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

BANGLADESH FLOOD ACTION PLAN

FAP 12
FCD/I AGRICULTURAL STUDY

RAPID RURAL APPRAISALS

OVERVIEW

August 1991

Hunting Technical Services Limited

in association with:
Bangladesh Institute of Development Studies
Flood Hazard Research Centre
Hunting Fish-Tech
Technoconsult International Limited

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Sanyu Consultants Inc.

under assignment to
JAPAN INTERNATIONAL CO-OPERATION AGENCY

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

The full series is expected to comprise the following reports:

FAP 12

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

Project Impact Evaluation studies of:

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

Rapid Rural Appraisal Studies of:

* Protappur Irrigation Project
* Nagor River Project
* Sonamukhi Bonmander Beel Drainage Project
* Improvement of Sukunia Beel
* Silimpur - Karatia Bridge cum Regulators
* Khatakhali Khal
  Halir Haor
* Kahua Muhuri Embankment
* Konapara Embankment
* Polder 17/2
* BRE Kamarjani Reach
* BRE Kazipur Reach

* Draft Final Report
* Final Report

FAP 13

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

Note: * Report not yet available

SUMMARY

INTRODUCTION

The Flood Action Plan 12 Study (FAP 12) aims to evaluate the impact of seventeen completed Flood Control, Drainage and Irrigation (FCD/I) Projects in Bangladesh. Five of these evaluations involve the application of Project Impact Evaluation (PIE) methods, using a formal questionnaire approach and probability sampling techniques. The remaining twelve completed projects have been assessed using Rapid Rural Appraisal (RRA) techniques, and RRA has also been used for preliminary reconnaissance of the five PIE projects. The present report summarises the findings from the Rapid Rural Appraisals.

RAPID RURAL APPRAISAL

RRA is an investigative methodology aimed at producing results more quickly than conventional sample surveys while avoiding many of the biases and weaknesses that are liable to be encountered by less disciplined methods of rapid data collection. The methodology is usually better at providing qualitative than quantitative data. As the FAP 12 study involved one of the first large-scale attempts at formal application of RRA methodology in Bangladesh the methodological aspects were given significant consideration, and the effectiveness of the techniques applied was given critical attention by the team.

PROJECT SELECTION

The seventeen projects for study were selected in consultation with the Flood Plan Coordination Organisation (FPCO). The selection process aimed to provide a sample of projects that were representative of the main project types, distributed regionally according to the proportionate importance of flood protection in different FAP regions. In addition the PIE projects were selected where possible from those which protect relatively large areas, only projects which were completed by 1989 at the latest were considered, and an effort was made to avoid returning to projects which had been evaluated in the past. In general the five PIE projects tended to "select themselves", as there were very few which satisfied all the criteria identified. In some of the RRA categories a number of projects appeared suitable, and in these cases projects were selected using standard random selection techniques.

The seventeen selected projects are broadly representative of the existing range of FCD/I projects in Bangladesh. They are summarised by project type and by FAP Region in Table S1.

FACTORS LIMITING IMPACT EVALUATION

Five factors have been identified which limit the effectiveness of efforts at the evaluation of completed FCD/I projects. Some are specific to RRA, but others will equally limit the effectiveness of evaluations using more sophisticated PIE methods.

The diversity of FCD/I projects is such that almost any attempt at generalisation is likely to be misleading. In presenting an overview of the 17 RRAs it is therefore inevitable that many statements have to be qualified, as there are almost invariably exceptions amongst the 17 projects to any broad trends or features identified.

Table S1 : Selected Projects by Project Type and FAP Region

Project Type	Number of Projects Selected in FAP Region						
	NW	NC	NE	SE	SC	SW	Total
FCDI	1	1		1			3
FCD Embankment along main river	2						2
FCD non-main river	3	1			1	2	7
Submersible Embankment			2				2
Flash flood rivers (canalised by embankments)			1	1			2
Semi-saline Polders FCD (Khulna area)						1	1
Total	6	2	3	2	1	3	17

FCDI = Flood Control, Drainage and Irrigation
FCD = Flood Control and Drainage

Source = FAP 12 Consultants

Many FCD/I projects are remarkably complex, in terms of their hydrological features (differing impacts on flooding in different parts of the project area for example), their subsequent agricultural impacts and the range of positive and negative impacts that they may have had both inside and outside the intended flood protected area. On larger projects it is sometimes difficult to fully quantify the extent of this complexity within the scope of an RRA, and even on smaller project areas it is sometimes extremely difficult to balance the diverse range of impacts (some of them inherently unquantifiable) in order to reach an overall positive or negative evaluation.

In many of the project areas there has been substantial agricultural and economic development since the project was completed. In some cases it is clear that this was or was not due to project interventions, but in some cases the project's impact in a particular area of activity is unclear or debatable. It is often difficult in particular to distinguish the impacts of rural roads and flood control infrastructure on economic development. During the PIE studies the examination of control areas outside the projects may improve the reliability of "with and without project" assessments, but for some of the RRAs an area of doubt will remain.

Quantification of project impacts during RRA was, as anticipated, difficult. Secondary data was used wherever possible, but its reliability was sometimes in doubt and in general the administrative areas on the basis of which statistics are compiled (Upazilas, Unions) do not coincide with project boundaries, and therefore have to be treated with caution as a guide to change within the project area.

Assessment of project impact must start from an understanding of project objectives. These were often inadequately defined, making it impossible to compare actual and planned impacts. Project objectives in engineering terms were generally clear in what was to be built and what was broadly intended to be achieved in FCD/I terms. However the precise parameters (reduced flooding frequency, depth, locations, timing) were rarely quantified. Agricultural objectives were often vague and unquantified, but were sometimes clear, particularly for the major projects. In most other areas (livestock, fisheries, nutrition, social, environmental) possible positive or negative impacts were rarely identified and virtually never quantified. This has proved to be a particularly serious omission in the fisheries sector, where the impacts of FCD/I projects have often been substantial. In some cases original project feasibility studies could not be located, and objectives have had to be inferred.

PLANNING AND DESIGN

The original approach to project planning (identification of project concept and objectives) was often poor. Local consultation was not usually involved. Those projects which were planned in consultation with local people have generally been better conceived, their structures better located and their operation and maintenance (O&M) facilitated.

Project plans (Project Proforma, Feasibility Studies) have usually failed to anticipate possible negative impacts within the project area. In the few cases where negative impacts were anticipated they were virtually never quantified, and no provision was made to compensate groups (apart from landowners whose land was to be acquisitioned) for the losses they were expected to suffer.

The plans for individual projects have not considered their expected impacts outside the planned benefited area. In some areas (for example the Atrai basin) the cumulative

external negative impact of a number of projects has been very serious, and each additional project has undermined the viability of its predecessors. The case for Regional Planning, understood by FPCO, and for consideration of external impacts is clear.

Project infrastructure has often been applied to multiple uses - embankments are used for roads, housing and social forestry and FCD/I structures often double as bridges. These uses were rarely anticipated by planners, and designs and project concepts were often inappropriate as a result.

Plans have sometimes been interpreted too rigidly. In some cases project construction has continued to follow an ordained path over more than a decade. Changed hydrological and agricultural circumstances have not been reflected in regular reviews of local requirements.

CONSTRUCTION AND O&M

Most projects were constructed broadly as designed, but standards of embankment compaction in particular were frequently inadequate. Construction sometimes involved substantial cost overruns and often took much longer than planned, with particularly long delays due to problems in land acquisition.

Project structures have generally been operated as intended, although where groups were supposed to be involved in operation these have rarely functioned. Khalashis who are supposedly responsible for the operation of structures are frequently absent and management has often devolved to a powerful individual.

Many of the protected areas suffer from severe problems of drainage congestion, caused or aggravated by the flood protection infrastructure. This has often led to disgruntlement, public cuts and even public disturbance.

Maintenance of embankments and structures has always been inadequate, and sometimes so poor that it has resulted in almost total failure to achieve FCD/I water control objectives. BWDB engineers rarely or never visit some of the projects studied.

A more detailed review of the O&M of completed FCD/I projects is presented in the Draft Final Report of FAP 13, which has been implemented in tandem with FAP 12.

AGRICULTURAL IMPACT

It is impossible to generalise the conclusions on agricultural impact. Some projects appear to have led to greater benefits than were anticipated while others have clearly not achieved their targets and in some cases no agricultural benefits due to the project were apparent.

Agricultural impacts identified include:

- protecting the Boro crop from losses previously inflicted by early flash floods (particularly, but not only, on the haors in the North-east);

- promoting the adoption of HYV Boro and irrigation of Boro in areas where early floods used to be a major hazard, particularly if there was any delay in harvest of the

Boro crop. However in many areas there has been a very substantial expansion in the irrigation of the Boro crop which cannot be credited to the FCD infrastructure;

- protecting the Aman crop from monsoon flooding, and thus promoting a move to T. Aman rice, adoption of HYV varieties and in some cases increasing the cropped area in the Kharif season;

- facilitating irrigation of the Aman crop after the monsoon in areas that were previously water stressed;

- facilitating irrigation of Rabi crops, by providing irrigation infrastructure, or by reducing the risk to private irrigation facilities from flood damage.

None of the above applied to all projects, and some only applied in a few cases.

Nevertheless it should be noted that in some cases negative agricultural impacts have been identified. Farmers on relatively high land sometimes suffer greater moisture stress or greater difficulty in irrigating their crops. Farmers in low lying areas have sometimes been severely hit by increased drainage congestion, and farmers in adjacent areas have sometimes been badly affected by increased flood heights. In a few cases farmers reported that the infrastructure had worsened flood risk and increased crop losses - in place of annual predictable slow rising and shallow flooding they now were at risk from sudden unpredictable deep inundation due to embankment failures or public cuts.

Where FCD/I projects have permitted increased cultivation rice has been by far the preferred crop, often to a greater degree than was anticipated by project planners. In some cases flood protection has also led to substantial increases in planting of both fruit and timber trees.

FISHERIES AND LIVESTOCK IMPACT

The two main areas of fisheries impact relate to pond culture, which was often facilitated by the FCD/I project, and capture fisheries which were often devastated. The former impacts tended to benefit a small group of privileged individuals, while the latter impact affected large numbers of poor and landless fishermen. The net impact was almost invariably negative and on some occasions the net annual value of the fisheries losses is estimated to approach half the annual value of the incremental agricultural benefits.

Wherever FCD/I projects have led to an increase in cropped areas this has led to reduced livestock activities as the increase in production of crop residues does not offset the loss in grazing land. There is a resultant loss in the availability of draft power. The latter has been offset by increased use of power tillers in some areas.

The combined impact of reduced availability of fish and of livestock products on protein consumption and nutrition as a direct result of FCD/I interventions is of particular concern.

ENVIRONMENTAL IMPACT

Many of the projects have had significant, usually unplanned, impacts on communications. Road travel has generally been facilitated, while travel by boat has been impeded. In areas where transport of heavy freight by boat remains very important the net

impact has been substantially negative. However in some projects the improvements to road communications appear to be more important.

The ecological impact of FCD/I projects in areas other than those discussed above has been fairly limited. Many of the project areas were already densely populated and developed for agriculture or fisheries and "natural" fauna and flora already changed from any "natural" state. However in several projects there were reduced areas of wetland and there were frequently said to be losses in soil fertility due to reduced flooding, resulting in falling yields.

New less-productive agro-ecological environments have developed in areas affected by sand deposition and erosion, following embankment breaches and public cuts. The development of social forestry on embankments has already emerged in some areas, and there is considerable scope for expansion of this activity.

In some cases there were serious off-site environmental impacts and it was clear that the negative impacts of flood protection on adjacent and downstream areas had been inadequately considered at the planning stage.

SOCIAL IMPACT

In general where projects had resulted in increased agricultural production this has resulted in increased employment and in some cases increased in-migration of labour. It was not always clear however that the increased demand exceeded the increase in the labour force due to population growth. The maintenance of embankments generally had a particularly important employment impact, and usually provided employment opportunities to more disadvantaged groups.

Where women were newly involved in embankment maintenance they gained relative to without project conditions. Where there was a move from B. Aman to T. Aman this sometimes provided additional employment for women in transplanting. Otherwise their benefits differed little from those accruing to men.

The overall distributional impact of FCD/I projects is complex. There is no doubt that most projects involved losses and gains to identifiable groups. However the net impact on the distribution of income between rich and poor was often difficult to calculate as there were poor and rich in both the losing and the gaining categories. In general no projects made provision to compensate those who suffered reduced incomes or loss of livelihood due to the project, even when these losses were anticipated at the planning stage.

The only exception to this is the compensation paid for land acquisition. In a few cases this was well handled, particularly when those affected were involved in project planning and understood the implications from the outset. In general however the land acquisition process has been a major cause of project delays and dissatisfaction. In general it is not the prices that are paid for land which cause discontent, but the long delays in payment and in particular the long delays in registration by BWDB of changes in land title, which result in ex-owners continuing to be levied for land taxes when their land is already under an embankment.

In several cases the FCD/I project has led to increased social disharmony, often between those inside a project boundary and those outside. Public cuts are a frequent symptom of this. Conflicts between fishermen and farmers are particularly common.

Nevertheless it was observed that at many of the projects the perceived reduction in flood hazard had a clear "psychological" impact on the population, leading to greater confidence in the security of housing and other assets and presumably to a greater willingness to invest within the protected area. This raises the risk of a false sense of security. In some of the projects studied the embankments have either already breached or been overtopped and on others this appeared likely, given their state of repair. In such circumstances there is a greater need for advance warning and emergency planning to avert disaster.

ECONOMIC EVALUATION

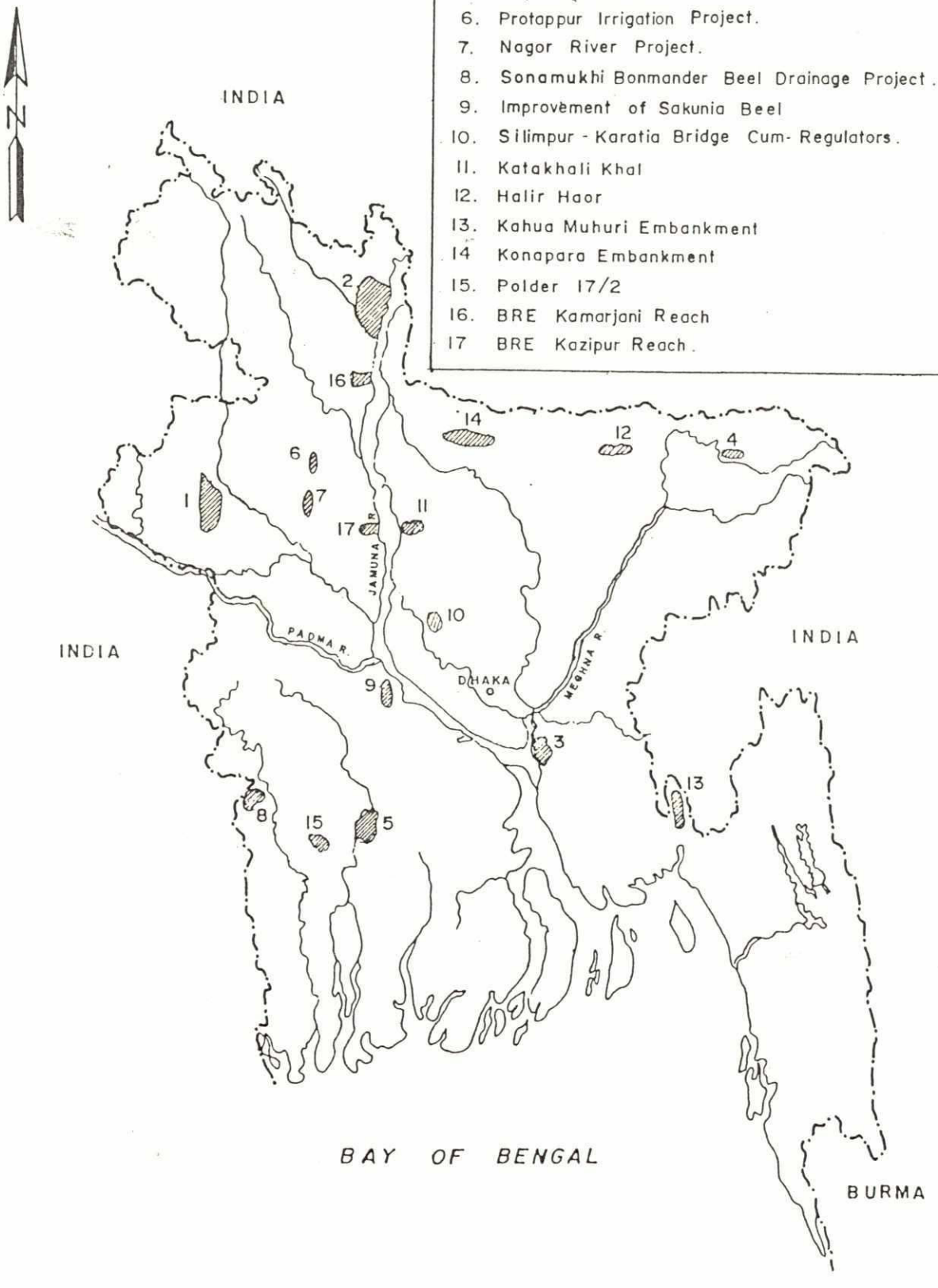
The quality of data from the RRAs makes any attempt at overall economic evaluation very tentative. In a few cases preliminary estimates indicate that project benefits substantially exceed costs and any disbenefits and the projects were clearly successful. This appears to be particularly true of the two haor projects examined.

