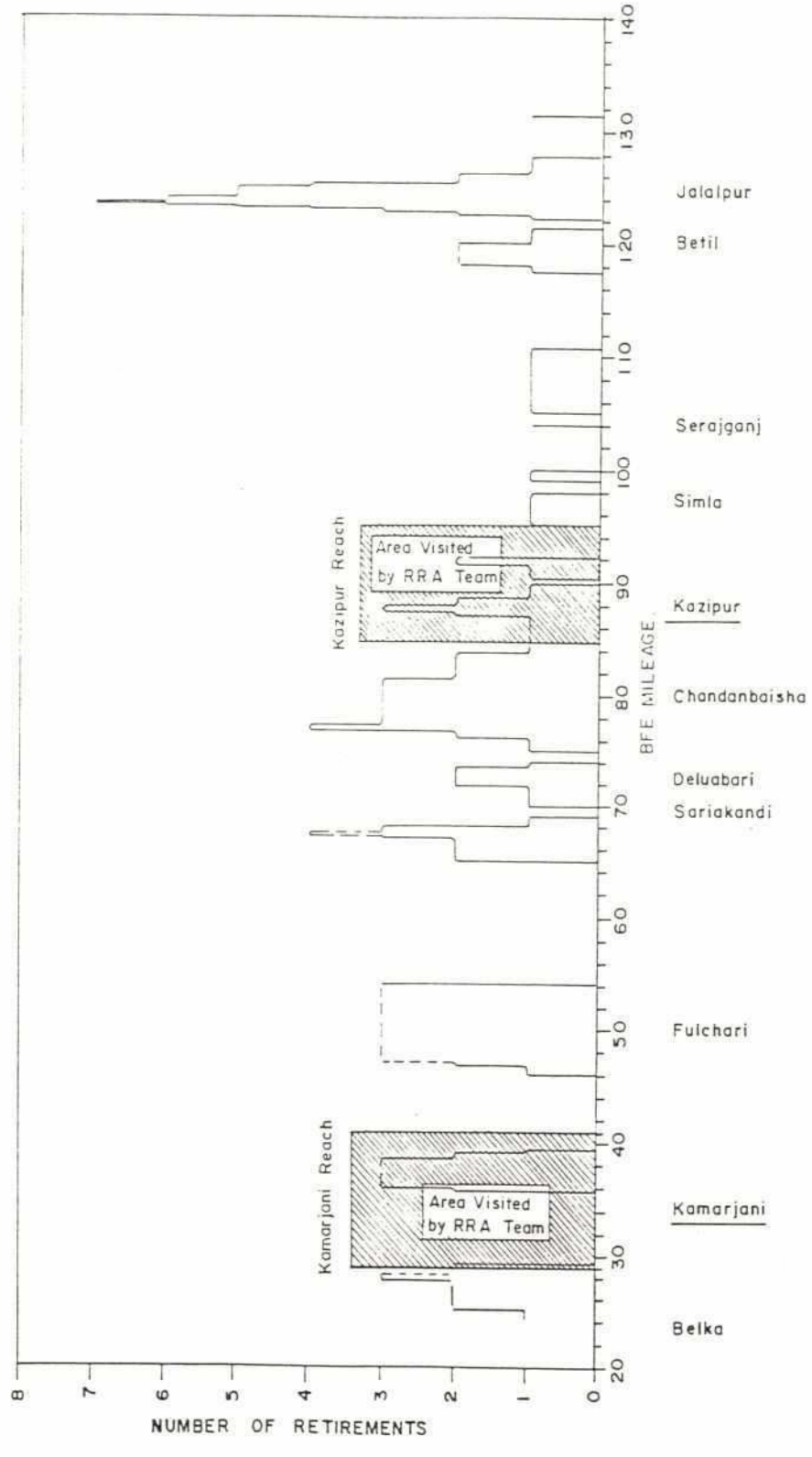
In the 1987 and 1988 flood, BWDB officials claimed there were no breaches and public cuts to the embankment though these were the highest floods for the decade. The BWDB recommendations for flood repair in 1987 refer to 900m of public cuts and 900m of breaches in the entire project. However, the study reach would appear to have been safe following the 1986 retirement.