In general however the data available suggests either that fisheries and (in some cases off-site) disbenefits were so large relative to agricultural gains that overall benefits did not justify the investment or that even the agricultural benefits alone have been inadequate, so far, to yield an acceptable rate of return.

THE EFFECTIVENESS OF RRA FOR PROJECT EVALUATION

RRA has proved to be an effective technique for post-evaluation of small FCD/I projects and for initial diagnosis of project impact in larger projects. The particular strengths of the RRA methodology as applied were in the high level of inter-disciplinary interchange and in the use of triangulation techniques (cross-checking the same data from a variety of sources). The time required for fieldwork, and particularly for report production, was under-estimated and the RRA teams would have benefited from a stronger hydrological input. However the adoption of most of the methodology applied in future exercises is strongly recommended.

MAP OF BANGLADESH



Source Consultants

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

ADB	Asian Development Bank
BADC	Bangladesh Agricultural Development Corporation
BCR	Benefit Cost Ratio
BIDS	Bangladesh Institute of Development Studies
BRDB	Bangladesh Rural Development Board
BRE	Brahmaputra Right Embankment
BWDB	Bangladesh Water Development Board
CEP	Coastal Embankment Polders
DAE	Department of Agricultural Extension
DLAC	District Land Acquisition Committee
DSSTW	Deep set shallow tubewell
DTW	Deep tubewell
EIP	Early Implementation Projects (Netherlands)
FAP	Flood Action Plan
FCD	Flood Control and Drainage
FCD/I	Flood Control, Drainage and Irrigation
FFW	Food for Work
FPCO	Flood Plan Coordination Organisation
GOB	Government of Bangladesh
HTW	Hand tubewell
HYV	High Yielding Varieties
IDA	International Development Agency (World Bank)
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
LLP	Low lift pump
O&M	Operation and Maintenance
ODA	Overseas Development Administration (UK)
PIE	Project Impact Evaluation
PP	Project Proforma
RRA	Rapid Rural Appraisal
R&H	Roads and Highways
STW	Shallow tubewell

LOCAL TERMINOLOGY

Aman	: B. Aman - Paddy sown broadcast during pre-monsoon period and harvested around November.
	: T. Aman - Paddy transplanted in July - August and harvested in December - January.
Aus	: Paddy planted in early summer (April-May) and harvested during August - September.
Baor	: Ox-bow lake
Beel	: Saucer-shaped depressions which may or may not hold water perennially.
Boro	: Paddy planted in winter and harvested during April - May.
Charras	: Small water courses (streams)
Haor	: Annually flood-filled water body (normally in north-east)
Khal	: Natural channel.
Khas	: Government-owned property
Khalashi	: Literary meaning "Cleaner". He who guards and operates sluices is called a "Khalashi".
Kharif	: Wet season (July to November).
Rabi	: Dry season (winter).
Samity	: Small association
Tara pump	: A kind of rower hand pump.

Conversions from Bengali to Gregorian Months

The Bengali year starts on 1 Baishak and the months are almost exactly half a month out of phase with the Gregorian calendar, starting on the 15th or 16th of each Gregorian month.

	April
Baishak	
	May
Jaistha	
	June
Ashar	
	July
Sravan	
	August
Bhadra	
	September
Aswin	
	October
Kartik	
	November
Agrahayan	
	December
Poush	
	January
Magh	
	February
Falgun	
	March
Chaitra	

1 INTRODUCTION

1.1 THE FAP 12 STUDY

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

The objective of FAP 12 is to conduct post-evaluations of 17 projects representative, in type and location, of the FCD/I projects so far executed in Bangladesh. The results of these evaluations will be passed to other FAP components for guidance in developing strategies for improved flood control and management in the future.

Of the 17 projects studied, 5 will be assessed mainly by Project Impact Evaluation (PIE) methods, using a formal questionnaire approach and probability sampling. The remainder will be assessed using Rapid Rural Appraisal (RRA) techniques and RRA has also been used for preliminary reconnaissance of the 5 PIE projects.

The present report summarises the findings from the Rapid Rural Appraisals.

The FAP 12 study is being implemented in close liaison with the FAP 13 Study of Operation and Maintenance (O&M) of FCD/I projects. The two project teams overlap, and the RRA fieldwork served the purposes of both studies. The present report includes a summary of the O&M findings and conclusions. More detail will be found in the Draft Final Report on FAP 13 (August 1991).

1.2 RAPID RURAL APPRAISAL

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

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

Further background on RRA Methodology has been presented in the FAP 12 Methodology Report (Draft, March 1991). In Chapter 4 of this report the effectiveness of the RRA techniques applied by FAP 12 is discussed, and lessons learned for future applications are presented.

1.3 ACKNOWLEDGEMENTS

The FAP 12 RRA Teams would like to take this opportunity to thank the enormous number of people who assisted the teams in Dhaka and at the seventeen projects. These included staff of the Bangladesh Water Development Board (BWDB), the Department of Agricultural Extension (DAE), District Upazila and Union Administrations, the Bangladesh Agricultural Development Corporation (BADC), the Bangladesh Rural Development Board (BRDB) and NGOs and many farmers, traders, landless,labourers, irrigation contractors, fishermen, women and health workers.

2 THE PROJECTS SELECTED FOR RRA

2.1 THE PROJECT SELECTION PROCESS

The project selection process was discussed in detail in the FAP 12 methodology report. It is summarised here, along with reasons for deviations from the initial selections where these have occurred. Selection of projects was required by the Terms of Reference to be "representative of the types of FCD/I projects undertaken in Bangladesh" and was to include some from the North-west and North-centre regions.

A comprehensive list of all completed FCD and FCDI projects, excluding ones south-east of Feni (outside the FAP area), was drawn up (Annex E of the FAP 12 Methodology Report). This was based on lists provided by BWDB with additional information from and crosschecked with various sources. These data sources usually included enough of the required project information to exclude projects which clearly did not fit the selection criteria.

It was intended that the 'projects' selected would be closer to the 'systems' considered by management and O&M studies than to the 'projects' considered by implementing and funding agencies. Each spatially distinct flood control system was considered as a separate project. There may have been several investments in the same system (for rehabilitation for example) but an attempt was made to only list this as one project - the earliest completed one - since the impact of later additions cannot easily be separated from the original project. Because BWDB often built on an older local embankment this principle did not always work in practice.

A **typology** of FCD/I projects in Bangladesh was developed comprising the following:

- FCDI projects;

- Embankments along main rivers;

- Polders and flood protection projects providing 'full' flood protection (up to some defined return period as a design standard) within the main fresh water drainage systems;

- Submersible embankments;

- Embankments along rivers subject to flash flooding; and

- Coastal zone polders protecting against flooding and salt water intrusion.

Hence the type of project also distinguished between the sources of flooding (fresh water or salt water) and velocity of flood occurrence. Projects which provided only irrigation or only drainage were excluded from consideration at the outset.

Other key factors in selecting projects were:

a) **Location** - the projects selected were to include ones from each FAP region and not from the non-FAP area of Bangladesh; and

b) **Age (year of completion)** - a compromise was needed between more recently completed projects where recall of pre-project conditions is more reliable but full impacts may not have occurred, and older ones where the reverse is true.

On the advice of FPCO and the Panel of Experts projects in the cyclone prone zone were excluded from consideration since a separate FAP component covers this area. Likewise projects which are restricted to town protection (usually from erosion) were excluded since the focus is on agricultural/rural projects.

In summary, the **key criteria** for project selection were that all projects selected should:

- have been completed between 1975 and 1988;

- not be south-east of Feni;

- not be in the cyclone prone coastal zone;

- not previously subject to a very detailed PIE style evaluation; and

- provide some form of flood protection.

For the **PIEs** additional criteria usually used for short-listing were:

- a preference for larger projects protecting 15,000 or more ha;

- and the availability of potential control areas (nearby unprotected areas unaffected by the project and similar to the project in the pre-project period).

For the **RRAs** additional criteria for short-listing were:

- small-medium projects of 2,000-15,000 ha;

- and a preference for those not previously evaluated, whether by RRA or PIE methods.

A compromise between the types of project indicated for study by RRA and PIE, based on the total areas under different types of projects, and the need for a regional and project type balance was sought in finalising the sample strategy for project selection. The key consideration was the need to provide feedback from completed projects which is relevant for the regional planning of future flood mitigation measures being carried out under FAP. This meant that polder type projects in both the North-west and South-west are identified for PIE, for example, since the river/drainage systems are different hydrological units. The RRA samples were then set to try to cover all of the project types. Some "distortions" from the population of FCD/I projects are noted in Section 2.2.

The detailed reasons for **selection of PIE projects** are given in the FAP 12 Methodology Report. Briefly these five projects were selected purposively following discussions with FPCO, the Panel of Experts, and the regional studies, and in three cases they were selected after reconnaisance visits to compare the suitability of alternative projects, and the availability of control areas. They were intended to be representative of each of the

main project types. However, some minor differences should be noted:

a) Zilkar Haor tuned out to include both a submersible embanked area and an area given full flood protection;

b) Kolabashukhali Project suffered tidal flooding, and part of the area is similar to the coastal embankment projects in protecting against saline water intrusion; and

c) Kurigram South Unit is in design a polder with drainage facilities. In practice it is primarily an embankment system along three main rivers rather than a polder around a lowlying central area.

For the **RRA projects** a short-list for each of the categories of project (by region and type) was drawn up. Between one and seven projects were identified as candidates for RRAs in each category. From these a random selection (using random number tables and projects ordered alphabetically) was made. Additionally a second (random) choice for each of the RRAs was also made. In three cases second choices had to be adopted:

i) In the south-west, Sonamuki-Bonmander Beel drainage scheme was selected in preference to Singia Nebugati, since the latter is adjacent to the PIE project (Kolabashukhali) and protects against identical flood characteristics;

ii) In the north-west, Nagor River Project was selected when it was found that Chiknai-Gechua Project had been subsumed within the Pabna project, and that any flood protection provided in the last few years would be due to the latter project;

iii) In the north-centre, Balushail embankment was found not to have been completed when PIE questionnaire pre-testing took place there. The first alternative, Lakhya-Old Brahmaputra Scheme, was then found from the responsible BWDB officer to have planned excavation of the channel, but since it is now cultivated the project was thought unlikely to be implementable. The last option from the original replacement list, Selimpur-Karatia bridges-cum-regulators had to be taken up, but does cover part of the Tangail pilot compartment (FAP 20).

For the RRAs along the Brahmaputra Right Embankment (BRE) a different selection procedure was neccessary. The two reaches were selected purposively through discussion with FAP 1 (and checked with FAP 2). They were selected to represent the most typical morphological and drainage conditions found along the BRE: one has not until 1991 suffered much recent erosion, the other has been affected by continuing persistent erosion since 1986.

2.2 THE PROJECTS SELECTED

In Table 2.1 key features of the selected projects are presented. The locations of the 17 projects are shown in Figure S1 Tables 2.2 and 2.3 summarise this data by project type and project location, and compare the sample with the overall distributions of FCD/I completed projects.

It will be noted from Table 2.2 that the distribution of projects by project type is not quite as planned. This arose because two projects turned out to differ from original expectations when they were investigated. Kurigram (South), selected as an example of an

Not consistent with statement in (c) on previous page

Embankment along a main river, was found to be fully empoldered, and therefore has been reclassified as a FCD project. The Silimpur-Karatia Project was selected as a FCD project in the North-centre region, but was found to have an intended irrigation component and has therefore been reclassified as a FCDI project.

It will be clear from these tables that in general the sample is reasonably representative. The representativeness by project type would have been greater if the two reclassifications noted had not been necessary. The only important ways in which the sample is unrepresentative are the flash-flood protection embankments (over-represented) and the Coastal Zone Polders (under represented). Both these "distortions" were agreed with FPCO. The representation by FAP Region is fairly well balanced (Table 2.3), except that the North-central and North-east are somewhat over-represented and the Southern regions somewhat under-represented.

Table 2.1 Key Features of PIE and RRA Projects

No.	Project Name	Project Type	Region	District	Gross Area[1] (ha)	Completion Year	Funding Agency	Level of Study
1.	Chalan Beel Polder D	FCD	NW	Rajshahi/ Naogaon	53055	1988/89	IDA	PIE
2.	Kurigram (South)	FCD	NW	Kurigram/ Lalmonirhat	63765	1983/84	GOB	PIE
3.	Meghna-Dhonagoda Irrigation	FCDI	SE	Chandpur	17584	1987	ADB	PIE
4.	Zilkar Haor	Submersible Embankment	NE	Sylhet	5263	1986/87	NTAP	PIE
5.	Kolabashukhali	FCD (+Saline exclusion)	SW	Khulna	25466	1983	IDA	PIE
6.	Protappur Irrigation	FCDI	NW	Bogra	5200	1977/78	GOB	RRA
7.	Nagor River	FCD	NW	Natore, Bogra	15400	1986	EIP	RRA
8.	Sonamukhi-Bonmander Beel Drainage	D	SW	Jessore	9000	1978	GOB(?)	RRA
9.	Sakunia Beel	FCD	SC	Faridpur	5700	1985	GOB	RRA
10.	Silimpur-Karatia Regulator and Bridges	FCD (I?)	NC	Tangail	2833	1983	IDA	RRA
11.	Katakhali Khal	FCD	NC	Jamalpur	>2660	1982/83	EIP	RRA
12.	Halir Haor	Submersible Embankment	NE	Sunamganj	>8000	1983	IDA/WFP	RRA
13.	Kahua Muhuri Embankment	Flash Flood Protection	SE	Feni	2638	NA	NA	RRA
14.	Konapara Embankment	Flash Flood Protection	NE	Mymensingh	3480(?)	1983/84	EIP	RRA
15.	Polder 17/2	FCD (+Saline exclusion)	SW	Khulna	3723	1983/84	GOB/EIP	RRA
16.	BRE - Kamarjani Reach	FCD (Main River Embankment)	NW	Sirajganj	10100	1970	IDA	RRA
17.	BRE - Kazipur Reach	FCD (Main River Embankment)	NW	Sirajganj	10500	1970	IDA	RRA

Note: 1 Sometimes best estimate only, NA = not available.
Source: Appendix A

Table 2.2 Selected projects by project type

Project Type	Proposed Sample			Actual Sample				Total flood protected area in Bangladesh	
	PIE	RRA only	Total	PIE	RRA	Total	%	Ha (estimated)	Percent
1. FCDI	1	1	2	1	2	3	18	236442	10
2. Embankment along main river	1	2	3	0	2	2	12	478254	20
3. FCD non-main river:									
a. North-west region	1	1	2	2	1	3	18	294242	12
b. South-west region	1	1	2	1	1	2	12	134603	6
c. South-centre and South-east	0	1	1	0	1	1	6	238755	10
d. North-centre (small)	0	2	2	0	1	1	6	128505	5
4. Submersibie embankments	1	1	2	1	1	2	12	152107	6
5. Flash flood rivers (canalised by embankments)	0	2	2	0	2	2	12	33434	1
6. Coastal Zone:									
a. Semi-saline polders (Khulna area)	0	1	1	0	1	1	6	417259	17
b. Other CEP Polders	0	0	0	0	0	0	0	282999	12
Total	5	12	17	5	12	17	100	2396600	100

Source : Consultants

Table 2.3 Selected Projects by FAP Region

FAP Region	Proposed and Selected Projects				Total Flood Protected Area in Bangladesh	
	PIE	RRA only	Total	%	Ha (estimated)	Percent
North-west	2	4	6	35	878809	37
North-central	0	2	2	12	36924	2
South-west	1	2	3	18	582046	24
South-central	0	1	1	6	325817	14
South-east	1	1	2	12	354728	15
North-east	1	2	3	18	218276	9
All	5	12	17	100	2396600	100

Source : Consultants

3. PROJECT OBJECTIVES, DESIGN, IMPLEMENTATION AND IMPACT

3.1 FACTORS LIMITING IMPACT EVALUATION

Five factors have been identified which limit the effectiveness of efforts at the evaluation of completed FCD/I projects. Some are specific to RRA, but others will equally limit the effectiveness of evaluations using more sophisticated PIE methods.

The diversity of FCD/I projects is such that almost any attempt at generalisation is likely to be misleading. In presenting an overview of the 17 RRAs it is therefore inevitable that many statements have to be qualified, as there are almost invariably exceptions amongst the 17 projects to any broad trends or features identified.

Many FCD/I projects are remarkably complex, in terms of their hydrological features (differing impacts on flooding in different parts of the project area for example), their subsequent agricultural impacts and the range of positive and negative impacts that they may have had both inside and outside the intended flood protected area. On larger projects it is sometimes difficult to fully quantify the extent of this complexity within the scope of an RRA, and even on smaller project areas it is sometimes extremely difficult to balance the diverse range of impacts (some of them inherently unquantifiable) in order to reach an overall positive or negative evaluation.

In many of the project areas there has been substantial agricultural and economic development since the project was completed. In some cases it is clear that this was or was not due to project interventions, but in some cases the project's impact in a particular area of activity is unclear or debatable. It is often difficult in particular to distinguish the impacts of rural roads and flood control infrastructure on economic development. During the PIE studies the examination of control areas outside the projects may improve the reliability of "with and without project" assessments, but for some of the RRAs an area of doubt will remain.

Quantification of project impacts during RRA was, as anticipated, difficult. Secondary data was used wherever possible, but its reliability was sometimes in doubt and in general the administrative areas on the basis of which statistics are compiled (Upazilas, Unions) do not coincide with project boundaries, and therefore have to be treated with caution as a guide to change within the project area.

Assessment of project impact must start from an understanding of project objectives. These were often inadequately defined, making it impossible to compare actual and planned impacts. Project objectives in engineering terms were generally clear in what was to be built and what was broadly intended to be achieved in FCD/I terms. However the precise parameters (reduced flooding frequency, depth, locations, timing) were rarely quantified. Agricultural objectives were often vague and unquantified, but were sometimes clear, particularly for the major projects. In most other areas (livestock, fisheries, nutrition, social, environmental) possible positive or negative impacts were rarely identified and virtually never quantified. This has proved to be a particularly serious omission in the fisheries sector, where the impacts of FCD/I projects have often been substantial. In some cases original project feasibility studies could not be located, and objectives have had to be inferred.

3.2 ENGINEERING

3.2.1 Project Objectives

FCD/I projects are highly diverse, and this is clear from an initial analysis of their basic objectives. The summary in Table 3.1 shows clearly that projects cannot be categorised easily. Their intended hydrological impacts vary in location (inside and outside the protected area), in the form in which they affect flooding within the protected area (depth, timing, location, extent, frequency) and in their achievement. In all the projects reviewed the major benefit of changed flooding, drainage and, where relevant, irrigation parameters, was expected to be agricultural. However the exact nature of the benefit expected varied according to the kind of hydrological changes that were anticipated. As Table 3.1 shows, while certain objectives were common to many projects very few of the seventeen projects visited were exactly alike even in their original intended impacts on cropping.

3.2.2 Planning

Planning was generally carried out by consultants or BWDB with little or no collaboration with other Departments. Roads and Highways (R&H) and the Department of Fisheries (DOF) in particular should often have been involved.

In virtually all cases there were no discussions with the intended beneficiaries at the planning stage, and this has resulted in a range of problems. In the few cases in which there was consultation at the planning stage projects were generally better conceived and their implementation and subsequent operation and maintenance was facilitated.

The planning of most of the projects studied appears to have been undertaken without extensive hydrological and other field surveys. The lack of proper comprehensive hydrological surveys and of regional and project level modelling studies has resulted in frequent public cuts, overtopping of embankments, back flow in rivers and channels, severe erosion or siltation and drainage congestion.

A comprehensive hydrological study for the Chalan Beel and Nagor Basin areas in particular could have contributed to far more effective planning of these projects. EIP studies of the Nagor Basin predict a rise of about 3 m in river water levels in the region after confinement of the rivers by embankments. The frequency of public cuts of the project embankments in this region is gradually strengthening the view that submersible embankments instead of full flood protection embankments may be the best planning option for some of the projects.

Embankment alignments sometimes do not appear to have been properly planned to avoid frequent construction of retired embankments. The set-back distance is a very important factor for the long life of the embankment, but in some of the projects it was found to be almost zero along major portions of the embankment (Nagor River Project, Meghna-Dhonagoda, Chalan Beel Polder D). At the Meghna-Dhonagoda site it was necessary to construct retired embankments before the completion of the project, but that may have been due to the very high 1987 and 1988 floods.

The multiple uses and impacts of embankments have very rarely been taken into consideration at the planning stage. In Bangladesh, boat transport is the cheapest and most important transport mode in many areas but in all the projects except one this aspect was

TABLE 3.1: INTENDED AND ACHIEVED HYDROLOGICAL IMPACTS

PRO-JECT NO.	PROJECT NAME	KEY HYDROLOGICAL CHANGES									KEY IMPACTS OF HYDROLOGICAL CHANGES								
		SURFACE WATER								Ground Water	Protection of Boro crops from Pre-monsoon Flash flood/ Tidal Submersion	Protection of Early Aus/Aman crops from Flash Floods/ Tidal Submersion	Protec-tion of Aman from Monsoon floods	Im-proved Drai-nage	Saline Exclu-sion	Irrig of Late Aman crop	Irrig of Boro crop[1]	Irrig. of Aus/ Early Aman crop	Breaches/ Public cuts
		INSIDE PROJECT (Flood Characteristics)				OUT-SIDE PROJECT (River Course)													
		Delayed onset of Floods	Reduced normal flood depth	Prevented peak floods	Drainage congestion	Silta-tion	Back-flow	Bank erosion	Water Level	Changes (GWT)									
1.	Chalan Beel Polder - D	Yes	Yes	Yes	I‡‡	Yes	No	No	I‡‡	D‡	(NA)	(NA)	Te (A)	Te (N)	NA	0	Ti (AA)	NA	P‡‡‡
2.	Kurigram South	Yes	Yes	No	I‡‡	Yes	No	Yes	?	?	0	0	Te (A)	Te (N)	NA	Te (N)	NA	NA	B‡ P‡‡
3.	Meghna Dhonagoda IP	Yes	Yes	(Partly) Yes	Eliminated Fully	No	No	Yes‡‡‡	?	?	-	-	Te (AA)	Te (AA)	NA	Te (A)	Te (A)	Ti (A)	B‡‡‡
4.	Zilkar Haor	Yes	Yes/No+	Yes/No+	D‡	Yes	No	No	I‡	0	Te (AA)	Te (AA)	Te (A)	Te (A)	NA	NA	Ti (AA)	NA	-
5.	Kolabashu-khali	TIDAL	Yes	Yes	D‡	Yes	TIDAL	Yes	I‡	?	Te (AA)	Te (AA)	TIDAL	Te (A)	Te (AA)	NA	Ti (A)	NA	-
6.	Protappur I.P.	Yes	Yes	Yes	0	Yes	No	Yes‡	I‡	D‡	Te (AA)	Te (AA)	Te (AA)	0	NA	Ti (?)	Ti (AA)	Te (A)	-
7.	Nagor R. Project	Yes	No	No	I‡	Yes	Yes‡‡‡	Yes‡‡‡	I‡‡	?	Te (AA)	NA	Te (A)	Te (N)	NA	NA	Ti (AA)	NA	P‡‡‡
8.	Sonamukhi-Bonmander Beel Dr. Project	No	Yes	Yes	D‡	Yes‡‡‡	Yes‡‡	No	I‡‡	?	0	(NA)	Ti (A)	Te (A)	NA	NA	Ti (AA)	NA	-
9.	Impv. Sakunia Beel	Yes	Yes	Yes	D‡	No	Yes	Yes	I‡	?	-	-	Te (A)	Te (A)	NA	-	Ti (A)	-	B‡‡
10.	Silimpur-Karatia Bridge-cum-Regulator	0	0	No	I‡	Yes	No	Yes	I‡‡	?	Te (A)	Te (A)	Te (N)	Te (N)	NA	NA	Ti (AA)	NA	B‡
11.	Katakhali Khal	Yes	Yes‡‡	No	I‡	Yes	No	Yes	I‡	?	Te (A)	Te (A)	Te (A)	Te (N)	NA	NA	Ti (AA)	NA	P‡‡ B‡‡
12.	Halir Haor	Yes	No	No	D‡	Yes	Yes	No	I‡	0	Te (AA)	0	0	Te (A)	NA	-	Ti (A)	-	B‡
13.	Kahua-Muhuri Embankment	No	No	No	I‡	Yes‡‡‡	No	Yes‡‡‡	I‡	?	? (A)	NA	-	? (N)	NA	-	Ti (AA)	-	B‡‡‡ P‡‡‡
14.	Konapara Embankment	Yes	Yes‡‡	No	I‡	Yes	Yes	Yes	I‡‡	?	Te (AA)	(AA)	(N)	Te (N)	NA	NA	Ti (AA)	NA	B‡ P‡‡
15.	Polder 17/2	TIDAL	Yes	Yes	I‡	Yes‡	TIDAL	No	I‡	0	0	Ti (A)	TIDAL	Te (A)	Te (A)	NA	NA	NA	P‡‡
16.	BRE-Kamarjani	Yes	Yes	Yes	I‡‡‡	Yes‡‡‡	No	Yes‡‡‡	?	?	Te (AA)	Te (AA)	Te (AA)	?	NA	NA	Ti (A)	NA	P‡‡‡ B‡‡
17.	BRE-Kazipur	Yes	Yes	No	0	Yes‡‡‡	Yes	Yes‡‡‡	?	?	Te (A)	Te (A)	Te (A)	?	NA	NA	Ti (A)	NA	B‡‡‡

Te = Target (explicit) AA = Broadly achieved A = Achieved to a Limited extent N = Not achieved at all
NA = Not applicable Ti = Target (implied) O = No change ? = Not clear
* = Moderate ** = Medium *** = Severe I = Increase/Rise
D = Decrease/Fall B = Breach P = Public cut + = Zilkar Haor part only
- = Nil

Note 1 = Where this was achieved the extent to which it was due to the FCD/I project is often debatable (see section 3.4)

Source: RRA Reports

ignored. The Meghna-Dhonagoda feasibility studies recommended the provision of navigation locks, but this was ignored in the detailed design.

The most common secondary use of embankments is as roads (almost invariable), and they often make a significant contribution to economic development as a result. However this role is again generally ignored at the design stage (the BRE is a notable exception) although it has significant implications both for design criteria and for subsequent operation and maintenance. Other uses of embankments include permanent housing (the BRE is often described as a linear housing estate), temporary refuge in times of flood, social forestry and even sweet potato seedbeds. Not all of these may always be appropriate, but a more realistic view of embankments' multiple functions should be taken at the planning stage. This would avert, for example, the situation in which structures are designed for water control but used partly (or even solely) as bridges.

A similar view needs to be taken in planning the location and specifications for borrow-pits, as these often can be subsequently used as fish-ponds. Fish ponds should often have been included in the original project concept to avoid subsequent problems in land acquisition.

The drainage congestion at Sonamukhi-Bonmander Beel drainage project could not be successfully overcome as the huge inflow of flood water from Indian territory (West Bengal) into the project area via several rivers and low reaches was overlooked during the planning stages. Nothing was mentioned in the Project proforma (PP) in this respect. To avoid similar failures the activities of the neighbouring country need to be considered when planning projects close to the border.

It was noted that when projects took a long time in implementation there appeared to be no process for the review of plans to reflect possible changes in the hydrological or agricultural environment. Given the speed at which rivers can change course in Bangladesh, and the very rapid changes in agriculture in the 1980s, this has resulted in at least one case in continued implementation of a project on the basis of an original concept that had become irrelevant.

3.2.3 Design

The design of the embankments and structures on most of the projects were generally found to be sound, given the purposes that the planners had identified for these structures.

However where designers had insufficient hydrological and subsoil data designs were inevitably sometimes inappropriate, and the projects are now facing problems with defective structures and embankment. As an example the Uddamdi Pumping Station at the Meghna-Dhonagoda Irrigation Project (MDIP) settled and cracked and two regulators at Kolabashukhali settled due to lack of subsoil data.

MDIP is also an exception to the general finding that embankments were well designed. The original proposal for the MDIP embankment was altered at the time of detailed design and the revised embankment section failed at several places due to insufficient earth section and piping below the embankment. The compaction of the embankment is a vital factor which the designer must specify for the long life of the embankment. Mechanical compaction should be specified for large embankment sections.

Many of the design problems observed relate to drainage. Almost all the FCD projects studied are experiencing moderate to severe drainage congestion (see Table 3.1) due to faulty hydrological assessment for structures and the absence of an adequate drainage network. The latter may be a planning or a design weakness, but the former relates to design in particular. For example at the Sonamukhi-Bonmander project the design capacities of the 6 vent Regulator at Shunkarpur and of the 3 vent regulator at Rudrapur on the Betna River and the Daudkhali khal respectively were wholly inadequate for the huge volume of water to be discharged. As a result they are causing back flow for a long distance upstream.

In some projects a few structures (mainly flushing/drainage sluices) were located in inappropriate places and have subsequently been abandoned. In general much could be gained by local consultation at the design stage, in order to make maximum use of local knowledge about existing drainage features.

At least eight of the seventeen projects experience frequent public cuts, and these are often so serious in their subsequent impact that they compromise the scheme's viability. In some cases they result either from the non-existence of drainage sluices or from inadequate discharge capacity of the sluices provided. However in other cases, as noted above, the original planning concept may have been at fault.

Regulator gates are leaking everywhere, as the rubber seals are either defective or absent. The wooden fall boards commonly used are an O&M menace to any FCD/I project. In submersible embankment projects these are very hard to operate and in all projects they are frequently stolen, damaged or washed away. In future projects their use should be avoided, except for the maintenance of regulators.

In some cases vertical lift gates are a more acceptable solution, even if more expensive. In Protappur Irrigation Project most of the regulators could have been easily replaced by simple masonry weirs, and this would have reduced the cost of the project and subsequent operational hazards.

In some drainage cum flushing regulators 2 flap gates are used instead of a single vertical lift gate, causing more operation hazards.

3.2.4 Implementation

BWDB, the only implementing agency of the projects studied, is also responsible for the operation and maintenance (O&M) of the projects after completion. Most of the projects took longer to implement than the period specified and some were left incomplete for a long period. The construction of a small component, such as one or two regulators or closures, was sometimes left until much later, disbenefiting all or part of the project area, even after more than 80% of the project cost had been disbursed. The reasons for such delays varied, and the long periods required to resolve problems encountered often reflected poor original planning or design.

Delay or lingering construction periods invariably increased the total project cost. Cost overruns in Taka took place frequently, but in many cases this reflected internal inflation, and project costs in US Dollars were often little changed.

Lack of proper compaction of embankments caused lots of problems in some projects. This was particularly the case where embankments were constructed under the FFW

programme, were retired embankments or were parts of new projects that had been hastily constructed in a short period just before the onset of flood. In these cases there was generally inferior quality control.

Mechanical works such as regulator gate sealings are defective and leaking in most cases.

The drainage canals on almost all the projects studied were either not excavated or were only partially excavated during the implementation period, although they were included in the plans and design. Absence of an effective drainage net-work is one of the major constraints on the drainage of scattered low pockets/depressions of the project areas.

Inconsistencies were noticed between the project planning, design and implementation of some of the projects, which subsequently have reduced the efficiency of the projects. This applies particularly to the failure during implementation to follow design specifications for embankment compaction and drainage channel excavation.

Record keeping of the project works was found to be very poor at all levels and most of the project documents, including departmental feasibility reports, Project Proforma (PP), As-built drawings and Project Completion Reports were not available in the project offices.

It was noted that there were often problems in operating projects. It is suggested that the "implementation" phase (often financed with outside assistance) ought to include two or three years of initial operation, to demonstrate that the projects can operate as planned and designed, and to train concerned staff in O&M procedures. In Pakistan this is facilitated by an organisational split between the planning and implementing agency (WAPDA) and the operating organisations. These (the Provincial Irrigation Departments) can refuse to take over a project if WAPDA cannot demonstrate that the project can operate as planned.