In 1990, although there was no severe flood in the country, four public cuts were reportedly made in this reach, three upstream of Manas regulator. Cuts for which information was obtained comprised: one of 31m between mileage M-30 and M-31 at Uttar Sripur, one of about 25m between mileage M-36 and M-37 at Charkerghat, and one of about 190m between mileage M-37 and M-39 at Katlamari. All these cuts were made by the local people in response to local drainage congestion as water remains stagnant in these areas due to a lack of drainage structures which were not constructed in the retired embankment. The water level inside the project was about 1.5m higher than the river side in 1990 and water was ponded in these areas previously served by drainage regulators. Although BWDB referred the cuts to the police no action was taken and there was no conflict of interest, cuts were the logical response of farmers to the lack of drainage facilities.

Upazila roads, which are constructed under CARE programmes without any drainage provision, are creating a major local drainage congestion problem in the project area. It was observed that CARE has undertaken an intensive programme for this particular area constructing 124 km of kutcha roads in the last three years (1988/89 to 1990/91) in Gaibandha Upazila with an allocation of 1233.34 mt. of wheat. The roads have aggravated the drainage problem severely.

The building of the Sonali embankment project behind the BRE has excluded surface flow from part of the study area, this means that water depths in the remainder of this reach are higher and previous drainage routes have been disrupted.

Figure 16·4



NUMBER OF RETIREMENTS ALONG BRE

Source BRTS First Interim Report (Four Volumes) – FPCO

Table 16.1 Retired embankments along the BRE constructed upto 1989-90

SL. NO.	NAME	YEAR	IN BETWEEN MILEAGE	LENGTH (MILES)
1.	LALCHMAR	1971	27-30	2.88
2.	KARAIBARI	1971	37-38	1.20
3.	BELKA	1974	19-22	3.29
4.	HARIPUR	1974	25-28	2.32
5.	MAIZBARI	1974	87-89	1.35
6.	SERAJGANJ STEAMER GHAT	1974	100-103	3.72
7.	BONBIRIA	1974	106-110	2.72
8.	MALIPARA	1976	124-127	3.20
9.	BELKA	1977	120-122	1.60
10.	FULCHARI	1977	49-50	0.80
11.	FULCHARI	1979-80	50-53	1.39
12.	KALAPANI	1980-81	48.50-53	3.06
13.	BHARATKHALI	1983-84	51-52	0.39
14.	KATLAMARI	1984-85	46-48	2.00
15.	BANGLABAZAR	1984-85	23.65-25	1.40
16.	KATLAMARI TO GAZARIA	1985-86	46-49	3.00
17.	KARAIBARI	1986-87	35.71-38.80	3.09
18.	GAZARIA TO KATLAMARI	1986-87	46.40-48.50	2.10
19.	PAINALGHAT	1987-88	9-11	2.00
20.	KATLAMARI	1987-88	47.80-49	1.20
21.	KATLAMARI TO KUKRAHAT	1988-89	46-49	3.00
22.	KARAIBARI	1989-90	37-39	1.00

Source: Brahmaputra River Training Study First Interim Report

16.4.2 Institutional Assessment of Operation

The BWDB officers in immediate charge of embankment reaches in BRE project are the Sub-Divisional Engineers (SDE). The SDE may delegate his authority to the Sectional Officers (SO). The next immediate charge is with the Work Assistant who is authorised to operate the regulator. Each regular is supposed to have one khalashi for guarding, cleaning and taking care of the regulator, and to operate the regulator with cooperation of the beneficiaries. In practice the khalashi is found either to be absent or to attend irregularly, and effective control is with influential parties.

There is no O&M Manual for the Project to guide these staff in their duties, although this was proposed in the PP.

Institutional arrangements for public participation in Project operation are absent: there are no management groups or committees for water management behind the embankment. Also the local people have been unable to influence the authorities to address the drainage problems which have been created by recent embankments (retirements and internal bunds).