3.2.5 Impact

Table 3.1 summarises, inter alia, the RRA evaluations of the actual impacts of the engineering works on hydrological parameters. This has to be the starting point for any subsequent evaluation of other impacts of FCD/I projects. It is noteworthy that almost all the projects succeeded in delaying the onset of floods - an aspect of particular importance if the tail-end of the Boro crop is to be protected. Most of the projects succeeded in reducing normal flood depths but many of the projects failed to give protection from peak floods, although in most cases the peak floods referred to were within the intended design capacity.

The table also notes some of the negative hydrological impacts associated with the projects. Breaches and public cuts leading to sudden inundation were experienced on 13 of the 17 projects, and in eleven of these the results were ranked as either moderately or very severe. Drainage congestion is judged to have increased on nine of the seventeen projects. In many cases negative off-site impacts are noted, related to increased sedimentation, bank erosion, raised river levels or induced backflow, caused by restrictions on previous drainage routes.

3.3 OPERATION AND MAINTENANCE (O&M)

3.3.1 O&M Performance

The operating status and problems of the projects are summarised in Table 3.2. **Operation** relates largely to operation of water control structures, although cuts in embankments are also made for operational purposes by insiders - in most FCD projects operation is synonymous with drainage. Virtually all projects had some operating problem, often ultimately because drainage facilities were inadequate or could never be sufficient when embankments keep out high river stages and heavy rainfall occurs over the internal catchment of the project.

Often there were also a lack of clear responsibilities for operation, and conflicts between different interest groups. This meant that operation often adversely impacted at least one interest. FCD/I projects in general mean that some people gain and others lose. Since project planning never allowed for compensatory measures, other than where land was acquired, this led to conflicts over operation.

Maintenance of course concerns both earthworks (embankments, khals and canals) and structures. Table 3.3 concentrates on embankments since these are the critical component of FCD projects - if these fail the project fails. Operating problems summarised in Table 3.2 may ultimately be due to maintenance problems, but this is rarely the entire constraint.

Table 3.3 shows widespread multiple use of project infrastructure, particularly as roads, and generally poor embankment maintenance. Breaches were either associated with overtopping due to greater than design standard events or with poor construction, and occurred in 12 out of 17 projects. Erosion has been notable in four of the projects, and affects ten to some extent. Cuts were only made by outsiders in three projects - but these indicate planning problems due to negative off-site impacts or problems in adjacent projects. More common were cuts made by the inhabitants of projects (in seven projects) to facilitate drainage in most cases, and in a few to introduce water for irrigation or shrimp farming. These are operating problems, but again are often due to inadequate drainage capacity or high river levels rather than to simple operating difficulties.

Overall the main constraints on benefit achievement and on O&M were O&M itself (insufficient resources, and institutional and operating difficulties), and inadequate planning and design (for example not allowing for differential impacts on different groups of people, ignoring off-site impacts on flood stages, underestimating drainage needs, and not planning for erosion). Poor construction was relatively rare as a cause of operating and maintenance problems, although retired embankments and hastily constructed closures of breaches are a problem when those protected expect full protection at the previous standard.

3.3.2 Planning, design and implementation

a) There is a general lack of public consultation in planning, design and implementation. Detailed decisions are dominated by engineering and not local opinions, needs, and plans. The beneficiaries may only learn of a project when construction starts.

b) Construction overruns in time and cost are often associated with sub-standard construction. This can lead to an incomplete project or defective components, which then cannot be operated or maintained effectively.

Table 3.2 Summary of structures and operating status of projects

Project	structures	committees	function-ing?	actually operated by?	drainage problems	conflict farmers v fishermen	conflict high v low	private surface water management initiatives
Chalan Beel Polder D	yes	no	no	BWDB	yes ++	yes +	yes +	irrigation inlets
Kurigram South	yes	no	na	BWDB	yes +++	yes +	yes ++	no
Meghna-Dhonagoda IP	yes	yes	some	BWDB	no	yes ++	no	yes LLPs from gravity canals
Zilkar Haor	yes	some	one	BWDB	yes +	yes +	no	no
Kolabashukhali	yes	yes	no	BWDB	yes ++	yes +	yes +	1 khal privately opened& closed for irrigation and drainage.
Protappur IP	yes	yes	no longer	no-one khalashis missing	no	no	no	LLPs as gravity irrig-ation not possible from river.
Nagor River	yes	some	no	no-one - only 1 khalashi	yes ++	yes +++	no	no
Sonamukhi-Bonmander	yes	no	no	anyone influential	yes ++	yes ++	no	private and local government embankment built, also impact of projects in India.
Sakunia Beel	yes	yes	slightly	committee	yes ++	no	no	LLPs over embankment.
Silimpur-Karatia	yes	no	no	not operated	no	no	yes +	no
Katakhali Khal Project	yes	yes	partly	at direction influential people	yes ++	yes +	yes ++	cuts and inlets for irrigation

Table 3.2 cont. Summary of structures and operating status of projects

Project	structures	committees	function-ing?	operate by?	drainage problems	conflict farmers v fishermen	conflict high v low	private surface water management initiatives
Halir Haor	yes	yes	yes but	influential people manage	some	some	no	regular cuts and repairs for drainage needed.
Konapara Embankment	no[1]	na	na	na	some	no	inside v outside	[1]effectively many privately controlled BWDB drainage outlets
Kahua Muhuri	yes[2]	informal	yes	local people	yes +	no	no	[2]later additions irrigation cuts.
Polder 17/2	yes	yes	yes[3]	BWDB	no	yes +++	yes +	[3]shrimp farmers have installed many private structures and control sluice operation
BRE Kamarjani Reach	yes	no	na	BWDB	yes ++	no	yes +	no
BRE Kazipur Reach	no[4]	na	na	na	no	no	no	[4]washed away, retired embankment breaches annually so open drainage.

Note: where drainage problems and conflicts occur these have been ranked: + moderate, ++ important, +++ severe

Source: FAP 12/13 RRAs

Table 3.3 Use and condition of embankment, and overall assessment of constraints or problems for O&M

Project	Embankment used for			% in poor condition	breaches	erosion	cuts by		Key problem		
	road	trees	houses				insiders	outsiders	plan design	constr uction	O&M
Chalan Beel Polder D	yes	yes	no	50%	no	no	yes	yes	**	0	**
Kurigram South	yes	yes	yes	+50%	frequent	yes	yes	no	**	***	**
Meghna-Dhonagoda IP	yes	no	few	20%	yes	yes	no	no	***	***	**
Zilkar Haor	yes	no	no	70%	no	no	no	no	0	0	**
Kolabashukhali	yes	yes	no	50%	no	yes	no	no	*	0	*
Protappur IP	yes	yes	yes	most	no	yes	no	no	*	0	**
Nagor River	yes	some	no	85%	yes	yes	few	yes	***	*	***
Sonamukhi-Bonmander	na - drainage project with short private embankment						no	yes	***	0	**
Sakunia Beel	yes	yes	no	70%	yes	yes	no	no	0	**	**
Silimpur-Karatia	yes	yes	no	15%	yes	yes	no	no	***	0	0
Katakhali Khal	yes	no	no	50%	yes	no	yes	no	*	0	***
Halir Haor	yes[1]	no	no	33%	yes	no	yes	no	0	0	**
Kahua Muhuri Embankment	yes	yes	yes	80%	yes	yes	yes	no	0	0	**
Konapara Embankment	yes	yes	no	60%	yes	yes	no	yes	**	0	***
Polder 17/2	yes	no	no	5%	no	no	yes[2]	no	***	***	0
BRE - Kamarjani Reach	yes	yes	yes	70%	yes	much	yes	no	**[3]	**[3]	**
BRE - Kazipur Reach	yes	yes	yes	50%	yes	much	no	no	0	**[3]	***

Notes: * = moderate problem, ** = important problem, *** = severe problem
1 seasonal route for moving harvested paddy before flood
2 installation of water control structures by shrimp farmers
3 applies to retired embankment but not to original one

Source: FAP 12/13 RRAs

c) Feasibility studies always show feasible projects with high rates of return. This is usually far removed from the reality of O&M problems and constraints (and consequent benefits). Had the likely performance and constraints on O&M been considered, different projects might have resulted.

d) Sometimes the details of project design cause problems for operation. The most obvious case is the use of fall-boards in water control structures - these were often stolen or removed by groups with different operating objectives, or became easily damaged, or could not be removed when operation was needed.

3.3.3 Institutional framework

a) Local Project Committees are now frequently mentioned. There were no attempts to form representative and accountable groups for water management with any permanency or formal status in any of the projects studied. No **project level committees** or organisations had been formed in the projects studied. However, in the majority some attempt at forming **structure (sluice) committees** had been made. Unfortunately these were very rarely effective.

b) Operation of structures usually becomes dominated by local 'influential' people. Sometimes they ensure reasonably fair and efficient operation of the structure. In other cases they operate the structure to further their own interests or remove vital parts to prevent it being operated against their interest. The lack of local participation can have many causes including a lack of benefits and a lack of resources for O&M.

c) Organisation of the committees is entrusted to the bottom tiers of BWDB. Even where these staff members are well intentioned and take this task seriously they have no training as social activists and are inclined to assign responsibility to someone else, often a local influential person.

d) BWDB often has khalashis appointed to a project (9 out of 15 of the study projects which had BWDB structures), yet they are often not present, or have disappeared or been reallocated to another project. If they are present they take their directions from local influential people (via a committee if there is one), and can do little more than report events to their superior officers. They receive no guidance or proper monitoring or in-house/on the job training, and are unable to compromise or arbitrate between powerful local interest groups.

e) The O&M Divisions of BWDB, despite employing technical and field staff, are engaged in administration and not in field level activities.

f) The tasks, responsibilities and accountability of those charged with O&M (both BWDB and local committees) are not clearly defined in practice. BWDB O&M officers have theoretical programmes of work laid down which would not be appropriate to efficient system management and in any case cannot be carried out in practice. There are minimal checks on the lower ranks who are the only ones who do any hands-on O&M.

g) O&M manuals in theory must be prepared by the BWDB engineer concerned for a project during the first two years after the project is commissioned. No-one does this. Some BWDB projects have O&M manuals prepared by outside consultants, but these are usually not available to the field staff, are rarely field guides to practical O&M, are not in Bangla, and are never implemented.

h) There is no training programme for O&M staff, nor for the O&M committees if formed.

3.3.4 Funding

Lack of funds for O&M is the most frequently cited constraint on O&M. Although this is undoubtedly a serious problem, simply giving more resources to the same institutional set up and for projects showing the same planning problems as those studied, would not solve the problem. Nor would more external resources for O&M alone result in sustainable infrastructure and rural development.

a) There is a lack of funds for routine maintenance. There is also a large staff in O&M in BWDB who get their salaries irrespective of whether or not they actively manage or maintain what presumably are **their** projects (at present). There are no incentives or clear responsibilities for keeping projects running, let alone for improving their performance.

b) BWDB is not, with the exception of irrigation related charges, able to raise revenue directly. No local revenue at present goes into O&M. It seems more appropriate for the Upazilas and Union Parishads, which are to some extent locally accountable through their elected representatives, to be active in local resource mobilisation. However, as BWDB is responsible for O&M this does not mean it should not explore every possibility at the local level for raising some revenue to improve project performance. For example, having embankments adopted as village roads to facilitate their routine maintenance, helping beneficiaries organise to guard a structure (saving khalashi costs) or buying materials for simple maintenance, or generating revenue from project infrastructure. At present there are no incentives for more efficient O&M. Yet a shortage of resources to achieve what ought to be the objectives of BWDB O&M divisions calls for initiative not complacency.

c) BWDB does not plan from the outset for the revenue budget it can anticipate. For example, khalashi 'sheds' are built even if the funds to employ a khalashi are uncertain. Even worse the khalashi is employed on a permanent basis with no clearly defined redundancy procedure. While he can be paid during construction from the project development budget, once this ends the post depends on the revenue budget and on cross subsidising from other ongoing projects.

d) Resources such as are available after establishment costs, tend to go to running costs of major facilities, such as large pumping stations. These already had high construction costs and fail to recover these costs. Most of BWDB's customers are supposed to benefit from small structures and earthworks.

e) In some cases the BWDB project served to reduce local community initiatives in water management (using small bunds for example). Local resources are no-longer raised even if the public project is technically and economically more efficient.

3.3.5 Lessons for future O&M

a) BWDB takes a **technical approach** to FCD/I projects aimed at achieving physical (implementation) targets. Not infrequently it effectively abandons responsibility for the projects upon completion. Yet long run sustainability depends on the beneficiaries being involved, and hence on the human aspects of management.

b) Where a project concept came from a **local demand**, or was built on local works, the project appears to have been appropriate and there has been more interest from beneficiaries in seeing that it works. Other projects have been imposed with no local consultation. In such cases, and particularly where they do not give clear benefits, there is no local interest in O&M.

c) A major part of the "O&M" problem stems from **project planning**. There is a lack of consultation and coordinated planning between consultants, government departments and agencies in the areas affected by a proposed project. There is also a need for local consultation and direct participation in the planning process to avoid inappropriate investments and to highlight potential conflicts which a proposed project will give rise to. In this way plans to minimise, mitigate, or compensate for losses could be made.

d) This **consultation** and wider planning/modelling is particularly important because one FCD/I project can have adverse impacts on flood conditions both on unprotected areas and on existing FCD/I projects, resulting in problems of rising river levels, public cuts in offending projects, and eventual violence. To this end BWDB in several cases has failed to model the off-site implications of its proposed projects. Internal liaison between completed projects and new ones is also minimal, largely because completed projects do not have a serious presence in planning.

e) Operation and maintenance problems often arise from poor design, implementation and construction. There is a lack of **liability**, on the part of designers and constructors, (BWDB, consultants, contractors, donors) for the shortcomings of projects, even when people are harmed by a project or it cannot function as intended.

f) The general problems behind **khalashis** providing a worthwhile service have been noted already. At the same time movable parts of structures are liable to go missing without someone guarding them. This could be avoided through devolving ownership rights to user groups or even to private individuals. Khalashis could then be reallocated to projects under construction, or to other work paid for directly by the beneficiaries.

g) Except in a single structure project, sluice committees are not an answer to project management (although they can be an important part of the set up). There is a lack of **coordinated operation** in more complex projects where actions in one sluice/area of the project can affect other areas. There is a need for a higher level of system management after a project has been built. This could involve a clear executive power with authority over the whole system and answerable to a management board representing all affected interests. There would be an advantage in having local government involved in system management to improve coordination within a project and with other government programmes, to facilitate local resource mobilisation, and to increase accountability. But direct local representation in system management would also be desirable. The emphasis would be on management, and thus on the ultimate aims of welfare improvements and beneficiary involvement for long term sustainability of the local economy, rather than just emphasis on the technicalities of raising and lowering gates and resectioning embankments.

h) **System management** has another advantage. Water resources, land uses and economic activities change over time. If the project is static it may fall into disrepair because in its current form it becomes largely irrelevant. There is a need to continually and periodically reassess project facilities, channels and hydrology, management plans, and agriculture and land uses; and to adjust the project/system

to changing needs and circumstances.

i) At the same time a lower level of **user groups** is essential to overcome local problems in water management. This is mainly needed for drainage (and irrigation if the latter uses project facilities). A drainage basin approach would be clearest - based on drainage area committees, sub-committees, or groups. Their responsibilities would cover both operation and routine maintenance of structures and maintenance of the earthworks/khals serving them. They could also plan and manage **cuts** if structures were not provided. There is a need to monitor drainage cuts to see how efficient they are, if they are cheaper than structures, how well a local group can repair the cut, their performance in floods, and the implications of repeated taking of earth for repairs.

j) Maintaining FCD projects is a problem because benefits/impacts are non-excludable - if charges are levied, an individual cannot be refused protection from floods for not paying the fee - the classic **"free rider" problem**. Even in projects with irrigation components fee recovery is very poor and it is unlikely to improve if infrastructure is provided free and the intended service is often not provided. However, much project infrastructure remains under utilised - embankments could be afforested and borrow-pits/khals cultivated for fish.

k) At present attempts to make direct productive use of embankments are very rarely carried out with the cooperation of BWDB. Yet a major benefit of embankments, for example, is as places of shelter, temporary or permanent, from floods and erosion. The best chance of directly resourcing maintenance would appear to lie in creating exclusive rights to these public goods through direct use of them. This might be arranged in various ways, through a private contract or a cooperative/group venture. If someone has invested in and has paid for rights to use a resource, they are much more likely to see that it continues to serve that purpose. The need is to ensure that the interests of the direct user coincide with those of the passive beneficiaries from FCD services.

3.4 AGRICULTURE

3.4.1 Introduction

The FCD and FCD/I projects have been justified in most cases on the grounds that they will improve the conditions for agriculture. More particularly, it has often been argued that protection from inundation in an area regularly ravaged by flood makes farmers less risk-averse and they no longer shy away from application of modern inputs such as high-yielding varieties, fertiliser and pesticides thereby increasing the yield and output of crops. Further, protection from flood is said to allow an increase in cropping intensity by encouraging the spread of irrigation during the dry season and by keeping land free from inundation during the monsoon. In addition, farmers are assured of more stable yields and output as flood water can no longer damage the crops. So much for theory. In practice many things may go wrong and they often do.

Firstly, the projects may fail to achieve their flood control objectives. Embankments may simply fail or people may cut the embankment to reduce waterlogging in one place or another, inside the embankment or from the outside, causing flood water to enter the project area and defeating the purpose of the embankment. If these breaches or cuts happen often, people may not have much confidence in these structural measures and may not respond to flood protection by changing agricultural practices or their response may be only partial.

Secondly, the expected agricultural growth may be observed but due to reasons different from those expected by the planners. Thirdly, agricultural development may take place as a result of the project, but take a different shape to that anticipated by the planners.

These factors relate to the impact of the project as a result of technical factors. In reality such factors do not totally or in some cases, mainly, determine the outcome of a project in terms of changes in agricultural output. Even if everything technically about a project is satisfactory, economic and other factors may not allow the technical features to play their roles fully. If, for example, there is no good communication network inside the project area, particularly when it is a large one, higher output may only depress prices and provide disincentives to farmers resulting in sluggish output growth. Although there has been some improvement in communications in many of the project areas, this issue could not be investigated properly during the RRA. Hence any observation regarding lack of change should not be taken as final, at least until the more in-depth observations are analysed.

3.4.2 Improvement in Agriculture

(a) Boro

The protection of the boro rice crop from early flash floods has been one of the major targets of some of the FCD projects - particularly (but not only - see Table 3.1) those of the submersible types in the north-eastern region. This has been achieved in both the submersible embankments that have been investigated. Further the removal of the risk to farmers has induced a switch in fully flood protected areas to HYVs from the cultivation of local varieties, thereby, increasing the yield per acre. Cropping intensity has also increased in some project areas as land previously under threat of inundation has remained free of water logging during the transplanting period and has been cultivated. In cases where this has not happened, water logging due to inadequate drainage facilities has prevented reclamation.

In most other cases, the protection from flood would, it was hoped, encourage investment in capital assets such as irrigation equipment, thereby ensuring cultivation of dry season crops such as boro HYV rice. Whether this has really happened could not be ascertained explicitly from the information collected during the RRAs. It has been observed, however, that the investments made in irrigation equipment had been mainly in shallow tubewells (STW). These are "foot loose" equipment by comparison with deep tubewells (DTW) which are more permanent fixtures. In fact, it has frequently been observed that shallow tubewell engines have been used during the floods as motors in country boats or for powering husking machines. STWs have been observed everywhere, including the very edges of beels, whereas DTWs have been observed only in places which usually remained flood free even before the projects. Further, it has been found that STWs are equally popular outside the project areas and are often installed in equally lowlying areas that are not flood protected. Thus, it is hardly the case that the FCD or FCD/I projects have been responsible for encouraging mechanical irrigation. On the contrary, it is possible that prevention of flood water from entering the project area may be lowering the ground water table and thereby creating problems of adequate discharge. This was however alleged at only one project, and this was in an unusually dry year.

(b) Aman

Protection from monsoon floods was another important general target of FCD and FCD/I projects. In areas where this has been more or less successfully achieved and B. Aman was a major rice crop in the pre-project situation, people have generally switched to the cultivation of T. Aman because the lower depth of inundation now favours the latter. B. aman

cultivation, however, continues in the very low lying areas. Where other agronomic factors have been favourable farmers have adopted HYV T. Aman, thereby increasing the average yield of the crop. High land areas in some projects continue to be cultivated with T. Aman as before.

Protection from post-boro floods, as distinct from monsoon floods, due to the embankments have in places also helped the switch over to T. Aman by facilitating the raising of seedlings. In some areas, such as Kahua-Muhuri, one finds extensive areas under seedbeds not just for use in the farmer's own cultivation but also for sale in the market.

Nevertheless, it must be noted that the above positive impacts are often muted by monsoon "flash floods" due to natural breaches or public cuts or to extensive water logging due to inadequate or inoperative drainage facilities. These problems have been found to be very common (see Table 3.1). The reasons are not purely technical in all cases and social issues and problems combine with the technical ones (see Section 3.7).

In some cases waterlogging or public cuts may not be unmitigated evils. For example at Kolabashukhali the area under mixed Aus and Aman cultivation has gone up because the area under water logging has increased while flood protection has lessened the damage to these crops. This is a positive project impact, although unintended. In the rest of the area under rice during the monsoon at Kolabashukhali T. Aman cultivation has been made possible due the prevention of saline water intrusion. This is further facilitated by the fact that rainwater washes away the residual soil salinity and is allowed to drain out through the regulators.

In the coastal areas a distinct form of Aman cultivation has developed. Many cuts are made (as many as six in Polder 17/2 in 1990) to allow semi-saline water into the "ghers", thereby facilitating shrimp cultivation. After the harvest of shrimp, however, the land is flushed with rain water and T. Aman is planted. The shrimp cultivation allows direct transplanting of paddy as the soil remains very soft and in a puddled condition. Further, the use of various shrimp foods, particularly urea, makes it possible to keep the level of application of other inputs to the Aman at a very low level. The cost of production as a result is kept at a minimum. Thus, while the public cuts to allow saline water reduce yield of T. Aman, the lowering of production cost may not have had a substantial negative impact on the net return to T. Aman cultivation. In this particular case the present shrimp-Aman cropping pattern has to be seen as a reaction to the FCD project as it is remote from the project's original intentions.

(c) Aus

Very little evidence of Aus cultivation has been found during the RRAs. Whether, there has been any impact of the projects on Aus cultivation could not be determined.

(d) Vegetables and Spices

The area under vegetables and spices has increased very substantially in some project areas. Generally speaking two types of factors have been responsible. Vegetables are grown on medium to high land which should be flood free and have good drainage. Flood protection has improved both these conditions on such land. However, the spread of mechanised irrigation, independent of FCD/I interventions, has also helped cultivation of winter vegetables.

(e) Pulses and Oilseeds

The area under pulses and oilseeds has generally decreased in the projects studied. It should be mentioned, however, that this is more a reflection of the spread of Boro cultivation than of any direct impact of the projects, per se, and as has been noted, Boro cultivation itself has often been only mildly influenced by the projects.

(f) Sugarcane, Potato, Sweet Potato and Groundnut

The cultivation of these crops have been in most cases facilitated quite ironically, not by the successful operation of the projects, but because of their failures. Breaches and public cuts have deposited sand and sandy silts in and around eroded parts of embankments, thereby raising the level of land and creating agronomically more favourable conditions for their cultivation. As a result, one finds in some cases (such as BRE-Kamarjani, BRE-Kazipur and Kahua-Muhuri) areas where sugarcane is being cultivated where there had been none before. The same applies to other crops such as potato, sweet potato and ground nut. In one instance an embankment has been used, in one of its most stable parts, as a seedbed for sweet potato.

(g) Fruit Trees

The introduction of fruit trees such as mango, banana and papaya which are susceptible to inundation, has been observed in some of the project areas. This is a good indicator of successful flood protection.

(h) Timber Trees

Introduction of valuable timber trees in some of the project areas is also an indicator of the degree of flood protection provided by the project. None of the projects had anticipated this benefit.

(i) Cropping Patterns and Varietal Change

Cropping patterns have not changed to a great extent. The major impacts of FCD/I projects appear to have been to strengthen the dominance of rice in cropping patterns, rather than promote the crop diversification some projects anticipated, and to induce changes within the rice cropping patterns - particularly from B. Aman to T. Aman but also from local to HYV varieties and from broadcast to transplanted varieties. The extent and nature of these changes has varied enormously from project to project. This is illustrated in Table 3.4.

(j) Cropping Intensity

Cropping intensity has increased in most of the successfully implemented projects. However this has come about in a large measure due to the cultivation of Boro HYV rice in hitherto fallow land following the introduction of mechanised irrigation facilities which, as has been discussed earlier, may not be a project impact.

(k) Yield

Increases in average yields following flood protection may theoretically arise from three factors - a switch to HYVs, increased use of crop production inputs given lower perceived risk of crop failure, or reduced annual or periodical losses due to flooding. In practice only the first and the last of these were identified as significant during the RRAs. Where information was

collected on input use pre and post project on the same crop variety little change was identified. The stagnation or even decline in apparent yields where the same variety is grown pre and post project is disturbing and may arise from reduced availability of organic manure or from reduced silt deposition due to flood protection.

Table 3.4 : Overview of Agricultural Impact

Projects	BORO			AMAN				Change in cropping intensity	Change in cropping pattern
	Increase in crop area	Increase in HYV area	Decrease in flood loss	Increase in area	Increase in HYV	Decrease in flood loss	Change from B. Aman to T. Aman		
Chalan Beel Polder D	NT	NTBA	NA	TAA	NTBA	TA	TA	TAA	Yes
Kurigram South	O	O	O	TA	TA	TA	TA	TAA	Yes
Meghna-Dhonagoda	TA	TA	O	TA	TA	TA	TAA	TAA	Yes
Zilkar Haor	TAA	TAA	TAA	TA	TA	TA	TNA	TAA	Yes
Kolabashukhali	TA	TA	TA	TAA	TNA	TAA	NA	TAA	No
Protappur	NT	NT	NT	TA	TAA	TAA	TAA	TAA	Yes
Nagor River*	TAA	TAA	TAA**	TAA	TNA	TNA**	TA	TAA	Yes
Sonamukhi-Bonmander	NTBA	NTBA	NTBA	TA	TA	TA	NT	TAA	Yes
Sakunia Beel	TAA	TAA	TAA	TNA	TNA	TA	TNA	TNA	No
Silimpur-Karatia	0	O	O	O	O	0	O	O	O
Katakhali Khal	TAA	TA	TA	TA	TA	TA	TA	TA	Yes
Halir Haor	TAA	TAA	TAA	NT	NT	NT	NT	TA	No
Kahua Muhuri*	TAA	TAA	TAA**	TA	TAA	TAA**	O	TAA	No
Konapara	TAA	NTBA	TAA	NT	NT	NT	NT	TAA	No
Polder 17/2	NT	O	TAA	TA	TNA	TAA	NT	TAA	Yes
BRE (Kamarjani)	TAA	TA	TA	TA	TA	TA	TA	TA	Yes
BRE (Kazipur)	NTBA	NTBA	TAA	TAA***	TAA	TA	TA***	?	?

TA = Target partially achieved
TAA = Target definitely achieved
NA = Target definitely not achieved
NTBA = Not targeted but achieved
NA = Not targeted and not achieved
O = No change

* = No document exists, based on farmer's interview
** = In years when there was no breach or public cut
*** = T. Aman production has decreased significantly due to breach after 1984

Source : RRA Reports

3.5 LIVESTOCK

None of the 17 projects (5 PIE and 12 RRA), that have been studied using Rapid Rural Appraisal methods, had any specific objectives related to livestock development. Most of the FCD/I projects aimed to increase crop production, particularly paddy production, through increasing the cultivable land area and/or the cropping intensity. Those projects which have increased cropping area and cropping intensity have led to reductions in fallow land and grazing area for livestock on one hand and increased requirements for draught power and draught animals on the other hand. The planners, at the time of project planning, rarely considered project impacts on draught power requirements, and how to meet the increased demand for draught power for timely land preparation.

The overall impacts of FCD/I projects on livestock may be grouped into the following categories:

a) Change in livestock feed resources;
b) Change in livestock population;
c) Change in draught power availability;
d) Change in livestock output;
e) Change in livestock health and incidence of diseases.

FCD/I projects did not have direct impacts on these livestock production parameters. However the projects have had direct impacts on livestock feed resources which, in turn, affect livestock production.

The impacts of the 17 projects have been grouped into the above five categories and the results are presented in Table 3.5.

The RRA results indicate clearly that livestock feed resources, particularly grazing area and hence availability of green feedstuff, have decreased in virtually all the FCD/I projects, due to conversion of fallow and grazing land into cropped land. Moreover, cultivation of pulses has fallen, and these tend to be replaced by Boro paddy.

Straw production, on the contrary, has increased in all the projects except in the Nagor river and Kahua-Muhuri projects where breaches of embankment and crop damage are caused by early flash floods. However, both the digestibility and the palatability of straw have significantly declined due to production of HYV rather LV paddy varieties. There are general complaints from the farmers that the health of the cattle gradually deteriorates as a result of feeding HYV Boro straw. With the increased paddy production, rice bran production has also increased. However, increased production of rice straw and rice bran could not compensate for the green feedstuff losses caused by the projects. + irrigated boro cultivation

The national cattle population is believed to have remained more or less constant since the early 1980s, (Hossain, 1989). However the cattle population in all the project areas has decreased, except in Protappur and Kurigram, where the cattle population has slightly increased. The decrease in cattle population is mainly due to shortage of nutritious feeds and financial distress of the farmers as well as to increased maintenance cost of the animals.

The goats population has increased in all the project areas except the Protappur and Kahua-Muhuri Projects. The increased goat population may have some relation to the decrease in cattle population. Farmers who were unable to buy a cow may have procured a few goats as an additional source of income.

?

yes or no needed

Table 3.5: Impacts of FCD/I Projects on Feed Resources and Livestock Performance

Project No.	Project Name	Change in Livestock Feed				Change in Draught Power Availability			
		Grazing Area	Straw Availability		Green forage/feed	Draught power demand	Draught animal availability	Use of cows	Power tiller use
			Quantity	Quality					
1.	Chalan Beel Polder-D	↓	↑	▲ due to HYV	↓	↑	↓	↑	NA
2.	Kurigram Project (South)	↓	↑	▲	↓	↑	↓	NA	NA
3.	Meghna Dhonagoda	↓	↑	▲	↓	↑	↓	NA	↑
4.	Zilkar Haor	↓	↑	▲	NA	NA	NA	NA	NA
5.	Kolabashukhali	↓	↑	▲	↓	↑	↓	↑	NA
6.	Protappur	↓	↑	▲	↑	↑	↓	↑	↑
7.	Nagor River	↓	↓in Low-land ↑in Highland	▲ due to HYV	↓	↑	↓	↑	↑
8.	Sonamukhi	↓	↑	▲	↓	↑	↓	NA	↑
9.	Sakunia Beel	↓	↑	▲	↓	↑	↓	↑	↑
10.	Silimpur-Karatia	NA	NA	NA	NA	NA	NA	NA	NA
11.	Katakhali Khal	↓	↑	▲	NA	↑	↓	↑	↑
12.	Halir Haor	↓	↑	▲	NA	↑	↓	↑	↑
13.	Kahua-Muhuri	↓	↑	▲	↓	↑	↓	NA	↑
14.	Konapara Embankment	↓	↑	NA	↓	↑	↓	↑	↑
15.	Polder 17/2	↓	↑ in non-gher area	▲	↑	↑	↓	NA	↑
16.	BRE-Kamarjani Reach	↓	↑	▲	↓	↑	↓	↑	↑
17.	BRE-Kazipur Reach	↓	↑	▲	Pulse Prod ↓	NA	NA	NA	NA

Continued.....