16.4.3 Technical Assessment of Maintenance

The condition of the regulators in this reach has already been discussed, as this constrains their effective operation. However, in addition the Manas regulator is protected by a guide or lead embankment on the river side. This was originally 3100 ft (945m) long, in early July 1991 it was 1200 ft (366m) - FAP 12/13 field visit, by mid-August 1991 it was 865 ft (264m) - FAP 1 letter to BWDB Director General (Planning), and by 9th September (FAP 12/13 field visit) it was reduced to about 500 ft (152m). This is a 58 per cent loss in about two months. It seems likely that this regulator will be eroded, and the embankment with it, in the near future.

The parts of the original embankment which were visited by the RRA team were constructed according to the original design criteria in terms of countryside and riverside slopes, crest width, and crest elevation.

The overall condition of the embankment in the reach is, however, threatened. The people displaced from the river side by erosion of their homesteads have taken shelter by cutting the slopes and excavating the toe area of the embankment to construct small clusters of huts. The stability of the embankment is deteriorating as a result of this housing development which covers long stretches of embankment. For example, the embankment is severely damaged in the Phalarghop/Raidasbari area as clusters of huts have been built on both sides of the embankment. Rain cuts and ghogs were also found throughout the entire Kamarjani Reach. Hence there is a need for urgent resectioning of the embankment to improve its durability and stability during the peak flow period.

The retired embankments are constructed without any compaction which causes the material to be eroded, even by a small shower of rain. In 1991 housing on the retired embankment at Raiduspur was being moved back onto the next retired embankment as the previous one eroded.

16.4.4 Institutional Assessment of Maintenance

Linked with the very poorly maintenance of this reach of embankment is the lack of public participation in O&M. There is no O&M committee, although this was proposed in the PP. There is no instance of public participation in the repair and maintenance of the

embankment or structures, except that people affected by serious drainage congestion organise themselves to make public cuts in technically appropriate locations.

The linear housing development along the embankment has damaged the embankment to a great extent. Yet the embankment has provided a great social service as a safe refuge for people displaced by erosion.

There is a strong social conflict over the Sonali embankment, reportedly built at the instigation of a local MP, due to aggravation of drainage outside that embankment but behind the BRE.

16.5 KAZIPUR REACH ASSESSMENT

16.5.1 Technical Assessment of Operation

In this reach there are no important structures to operate since the land slopes away from the Brahmaputra (as explained in Section 16.1.3), and hence there are no public cuts. The main operating decisions have, therefore, been when and where to retire the embankment in the face of erosion. It is notable that Kazipur town itself is being lost to the Brahmaputra - the town now lies outside the retired embankment and that buildings, such as the Upazila Health Complex, have been flooded to the level of the first floor in 1991.

In 1991 there were four sections of this reach of the BRE undergoing or with planned retirement, at Baishakhi - 1.4 km, Maizbari - 3.2 km, Khudbandhi - 1.1 km, and Sonalibazar - 4.8 km. This amounts to 66 per cent of the original embankment length in this reach.

16.5.2 Institutional Assessment of Operation

Alignment of retired embankments was found to have been discussed and agreed with local representatives, but there has been no further participation in the management of the project here. Local resentment of the frequent retirements, history of breaches, and poor land acquisition procedures (particularly speed of payment) is very evident.

16.5.3 Technical Assessment of Maintenance

Erosion has been the key factor in O&M of this reach of BRE, as a result a number of breaches have occurred and the embankment has been retired (for example five times at Meghai). The problem is worsening since the retired embankments have been built to lower specifications than the original embankment - 14 ft rather than 21 ft crest width and no compaction, at Meghai no clay core was used in the embankment although the soil is very sandy.

Due to these poor construction standards rain cuts are eroding the retired embankment, and it is liable to breach. For example, at Jhunkail the original embankment is breached but the retired embankment had been built immediately inland and this too had breached in 1991 resulting in a sudden flow of flood water into the protected area.