Table 3.5: Impacts of FCD/I Projects on Feed Resources and Livestock Performance (Continued)

Project No.	Project Name	Change in Livestock Population				Change in Milk output	Change in disease incidence
		Cattle and Buffaloes	Goats and Sheep	Chicken	Ducks		
1.	Chalan Beel Polder-D	↑	↑	↑	↑	↓	NA
2.	Kurigram Project (South)	↑	↑	↑	↓	↑	↑
3.	Meghna-Dhonagoda	NA	NA	↑	↓	NA	NA
4.	Zilkar Haor	↓	NA	NA	NA	↓	NA
5.	Kolabashukhali	↓	No Change	↑	↓	↓	↑ Parasitic
6.	Protappur	↑	↓	↑	NA	NA	↓ due to vaccination
7.	Nagor River	↓	↑ seasonal	↑	↑	↓	↑
8.	Sonamukhi	↓	↑ Goats	↑	NA	NA	↓
9.	Sakunia Beel	↓	↑	↑	NA	↓	↑
10.	Silimpur-Karatia	NA	NA	NA	NA	NA	NA
11.	Katakhali Khal	↓	↑	↑	↑	↓	NA
12.	Halir Haor	↓	No Change	↑	↑	↓	↑
13.	Kahua-Muhuri	↓	↓	↑	↑	↓	↑ Parasitic infestation
14.	Konapara Embankment	↓	↑	↑	NA	↓	
15.	Polder 17/2	↓	↓	NA	↓	↓	↓ in non-gher, ↑ in gher area
16.	BRE-Kamarjani Reach	↓	↑	↑	↑	↓	↑
17.	BRE-Kazipur Reach	↓ Since 1984	↓ Since 1984	↑	NA	↓ Since 1984	↑

Note: ↑ - Increased; ↓ - Decreased; ▲ - Deteriorated; NA - Not Available

Source: RRA Reports

The chicken population has increased in all the projects, facilitated by increased availability of food grains and insects in the homestead. Ducks, on the contrary, have increased only in those projects where more natural duck feeds are available (for example at Kahua-Muhuri). However, increased vaccination against Ranikhet and Fowl Cholera may also have some role in increasing the chicken population.

Milk production has decreased in all the projects mainly due to a decrease in average milk production per cow, as well as to the declining number of milking cows. This may be attributed to reduced availability of nutritious cattle feeds, particularly green feedstuff. Egg production, on the contrary, has increased in all the projects.

Draught power requirements have increased in the FCD/I projects but draught power supply, on the contrary, has fallen due to the decrease in cattle population and deterioration of cattle health. In many cases there has been a substantial switch from bullocks to power tillers as the source of draught power, but in some cases there has also been a tendency to increased use of cows in the place of bullocks.

Cattle health conditions have deteriorated, mainly again due to shortage of nutritious cattle feed, extreme seasonal fluctuations in nutrient supply and seasonal overwork of the animals.

3.6 FISHERIES

3.6.1 General Comments

During the 1970s and 1980s there was growing evidence of damage to fish stocks and of a decline in inland capture fish production because of the cumulative impact of the progression of FCD embankment and polder projects.

by whom?

Despite these negative impacts it is alleged that in virtually all cases there was no consultation between BWDB and the Fisheries Department concerning fisheries aspects during project planning and implementation. BWDB appears to have simply ignored such adverse consequences in favour of what they regarded as the greater good of increased rice production, and made no effort to modify the plans so as to minimise the damage to fisheries.

Furthermore, despite the certainty that the FCD project concerned would destroy the livelihood of many fishermen and disrupt their communities, there was never any suggestion of compensatory measures or assistance towards relocation, in the way that land acquisition was compensated.

The donors, including IDA and the Dutch and Swedish supporters of the Early Implementation Programme, appeared to be as remiss as the BWDB, in their failure to recognise and do something about the plight of fishermen. In at least one case (Polder 17/2) EIP consultants quite deliberately allowed the FCD project to be used in an unsuccessful attempt to destroy existing shrimp farming enterprises which were considered to be socially undesirable. They recognised that this would also negatively affect artisanal capture fisheries in the area and in that respect they were regrettably proved correct.

In the very few cases where there were attempts at quantifying the fishery losses, at appraisal stage usually, these were invariably underestimated in terms of both catch quantities and values, so that the cost/benefit analyses were inaccurate and in some instances grossly misleading.

3.6.2 Fisheries Impacts

Factors governing the original selection of projects for study by RRA methods included full regional coverage and the different types of flood protection being provided. The relatively small sample size and the results obtained do not indicate any conclusive regional differences in fisheries impacts, but the different types of flood control structures have produced some more significant variations.

There are three principal categories of FCD projects from a fisheries view point, some of which also have an irrigation development component. These are:-

(a) high embankments providing full protection against riverine flood water;

(b) low, submersible embankments intended to delay, rather than prevent the inflow of flood water;

(c) tidal zone polders intended to protect against year round tidal inundation as well as monsoon season riverine flooding.

The distribution of projects within these categories is

Full Flood Protection	Submersible Bunds	Tidal Flood Protection
(a) **Polder Type**: (1) Chalan Beel D (2) Kurigram South (3) Meghna-Dhonagoda (4) Zilkar Haor (part) (6) Protappur (7) Nagor River (9) Sakunia Beel (13) Kahua-Muhuri (b) **Embankment on 1 side** (10) Silimpur-Karatia (11) Katakhali Khal (14) Konapara (16) BRE Kamarjani Reach (17) BRE Kazipur Reach	(4) Zilkar Haor (part) (12) Halir Haor	(5) Kolabashukhali (15) Polder 17/2

Project no. 8, Sonamukhi-Banmander Drainage Project was exceptional in that it did not depend on bunds but reduced the levels of flooding by the provision of drainage canals.

As might be expected there was considerable variation in the nature and degree of positive and negative impacts among the projects, as perceived by the different respondents approached during the RRAs.

The most significant findings are:

a) that virtually all the projects contribute to the decline in fish stocks for the inland capture fisheries, by obstructing fish migration routes, but the submersible embankments do least harm, because the obstruction is only temporary;

b) that all the projects **except** for the submersible embankments create improved conditions for expanding fish farming and culture-based commercial fishing in larger khas water bodies and private ponds;

c) that all the projects **except** for the submersible embankments have greatly reduced the traditional flood season right of free common access to catch fish for subsistence needs;

have fish prices increased more in project areas than outside project areas?

d) that virtually all the projects **except** for the submersible embankments have forced many fishermen to seek other work, reduced the availability and greatly increased the cost of fish in the markets and contributed to reduced per capita fish consumption especially in low income groups;

e) that very few of the `beneficiary' pond owners interviewed during the RRAs and none of the fishermen, acknowledged having been consulted prior to the project concerned. Most stated that the first they knew about it was when construction started;

f) that the benefits to fish farming, noted in (b) above, proved in many cases to be of short duration because of BWDB failure to properly maintain and repair the embankments and other structures, or because of faulty design especially of drainage facilities which led to breaches, "public cuts" and renewed inundation of large parts of benefitting areas.

A wide range of both beneficial and negative impacts on fisheries was identified during the RRAs. In the following sections these are summarised, and the Projects at which each impact was noted are recorded.

3.6.3 Beneficial and Non-Damaging Impacts

Flood protection benefits ponds in medium land previously subject to overtopping - increasing numbers being cultured since project completion.	(1) Chalan Beel D (2) Kurigram South (3) Meghna-Dhonagoda (4) Zilkar Haor (part) (5) Kolabashukhali (6) Protappur (7) Nagor River (9) Sakunia Beel (10) Silimpur-Karatia (11) Katakhali khal (13) Kahua-Muhuri (14) Konapara (15) Polder 17/2
Even in lower land, where the drainage provision was effective, there was evidence of pond rehabilitation and even some new fish pond construction.	(1) Chalan Beel D (3) Meghna-Dhonagoda (5) Kolabashukhali (6) Protappur (8) Sonamukhi (10) Silimpur-Karatia (11) Katakhali khal (14) Konapara
FCD projects can facilitate NGO efforts to form fishermen's groups or cooperatives to benefit from New Fisheries Management Policy opportunities.	(2) Kurigram South (5) Kolabashukhali (8) Sonamukhi (9) Sakunia Beel (12) Halir Haor (13) Kahua-Muhuri

Coastal polders unintentionally create opportunities for large scale brackish water shrimp farming, even though this conflicts with the original aims of the project.	(15) Polder 17/2
Prevention of tidal flooding and minimised salt water inflow.	(5) Kolabashukhali (15) Polder 17/2
Borrow-pits for embankment construction, canals and khals, converted into ponds for shrimp and fish farming.	(2) Kurigram South (3) Meghna-Dhonagoda (15) Polder 17/2
Submersible embankments delay but do not wholly prevent fish migration and natural annual recruitment.	(4) Zilkar Haor (12) Halir Haor
Expansion of fish farming has slightly improved prospects for commercial fishing groups who can now fish the ponds (for new owners) in addition to fishing rivers and other water bodies.	(1) Chalan Beel D (5) Kolabashukhali (6) Protappur (7) Nagor River (10) Silimpur-Karatia (11) Katakhali khal (13) Kahua-Muhuri (14) Konapara
Perennial beels remaining within project embanked areas are now being restocked with hatchery produced carp fingerling by lease holders, as a result of improved protection afforded by project.	(4) Zilkar Haor (part) (8) Sonamukhi (11) Katakhali khal
Some fishermen owning land within former perennially flooded beels now drained, are able to devote at least part of their time to rice farming and part to fishing.	(5) Kolabashukhali (12) Halir Haor
Non-embanked drainage projects do not interfere with fish breeding migrations	(8) Sonamukhi
Irrigation components designed to retain and store water provide extra opportunities for fish production	(3) Meghna-Dhonagoda (6) Protappur

3.6.4 Negative Impacts

Inadequate provision for drainage causing congestion, over-flooding of ponds and other water bodies in lower areas, inhibiting restocking programmes.	(2) Kurigram South (5) Kolabashukhali (6) Protappur (7) Nagor River (9) Sakunia Beel (13) Kahua-Muhuri (16) BRE Kamarjani Reach

Blockage of khals and inlets formerly linking rivers to beels, by embankments, prevents the breeding and recruiting migration of major carps and other species.	(1) Chalan Beel D (2) Kurigram South (3) Meghna-Dhonagoda (5) Kolabashukhali (6) Protappur (9) Sakunia Beel (10) Silimpur-Karatia (11) Katakhali khal (13) Kahua-Muhuri (14) Konapara (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
Project contributes to decline of some fish and to changes in fish stock composition	(1) Chalan Beel D (2) Kurigram South (3) Meghna-Dhonagoda (4) Zilkar Haor (part) (5) Kolabashukhali (7) Nagor River (8) Sonamukhi (9) Sakunia Beel (11) Katakhali khal (12) Halir Haor (13) Kahua-Muhuri (14) Konapara (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
Capture fisheries production in beels and rivers now decreased, sometimes to as little as 25 percent of pre-project levels.	(1) Chalan Beel D (3) Meghna-Dhonagoda (5) Kolabashukhali (9) Sakunia Beel (11) Katakhali khal (14) Konapara (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
Former flood season free public access for subsistence fishing no longer possible.	(6) Protappur (9) Sakunia Beel (13) Kahua Muhuri (15) Polder 17/2
Formerly perennial beels now silted up and dry out wholly or partially each year	(1) Chalan Beel D (2) Kurigram South (11) Katakhali khal (14) Konapara (16) BRE Kamarjani Reach (17) BRE Kazipur Reach

Formerly productive beels deliberately drained so as to create more rice land but at cost of reducing or destroying the fishery.	(4) Zilkar Haor (part) (5) Kolabashukhali (8) Sonamukhi (9) Sakunia Beel (14) Konapara (15) Polder 17/2
Reduced availability of fish in the markets and greatly increased prices payable by the consumers, result in reduced per capita fish consumption.	(1) Chalan Beel D (4) Zilkar Haor (part) (5) Kolabashukhali (9) Sakunia Beel (14) Konapara (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
Numbers of full time fishermen greatly reduced:- - emigrated to other areas	(1) Chalan Beel D (7) Nagor River (9) Sakunia Beel (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
- now only part-time fishing or having to do other work instead of fishing.	(1) Chalan Beel D (3) Meghna-Dhonagoda (4) Zilkar Haor (part) (5) Kolabashukhali (7) Nagor River (9) Sakunia Beel (11) Katakhali khal (13) Kahua-Muhuri (14) Konapara (15) Polder 17/2 (16) BRE Kamarjani Reach (17) BRE Kazipur Reach
Reduction in numbers of fish traders	(4) Zilkar Haor (part) (11) Katakhali khal (16) BRE Kamarjani Reach
Area now changed from surplus to deficit fish production.	(1) Chalan Beel D (5) Kolabashukhali (9) Sakunia Beel (10) Silimpur-Karatia (11) Katakhali khal (15) Polder 17/2

Large scale brackish water shrimp farming has developed in an uncontrolled manner, with avoidable bad effects on other land users and project structures, as a consequence of Government failure to implement enforceable means of regulation.	(15) Polder 17/2
Submersible embankments do not protect ponds from over flooding thus do not contribute to expansion of culture fisheries.	(4) Zilkar Haor (part) (12) Halir Haor

3.7 SOCIAL IMPACTS

The projects studied generally had no explicit objectives related to social development, but in some cases it was expected that increased production and hence increased employment would bring about changes in social aspects of the project area.

The RRA results suggest that social impacts varied between projects. In some projects there are clear positive social impacts while in other cases there was little or no impact.

The social impacts of the studied projects are summarized in Table 3.6 and discussed below.

3.7.1 Participation in O&M

In general, local people were not consulted at any stage of project planning or construction. As a result local knowledge about the physical and social features of the project area could not be utilized. People's participation in the regular O&M of the projects was in general absent, although there are some instances of local peoples' mobilization to protect the embankment at critical stages when there are threats of breaches, overtopping or public cuts. In several projects, where people perceived the positive benefits of the embankment, the local people voluntarily mobilized themselves and raised money and materials in order to protect or repair the embankment during the high floods.

3.7.2 Employment

In general construction, repair and maintenance of embankments have created direct employment, in some cases on a regular basis, especially for the disadvantaged groups.

In projects where there has been an increase in monsoon rice, resulting from the projects, this has generated employment for both family and hired labour for both men and women. Where Boro rice production has increased due to FCD/I projects there has been a substantial increase in employment. As regards seasonal migration of labour, the RRA could not establish any clear pattern, some projects clearly promoting in-migration at peak periods, others failing to stem persistent out-migration patterns.

Almost all the projects showed disbenefits in terms of reduced productive employment to several communities such as fishermen, boatmen and boat making carpenters because the projects led to a remarkable decline in capture fisheries and boat transport.

While there has generally been a decline in employment of fishermen and boatmen, improved year-round road communication in all the projects, except those with submersible embankments, appeared to have generated self-employment opportunities in road transport, marketing of agricultural inputs and outputs and petty trades in goods and services. The improved road communication, partly attributed to the internal road construction under FFW programmes, also facilitated government and non-government development activities, which have generated additional employment and income accruing by and large to the poorer sections of the population. In addition, some projects, where the level of inundation decreased and internal road communications improved, led to an increase in school enrolment, especially in the wet season (for more on the impact of improved communication see Section 3.9).

3.7.3 Income Distribution

The overall impact of FCD/I projects on income distribution seemed complex and unclear. It is clear that most projects resulted in income losses for certain groups, and income gains for others. In projects where distressed women and landless groups are employed in maintenance of embankments and internal roads, (the latter under the Infrastructure Development Programme of LGEB), this has had some favourable income distribution impact.

In projects where there has been some positive increase in crop production, benefits of net incremental output went by and large to those who had access to land and water resources, while the poorer members of the population gained marginally from increased wage labour in production and post-harvest operations. As mentioned earlier, the regular earthwork, for repair and maintenance of embankments contributed to providing some increase in wage income to the poorest of the poor.

One of the conspicuous negative impacts of the FCD/I projects is that these led to a significant decline in income of part-time or full-time fishermen and boatmen, but in none of the projects was there any institutional arrangement to compensate these people for such loss, even when it was anticipated during project appraisal.

In projects where the intensity of river erosion has been exacerbated by the construction of embankments, the extent of landlessness in terms of numbers of landless people and the abruptness of dispossession from permanent dwelling houses, land and economically valuable trees has increased tremendously. The obvious consequence of this is that the affected people have become distressed overnight and their poverty and miseries drive them to take up any kind of activities for survival.

Another source of unequal income distribution has been induced by BWDB through the construction of pucca irrigation inlets. In some cases local influential members of the public have been using these state-built structures to operate LLPs and sell irrigation water to earn monopoly rents. However, no instances of social conflicts were reported in this regard.

3.7.4 Social Conflict

Despite a definite increase in agricultural production and consequent increase in employment in the crop and non-farm sectors in most of the studied projects, the FCD/I projects have been responsible for increasing conflicts of interest between opposing groups. The major forms of conflict are as follows:

i) Several projects led to discontent between those living inside the project boundary and those left outside the project, because the latter face more inundation and water congestion than in the pre-project situation, leading to public cuts or threat of public cuts in the embankment;

ii) Conflicts of interest between farmers and fishermen were frequent. In some projects, such as Zilkar Haor this led to disagreement over the timing of opening and closing of sluice gates;

iii) In projects located in the southern part of the country, conflicts of interest between farmers and shrimp culturists are evident, because the shrimp culturists want to bring saline water into the polders while the farmers resist the spread of saline water to their paddy fields.

In several projects the resolution of such conflicts necessitates local and official intervention and thus increased the demands on scarce administrative and political resources.

3.7.5 Land Acquisition and Social Dissatisfaction

The major source of dissatisfaction has been in respect of payment of compensation for lands that were acquired for the construction of embankments and retired embankments. Generally, prices paid for acquired land were not the source of discontent, although acquisition prices were less than prevailing market prices. The extremely cumbersome process of land acquisition and long delays in making the actual payment (in some cases many years) have been the major sources of discontent of those whose lands were acquired.

Discrimination about the fixation of compensation value between land categories, standing crops or groups of affected people was also a source of discontent in a number of major projects such as the BRE. This needs to be minimized by the BWDB through expediting the process of compensation payment. This seems to be a prerequisite for involving the local people in the implementation of projects.

A further problem relates to the long delay in transfer of land title by BWDB after payment of compensation. In some cases farmers continued to be charged land taxes for years after their land had been occupied by an embankment.

3.7.6 Temporary and Permanent Housing

In about half of the projects, embankment sections are used as flood shelters and this together with the perceived reduction in flood hazard and increased security of housing and other assets led to a `psychological' improvement. There may be a false sense of security in some cases where embankments could soon be washed away either by abnormal floods or by river erosion. In such cases measures should be taken to provide advance warning mechanisms and to prepare contingency plans for flood events.

In projects such as BRE, that have experienced unprecedented river erosion and abrupt landlessness, embankment sections have been used for permanent or semi-permanent linear housing by those who have lost land due to river erosion. In a land scarce situation this can be treated as unintended but low-cost rehabilitation of dispossessed people, but it certainly undermines the quality of the embankments. In some cases such as BRE, the embankment must be designed for this as there is no alternative.

3.7.7 Nutritional Status

As regards nutritional status, the projects did not seem to have any perceptible impact on the quantity of food consumed per capita, despite an increase in foodgrain production. The majority of households, constituting the poorer section of the population, still suffer from scarcity of food for at least part of the year, as before. Nutritional status has deteriorated due to FCD projects which have been responsible for a significant decline in the production of fish and pulses, which used to be the major sources of protein for poor people.

The degradation of nutritional status has been further exacerbated by the reduced availability and consumption of meat, although there is evidence that production of chicken, ducks and eggs has increased in the post project periods.

3.7.8 Women's Issues

Womens' issues were not at all focused on in project feasibility studies and planning, nor was there any objective in FCD/I projects for women's development. There are however a number of changes that have been caused directly or indirectly by the implementation of the projects.

The project impacts on women could be divided into two broad categories:

i. those that have directly resulted from the projects, such as embankment maintenance, and

ii. those that result from linkage effects, such as increase in post-harvest activities due to increased agricultural production within the project area.

The RRA findings on women issues are summarized in Table 3.7.

As regards direct impact, the projects in general provided employment for embankment repair and maintenance work and in some cases drainage channel excavation work under the FFW programme.

The increased volume of paddy production in most projects also increased women's work load and work opportunities for post-harvest processing. Improved road connections provided by the embankments facilitated NGO development activities, some of which are especially directed towards women.

The projects did not have any significant negative impact on women, except that the projects which have breaches or drainage congestion problems adversely affected women from poorer sections during the period of inundation, because their movement to and from the homesteads became more difficult.

Table 3.6 : Social Impact

Name of Project	A	B	Employ-ment Opportunity	Transport Trading & Facilities	Seasonal Labour migration		Conflict of interest dissatis-faction	Dis-benefitted Groups	Flood Shelter/ security	Develop-ment Activities	Sense of Security
					Out-Migration	In-Migration					
Chalan Beel	NE	+1	+1	+1	+1	+2	+1	+1	0	+1	0
Kurigram	NE	0	+1	+1	+1	0	+1	+1	+1	+1	+1
Meghna-Dhonagoda	NE	0	+1	+2	-1	0	+1	+1	+1	0	+1
Zilkar Haor	NE	+1	+1	+2	-1	0	0	+1	+2	+1	+1
Kolabashukhali	NE	0	+1	+1	+1	0	0	+1	0	0	0
Protappur	NE	0	+1	+1	0	+1	+1	0	0	0	+1
Nagor River	NE	0	+1	+1	0	+1	+2	0	+1	+1	+1
Sonamukhi	NE	0	+1	+1	0	+2	+2	0	0	+1	0
Sakunia Beel	NE	0	+1	+1	0	+1	+1	+1	+1	+1	+2
Silimpur	NE	0	+1	+1	0	0	+2	0	0	+1	0
Katakhali Khal	NE	+1	+1	+1	+2	0	0	+1	0	0	0
Halir Haor	NE	+1	+1	+1	+1	-1	+1	0	0	0	0
Kahua-Muhuri	NE	+1	+1		+1	+2	0	+1	+1	0	0
Konapara	NE	0	+1	+1	-1	0	+2	+1	0	0	0
Polder 17/2	NE	0	+1	+1	0	0	+2	+1	+1	+1	+2
BRE-Kamarjani	NE	0	+1	+1	+1	0	+1	+2	+2	+1	+1
BRE-Kazipur	NE	0	+1	0	+1	+1	+1	+2	+2	+1	0

A = Social impact considered as a project objective? NE = Not explicitly mentioned
B = Social participation in embankment protection 0 = No Change; +1 = Increased to some extent; +2 = Increased substantially;
1 = Decreased to some extent; -2 = Decreased substantially

Source : RRA Results.

Table 3.7 : Women's Issues

Project Name	Change in activities				Change in Earning		Education Status	Out Migration	NGO Activities Facilitated
	Off-farm	On-farm	Gardening	Others	Opportunities	Wage			
Chalan Beel	↑	↑	↑	↑	↑	NA	↑	NO	↑
Kurigram (S)	↑	▲	↑	NA	↑	NA	NA	NA	↑
Meghna Dhonagoda	↑	NA	NA	NA	↑	NA	NA	NA	NA
Zilkar Haor	↑	NA	NA	↑	↑	NA	NA	NA	↑
Kolabashu Khali	↑	NA	NA	↑	↑	NA	NA	NA	NA
Protappur	↑	▲	↑	↑	↑	↑	↑	NA	↑
Nagor River	↑	↑	↑	↑	↑	NA	↑	NA	↑
Sonamukhi Bonmander	↑	↑	▲	↑	↑	NA	↑	NA	↑
Sakunia Beel	↑	▲	▲	↑	↑	↑	↑	NA	↑
Silimpur	↑	↑	↑	↑	↑	↑	NA	NA	NA
Katakhali khal	↑	▲	↑	↑	↑	NA	NA	NA	↑
Halir Haor	↑	▲	▲	↑	▲	↑	NA	NA	↑
Kahua Muhuri	↑	↑	↑	↑	▲	NA	▲	NA	NA
Konapara	↑	↑	↑	↑	↑	↑	▲	NA	↑
Polder 17/2	↑	↑	↑	↑	↑	↑	NA	NO	↑
BRE - Kamarjani	↑	▲	↑	↑	↑	↑	↑	NA	↑
BRE - Kazipur	↑	↑	↑	↑	↑	↑	↑	YES	↑

Note: ↑ - Increase ▲ - No Change
NA - Not Available

Source: RRA Results

3.8 ENVIRONMENTAL IMPACT

3.8.1 Introduction

The FAP 12 team was originally expected to carry out its environmental studies following guidelines provided by the FAP 16 Environmental Study. These were unfortunately delayed and FAP 12 had to develop its own approach. It was recognised that there were contrasting interpretations of the environmental remit, a narrow view which considered that the environmental studies should be limited to certain aspects of ecological change (water quality, soils, plants, wildlife) and a broader view, similar to that which is internationally understood as Environmental Impact Analysis, in which the environmental studies take a holistic view, bringing together physical, biological and social impacts.

After discussion with FPCO the FAP 12 team has adopted the latter approach, and is broadening the scope of its environmental studies. In particular the five PIE studies will include studies of their overall environmental impact. It is proposed to refer to these as Preliminary Environmental Post-Evaluations (PEP), in order to distinguish them from the more thorough Environmental Audits which are carried out by international agencies to evaluate the impact of major projects in great detail.

In some of the Rapid Rural Appraisals a simpler approach to environmental analysis will be included. The methodology to be applied was inevitably not developed until the RRAs were underway, and as a result a rigorous overview is not possible. However the information collected by the various study disciplines, and the data collected on change in ecological parameters, permit an initial assessment.

The environmental studies distinguish impacts on the physical, biological and human environments, and where relevant look at impacts both within the project area and outside it (off-site impacts).

3.8.2 The Physical Environment

The major physical impacts of FCD/I projects are on river and flood characteristics, drainage, open waters, groundwater, water quality and soil and land characteristics.

(a) River and Flood Characteristics

The impacts of FCD/I projects on rivers and flooding have been discussed in Section 3.2 and are central to this study. In general the RRAs have concentrated on the impact of flooding changes within the protected areas. However it has been observed in Table 3.1 that in many of the 17 projects the flood protection afforded to the area studied caused worse flooding downstream, or in one case, upstream. These off-site impacts had not been considered during appraisal, and in the Atrai Basin in particular it is clear that each new polder has undermined the viability of preceding flood protection projects.

(b) Drainage

Changes in drainage characteristics are closely linked to those related to flooding, but deserve separate consideration. Within the protected areas FCD/I projects have often had unplanned impacts on drainage. In particular embankments have often caused severe drainage congestion, either inside or beyond the protected area, leading to public cuts.

(c) Wetlands and Waterbodies

It has often been the intention of FCD/I projects to reduce the areas of perennial open water bodies in the protected areas, in order to permit expansion in the cropped area. It has, inevitably, been their intention to reduce the areas of seasonally open waters. The changes achieved have sometimes been dramatic. They have however brought other changes in their train, which relate to the biological and human environments.

(d) Groundwater

The impacts of FCD/I projects on groundwater recharge are difficult to assess. During the RRAs only one complaint was heard of declining water tables, although many of the areas had seen substantial groundwater development during the 1980s. The RRA team are aware that impacts have been alleged, but the evidence assembled did not suggest this is perceived to be a major impact of FCD/I projects.

(e) Water Quality

The major impact of FCD/I projects on water quality is in the south, where polders have been deliberately designed to exclude saline water from protected areas for at least part of the year. The projects studied in this area had substantially achieved their objective, although the conjunctive use of saline and fresh water in some areas (for a shrimp - Aman rotation) indicated that some review of the design concepts was required.

(f) Soils and Land Characteristics

The two major impacts identified are to some extent perverse, one being related to reduced silt deposition and the other to increased sedimentation.

In many of the projects farmers complained that the loss of annual flooding meant a loss of silt deposition resulting in a perceived decline in soil fertility. This is a widespread belief but can only be verified and quantified by thorough soil investigations on a substantial scale. This may be a suitable assignment for one of the FAP 16 special studies.

In some projects there were serious problems of siltation and sand deposition associated with embankment breaches and public cuts, leaving substantial areas uncultivable. In the case of the Kahua Muhuri project there were almost annual discernable increases in land levels associated with silt deposition, and regular shifting of cultivated areas as changes in fertility took place at different locations.

The construction of embankments in itself constitutes establishment of a new land form which fills a distinct new ecological niche in many areas, offering new opportunities for both biological and human environmental change.

3.8.3 The Biological Environment - Flora and Fauna

The major FCD/I impacts on the biological environment relate to fisheries. These have been discussed in Section 3.6. However the RRAs have also provided evidence of other aspects of the biological environment which are affected, mainly because of the substantial reductions in wetland ecosystems. Some of these wetlands have international significance and their gradual elimination is attracting considerable attention.

(a) Plants and Weeds

In many projects, the aquatic ecosystem supported the growth of wet land grasses, such as Dal grass (Hymenachne pseudointerrupta) Nalkhagra (Phragmites) and Chailla grass which were the main source of cattle food for the greater part of the year. These species now rarely grow in the project areas.

HYV cultivation has encouraged the growth of a number of weeds, such as Karenda grass (Caesulia axilaris), Cyperus sp, and Alternanthera sp. which are extensively used as fodder. Since heavy doses of insecticides are also used on the HYV varieties, it is possible that these fodders may contain toxic substances and be detrimental to cattle health.

(b) Social Forestry

The new "ecological zones" created by embankments offer opportunities for new plant communities to develop. In many areas these zones are exceptional - the only areas that are never underwater. Some of the RRAs found that social forestry programmes were already developing on embankment slopes or tops, and that specific tree species were being promoted. The embankments were not designed with this in mind, and it is possible that a conscious promotion of social forestry on embankments would require both design adjustments and a more selective approach to species selection, planting procedures and organisational arrangements. This may be another area for attention from FAP 16.

(c) Animal and Birdlife

Disappearance of the wetland ecosystem in a few projects has also significantly reduced the frog and snake populations. The subsequent effect has been a strong increase in the pest and insect populations in the crop fields. The food chain and food web in the ecosystem have thus been disturbed and this may have further ecological consequences.

The reduction in the areas of perennial water (beels) has resulted in some reduction in the number of wintering wild fowl.

Since the areas are free from seasonal flooding, the rodent population appears to have increased. Large numbers of holes made by the rodents are very common and ultimately may lead to a major failure in an embankment (for example at Kahua Muhuri).

3.8.4 The Human Environment

FCD/I impacts on the population of the protected areas, and where relevant on off-site populations, are discussed in previous sections and in Section 3.9. They include human use impact (including agriculture, livestock, fisheries), social impacts (including gender, health, nutrition, equity), economic impacts (incomes, employment, land prices), institutional impacts and cultural impact.

Most of these have been discussed in other chapters, and the PIE environmental studies will bring together the results of the whole range of studies, without any attempt to duplicate them.

In the present report the one important area that is not covered elsewhere is health. Some of the FCD/I projects have influenced health conditions, in varying ways.

It has been observed in Section 3.4 that the reduced risk of flood hazard has in some areas (usually lowlying areas of projects subject to early monsoon flash floods) contributed to the development of groundwater irrigation for Boro crops. Similarly it was found on eight of the projects studied (see Table 3.8) that tubewells for domestic water supply had been installed in areas that were protected from flooding. The availability of clean water is of course a key requirement for public health improvements.

Reduced flood hazard should also have reduced the incidence of water borne diseases - diarrhoea epidemics in particular are associated with flooding in Bangladesh. This was not however reported to any of the RRA teams as a perceived benefit. On the contrary, it was reported that the loss of an annual "flushing" in some areas (for example in Chalan Beel) was

leading to an accumulation of debris and this has led to increase in diarrhoea incidence. This may indicate the need for public health interventions to mitigate this unanticipated impact of successful flood control.

On some occasions it was reported that the irrigation components of FCDI projects had resulted in increased mosquito populations associated with the irrigation of HYV Boro. This may relate to a new presence of standing water in the dry season, but again would seem an unlikely normal impact of FCD/I projects.

In Table 3.8 a preliminary attempt to scale the degree of impact of some of the environmental variables of the RRA projects is presented. The degree of impact is as follows:

0 - nil or negligible impact
1 - minor impact
2 - moderate impact
3 - major impact

Impacts thus scaled may be positive (+) or negative (-). In the PIE studies this will be developed into a more comprehensive environmental impact analysis.

Table 3.8 : ENVIRONMENTAL IMPACT

Project No.	Project Name	Wetland/ marshland	Soil Environment	Siltation/ Erosion	Sand Deposition	Aquatic vegetation	Wild Life	Drinking Water	Health and Nutrition	Sanitation and Pollution	Off-site Impacts
1.	Chalan Beel Polder-D	-2	0	0	0	-1	-1	0	+1	0	
2.	Kurigram south	-1	0	-1	-1	-1	-1	+1	0	0	-1
3.	Meghna-Dhonagoda	-3	-1	-2	-1	-3	-2	+2	+1	-1	-1
4.	Zilkar Haor	-1	0	0	0	-1	-1	0	0	-1	-1
5.	Kolabashukahli	-1	-1	0	0	-1	-1	+1	+1	0	0
6.	Protappur Irrigation	0	0	0	0	0	0	+1	0	0	0
7.	Nagor River	0	0	-1	-1	0	-1	0	0	0	-1
8.	Sonamukhi Bonmander	-1	0	0	0	-1	-1	+1	+1	0	0
9.	Sakunia Beel	-1	0	0	0	-1	-1	+1	0	0	-1
10.	Silimpur-Karatia	0	0	-1	0	0	0	0	0	-1	-1
11.	Katakhali khal	-2	0	-1	-1	-1	-1	0	0	-1	-1
12.	Halir Haor	-1	0	0	0	0	-2	0	0	0	0
13.	Kahua-Muhuri	-2	0	+1	-1	-1	0	0	+1	0	0
14.	Konapara	-1	-1	-1	-1	-1	0	+1	+1	0	-1
15.	Polder 17/2	0	+1	-2	0	-1	0	+1	+1	0	-1
16.	BRE Kamarjani	0	0	-1	-1	-1	-1	0	0	0	-1
17.	BRE Kazipur	0	-1	-1	-1	-1	-1	0	+1	0	-1

Note: 0 - nil or negligible impact; 1 - minor impact; 2 - moderate impact; 3 - major impact

Source: RRA Reports

3.9 ECONOMIC ASPECTS

3.9.1 Introduction

Flood control projects are assessed in terms of the economic contributions that they are expected to make, before an investment decision is finalised. This usually means undertaking a technical-economic feasibility study and the estimation of a summary statistic such as the BCR, the NPV or the IRR. While useful, such summary figures can hide much more than they reveal, particularly when all the underlying assumptions are not clearly spelt out or justified. These exercises should at best be used to supplement a more detailed, and not necessarily quantifiable assessment of project worth, if project evaluation is to be more than an indulgence in a numbers game.