16.5.4 Institutional Assessment of Maintenance

Food for work is used to patch the embankments which are initially inadequate. There is a lack of quality control or incentives and accountability to do a good job, even though the consequences of this omission are severe for many poor people (breaches and loss of

property and crops). It may be that this reflects a view that continued erosion is inevitable, this would appear valid, but means that people should be told what is expected and what embankments can and cannot do, the negative impacts are worsened by people having too high expectations of embankments. An improved strategy needs to be developed involving abandonment, prompt retirement, and proper maintenance of embankments which are expected to last for at least a few years.

16.6 LESSONS

1. Retired embankments have been unplanned and a hasty response to predictable erosion. They have been poorly constructed and associated with late starts and non-payment of compensation, this has resulted in continued flood losses to a population which for nearly 20 years (in the case of Kazipur) had enjoyed flood free conditions. Starting an embankment which cannot be finished in time to a standard capable of withstanding normal floods is irresponsible and worse than useless. It gives poor people a false sense of security, results in continued flood losses, and lines the pockets of contractors, labour leaders, local influential people, and in some cases officials, having access to political and other patronage over building embankments. Identifying areas which could be protected for a reasonable length of time, protecting these areas, and then in the remaining areas spending resources on emergency planning and investments to increase the economic resilience of people to erosion (non-agricultural trades, high value winter cultivation, safe homestead areas) could make more sense.

2. There is a need to plan phased abandonment or protection of the embankment based on rational choices - a data base of what there is to be protected or abandoned and the likely life of the embankment with different set back distances would help. It is hoped that FAP 1 is achieving this through its prioritisation of embankment reaches and assessment of morphological trends.

3. A formal framework for consultation between BWDB and the administration (District, Upazila and Unions) is clearly needed if a mixture of abandonment and protection is to be accepted, and the social problems of erosion and abandonment are to be minimised.

4. Coordination within BWDB is needed if the adverse impacts of later projects on existing ones are to be avoided. Impacts external to the latest project appear to be ignored at present and the adverse impacts are revealed as "O&M problems" in the other project(s), rather than as planning failures.

5. Regulator committees or "drainage area" committees are needed so that drainage operations better represent the needs of farmers. This may extend to public cuts in designated places, which could be permitted on condition that they be repaired before Brahmaputra floods threaten the area.

6. It may be that public cuts are a low cost alternative to structures, but the repairs cannot be consolidated into the embankment. Experiments and monitoring are needed in order to assess the relative merits of these alternatives, given that structures may have short lives before they are eroded and are not (so far) well maintained, and that it is easier for people to organise to cut than to repair an embankment.

7. An alternative might be pre-fabricated drainage regulators which could be dismantled in the face of erosion threat and re-installed in the retired embankment. Although this idea may not be practical it would be worthy of a proper design and evaluation study. Obviously the foundations would be lost to erosion, but it might overcome some of the problems found in reaches such as Kamarjani.

8. A compromise between technical and social aspects of linear housing development on the embankment is needed. A clear policy regulated by either or a combination of BWDB and the Upazilas is needed - this would have implications for new works and for O&M. The following elements might be involved:

   i. acquisition of further land if the existing BWDB land is insufficient to incorporate housing (this should be kept to a minimum);

   ii. not permitting settlement outside designated reaches of embankment (in particular, not on reaches likely to erode in the next 0-10 years);

   iii. a structurally sound design of embankment plus rural housing platform;

   iv. embankment settlers should have lost homestead land to river erosion, preference might be given to the landless (due to erosion), and/or to people with farmland outside the embankment but who lost their homestead;

   v. earth raising for homesteads would be done by the beneficiaries under BWDB guidance;

   vi. a rent in cash or kind would be provided by beneficiaries in return for a fixed term renewable lease to that embankment section (say 15 years, or until eroded). The lease would be terminated if embankment use is other than designated or rent in kind is not paid;

   vii. the rent might simply be a duty to maintain to a proper standard the whole embankment section associated with the homestead; and

   viii. associated uses by settlers such as tree planting could be encouraged if not damaging to the embankment.