It appears that some of the economic analysis that were carried out may have distorted the numbers to obtain the desired results. Thus in the feasibility studies for some of the projects reviewed, pre-project crop yields were shown to be considerably lower than the RRAs indicate that they actually were, thereby "improving" the IRR estimates (eg. Konapara, Protappur?).

Typically, benefit-cost analyses of FCD projects are concerned entirely with expected changes in crop (paddy) production. Not one case has been found where an attempt was made to incorporate the effects on other areas, eg. fisheries or navigation. To an extent this is probably explained by the difficulties involved in quantification of non-agricultural costs and benefits. If quantification is difficult in conventional exercises, this is doubly so for RRAs. RRA is not suitable for quantification, and is essentially a blunt instrument meant to provide a qualitative assessment of project health.

3.9.2 Approach

Despite the limitations of RRA, attempts have been made to quantify the impact on agriculture (crop output) by combining acreage data available from the 1983-84 Agricultural Census, contour maps from the BWDB when available, and crop yield rates by land levels obtained from field interviews. For some projects, attempts were made to quantify the loss to fish output (see Section 3.5). Similarly, in some cases, a financial BCR was tentatively estimated. The figures only reflect broad orders of magnitude, and no confidence levels can be attached to these estimates. For the purposes of presentation therefore, the results are shown in Table 3.9 in qualitative terms, by ranking impacts as + or - and attaching a 1 for small impact and a 2 for a large impact.

3.9.3 Broad Findings

Table 3.9 summarises the impact of the different FCD/I projects studied, in terms of the impact on various critical variables: agriculture and fisheries output, livestock numbers, transport and navigation, employment and non-farm activities. In the final column, an overall comment on project achievement is provided.

Except for two projects that are clearly "negative" or zero, all others demonstrate some positive impact on agriculture. In a few instances, the agricultural impact is substantial (eg. BRE- Kamarjani Reach, Halir Haor, Zilkar Haor). Fish and livestock sectors have almost invariably suffered, sometimes quite severely. These negative impacts, if taken into account in project planning, would very significantly alter rates of return. Less uniformly, boat

navigation has also been found to be adversely affected, causing loss of livelihoods and raising bulk haulage costs. In some areas, this has led to severe social tensions between beneficiaries and boatmen (eg. in Silimpur-Karotia project). Road transport, on the other hand, has improved and in every case promoted better communication in the project areas.

Out of seventeen projects, eight are shown to have had a "moderate" positive net economic impact, three are seen to have had an overall negative impact and the remaining had an indeterminate or small or small/moderate positive impact.

The sectoral impacts are translated into effects on income, employment, demand and growth of non-farm activity. Employment is primarily related to agriculture and processing and embankment O&M and is generally found to have increased, although certain types of employment opportunities have suffered a setback (i.e. those related to fishing, boat transport and livestock). The effect on non-farm activity is much more indirect, and is difficult to separate from autonomous influences that shape it. However, there is little doubt that the greater security to life and property, and the reduced probability of disruption to normal economic life, associated with a flood control project, has usually had a beneficial impact on non-farm activity. This point has been repeatedly made by local NGO officials and workers who were interviewed.

Table 3.9 Flood Control Projects: An Assessment of Economic Impact

Sl.	Name	Cost Tk(m)	Cost per ha (000 Tk)	IMPACTS Agr	Live	Fish	Road Trans	Navgn	Empt	Non Farm	Overall Evaln
1	Chalan Beel D	436	11.7	+1	-1	-2	+1	-1	+1	+1	moderate
2.	Kurigram South	182	3.6	+1	-1	0	+1	0	+1	+1	small
3.	Meghna Dhonagoda	1859	129.4	+1	-1	-2	+1	-2	+2	?	sm/mod
4.	Zilkar Haor	62	14.5	+2	-1	-1	+1	-1	+1	+1	moderate
5.	Kolabashukhali	168	9.0	+2	-1	-2	+1	0	+1	+1	sm/mod
6.	Protappur	10.5	26.3	+2	0	-1	+1	0	+2	+1	moderate
7.	Nagor River	36.2	3.9	-2	-2	-1	+1-1	0	-1	0	negative
8.	Sonamukhi	?	?	+1	-1	0	+1	0	+1	+1	moderate
9.	Sakunia	27.4	4.8	+1	-1	-2	+1	-1	+1	+1	small
10.	Silimpur Karotia	10.5	10.4	0	0	0	+1	-2	-1	0	negative
11.	Katakhali Khal	18.1	8.1	-1	-1	-2	+1	0	0	+1	small
12.	Halir Haor	16.2	1.9	+2	-1	0	+1	0	+1	0	moderate
13.	Kahua Muhuri	?	?	+1	-2	-1	+1	0	+1	+1	small
14.	Konapara	?	?	+2	-1	-1	+1	0	+1	0	moderate
15.	17/2	20.2	7.2	+2	-1	-1	+1	0	+1	+1	moderate
16.	BRE Kamarjani	?	?	+1	-1	-2	+1	0	+1	+1	moderate
17.	BRE Kazipur	?	?	-2	-2	-1	+1	0			negative

Notes: In Kahua-Muhuri, crop output benefits were modest before the breach in 1988. Similarly, the Kazipur Reach of the BRE was a successful project until 1984, since when it has reverted to conditions which are reportedly worse than they were before the project. The adverse impact on fisheries in the Nagor River project is due to changes in the hydrological regime in the entire Nagor basin, and not attributable to the project alone. The cost figures are in 1990 prices.

Source: RRA Results

4 RAPID RURAL APPRAISAL

4.1 INTRODUCTION

Rapid Rural Appraisals, though not unknown in Bangladesh, have been used rather infrequently for evaluation of development projects. One of the objectives of this report is to discuss and debate how far such field methodology was found to be a useful tool of investigation. The experience that has been gathered during the RRAs in 17 FCD and FCD/I project sites indicates that the methodology is useful although not all aspects of the methodology applied were successful. The lessons that have been learnt are described below.

4.2 PRINCIPLES OF RRA

RRA evolved during the 1970s as a response to the need for an alternative technique of information and data collection which is comparatively inexpensive, less time-consuming than traditional survey methods and avoids professional and other biases. For details of these biases the reader is referred to Section 5 of the FAP 12 Methodology Report (Draft, March 1991). RRA tries to avoid four types of bias:

- spatial bias, by visiting as many areas as possible which reflect the range of conditions existing within the project area;

- person bias, by discussing issues and collecting information from a very wide range of people including, but not limited to, officials and ordinary people, people with various occupations in the villages, farmers, fishermen, traders, the landless, those in various land-ownership categories, and men and women;

- professional bias, by working in teams composed of people drawn from various disciplines, rotating disciplinary groupings between project sites and within teams and holding regular group meetings in the project sites; and

- time bias, by consciously investigating conditions not only at the time of investigation but at other times, seasons and years.

4.3 RRA TOOLS

Over time, through trial and error, various tools for an effective RRA, have been developed. These include:

- careful preparation prior to fieldwork for a clear understanding, on the basis of available information, of the characteristics of the area that is to be visited;

- preparation of checklists of the issues to be investigated in the field;

- triangulation - getting to understand as many different views as possible from as many types of informants as possible on the same question in as many different ways as possible;

- fielding of inter-disciplinary teams not only to understand the multi-faceted nature of the issues at hand but also to broaden the visions of the professionals themselves. This is achieved by intensive group discussions and by combining collection of information and discussion with people on aspects that bear upon not only the discipline the professional expert primarily represents but also on other (as far as possible, related) disciplines; and

- use of transects and sketch maps to elicit information from respondents and for later use as visual aids in understanding some of the changes that may or may not have taken place in the study area.

4.4 THE LESSONS

4.4.1 Length of Time for RRA

The time allotted for RRA in each project site was 3 weeks, divided as roughly one week each for the preparatory stage, fieldwork and write-up. The experience suggests that the time allocation was at least one week too short. By the time one begins to understand some of the seemingly conflicting information and explanations of the events going on in the area, one week has passed and no time is left for final verification.

In RRA one is expected to make the maximum use of secondary information. For all practical purposes, this means more than one visit to the upazila centre. In quite a few cases more than one upazila was found to have jurisdiction over the project area. In such a situation up to nine to ten days may be necessary for collection and fuller understanding of the characteristics of the area, the people and the changes that may or may not be taking place in the field.

More critical than the time allowed for fieldwork has been that for synthesis and analysis of the collected information and for write-up after coming back from the field. One week was found to be inadequate. Two weeks are necessary for this stage to be completed. Several days are necessary for reconciling and properly editing the various parts of the field report before it can be claimed to be an integrated whole.

There is another aspect to the length of time necessary for field work. This relates to the size of the area covered. In most project areas 6 to 7 professionals were in the team and visited and held extensive discussion and investigation in 20 to 24 locations. These locations were partly pre-selected and partly dictated by information collected in the field while looking for particular groups of people or mouzas/villages with particular characteristics.

The speed of work in the field was possible due to the combination of several factors - the size of the team, the network of village roads allowing access to almost any place with a motorised vehicle and the availability of a sufficient number of vehicles. The road network was not equally favourable in all locations and the RRA team members sometimes had to cover considerable distances on foot. At two of the projects all fieldwork was done by boat. It was the RRA Teams' conclusion that for areas of 5000 to 10000 ha a team of six or seven professionals could carry out an effective RRA in 7 to 9 days fieldwork. Projects larger than this often proved much more complex and RRAs may find it difficult to generalise conclusions from the areas visited.

4.4.2 Multi-disciplinary Team

The present investigation had many dimensions, but emphasised agriculture and fisheries and the associated economic and social changes. The teams were led by either an economist or a rural institutions specialist with formal training in economics or agricultural economics. The other members included in all cases an agricultural expert, an engineer, an economist, and a social institutions specialist. In most cases they were joined by a fisheries expert and in some cases by a livestock or an environment expert. The question of inclusion of women's issues during the investigation came up after work had started. Therefore, later on an expert on women's issues was included in most cases. Where this was not possible, one of the agricultural experts who fortunately happened to be a lady doubled as the WID specialist.

It became quite clear to the consultants early on that there should be more emphasis on investigation and analyses of environmental changes. As a result the consultants acquired the services of an additional expert on environment. In retrospect the RRA Teams felt that they should have placed more stress on the investigation of change in hydrological (flooding) parameters. This might have been facilitated by inclusion of a hydrologist in the teams.

The formation of multi-disciplinary teams for RRA was found to have worked well. This was due to the interactive nature of investigation which is necessary for the success of such teams. The interaction took several forms.

One of these was to split the full team for a specific RRA into two or three smaller teams, the membership of which was changed for different locations. Each of the smaller teams either went to different areas or went to the same general area but conducted their appraisal with separate groups of people in other locations. Although both the methods appear to have worked fairly well, the latter method is preferred as this allows better understanding of the interactive nature of events and human response.

The second type of interaction was the meeting of the whole group after coming back from the field. Although in the beginning the idea was for the groups to meet every evening, it did not happen that way all the time, particularly when the whole group went to the same general area and then split to form smaller sub-groups. In these cases the group did not wait for the discussion to take place in the evening. Rather they began exchanging notes and debating issues as soon as they had reassembled.

A third way in which the professionals interacted was in the final wrap-up meeting before coming back from the field. These meetings showed that even after almost continuous discussion and debates in the field and repeated attempts at verification of information significant differences in perception could remain. As a result the wrap-up meetings took quite some time - up to four hours.

A fourth method used was to change the composition of the entire RRA teams after each round. This was also effective, though the team leaders rarely had the opportunity of working with each other.

4.4.3 Checklists

The initial checklists prepared by the consultants were rather long. These were trimmed down before going to the field for the first time. Afterwards, they were further cut in

length. Even then the checklists were used by some specialists more as reminders before going out every day while others used them substantially when they went to the field.

An attempt was made to understand the change in inundation levels and associated agricultural changes using an agricultural assessment matrix. The agricultural changes included those in cropping pattern and yield hence deriving changes in cropping intensity. It was not difficult to get the required information but it was quite time consuming.

4.4.4 Triangulation

Triangulation went very well. It helped a great deal in understanding seemingly contradictory statements or the "language" of the people so to speak. Triangulation also helped in broadening the visions of the professionals and made them appreciate the other side of the story. Thus while the fisheries expert talked to fishermen, he heard about the conflicts between fishermen and farmers. But when he discussed the same problems with the farmers, he could understand the trade-offs between fishing and farming more clearly. This would not have been possible only by discussing the issues with the agricultural experts.

Only in one aspect could triangulation not be used fully and that involved womens' issues. This was because of various reasons including societal norms against women talking to males who are complete strangers. Whenever opportunities arose, such as when women were found to be involved in NGO activities or in repair and maintenance works and found moving earth, the team members tried to talk to them. However, it must be admitted that there was little chance of independent verification of statements made by women to women members of the team.

4.4.5 Transects

Transects were attempted in some of the project areas but not all. One possible reason was that much time was already devoted to the agricultural assessment matrix. Secondly, there appeared to be quite complex cropping patterns in some areas depending on micro variations in moisture availability in the soil. (In case of the Chalan Beel Polder D, for example, one could discern quite different cropping patterns on the northern side of a village compared to the south, though both sides ended up in beels, because the general level of one beel was slightly higher than the other). Problems of time and access also constrained the effectiveness of transects.

4.4.6 Diagnosis versus Evaluation

Experience suggests that RRA is a very good method for diagnosis of problems. It may not always be effective for impact evaluation, particularly if people are attempting to evaluate the impact of specific structural interventions made in the fairly distant past.

4.5 CONCLUSIONS

The lessons learnt during the RRAs in the FCD and FCD/I project sites may be summed up as follows:

- for an effective RRA, one should allow one month's time, about half of which will be needed for writing up the report;

- a multi-disciplinary team is essential for evaluation of FCD/I projects;

- one member of the team should be specifically assigned to quantifying and mapping the impacts of the FCD/I intervention on flooding, drainage and irrigation water availability;

- the project area should be small, preferably not more than 5000 to 10000 ha, for RRA to be effective;

- for better interaction among the members of the team the composition of smaller teams should be changed either every day or for each separate location. Further, there must be formal and informal discussion within the team. A final wrap-up meeting before leaving the field is absolutely essential to present a unified view of the team;

- triangulation is an extremely useful tool for RRA while transects may not be so in the present context;

- the team must look at conditions in adjacent areas to assess possible off-site impacts and to define the boundaries of affected areas. In addition control areas should be visited if it is possible to identify any such areas;

- RRA is a highly suitable methodology for diagnostic purposes and is effective for evaluation under certain circumstances.

REFERENCES

Hossain M.A. "A Review of the Livestock Sub-Sector in Bangladesh." In Bangladesh Agriculture Sector Review. Vol.II, UNDP, 1989.

APPENDIX A

SUMMARIES OF THE RRA RESULTS

CHALAN BEEL POLDER D

Project Summary Sheet

Project Name	: Chalan Beel Polder D
Project Type	: Flood Control & Drainage
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. 373.2 million (1988)
Major Flood Damage	: 1986-88
Repair/rehabilitation	: 1987/88 - 1990

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 Pabna 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 R. Barnai when it turns east defines the western and southern limits.

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% of the area with pre-project submergence of up to 0.9m (3 feet) lies at the north-eastern side, mainly along the R. 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 the regular flooding. B. Aman which is low-yielding was the major crop. Floods caused damage 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 was 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 in at least 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 were brushed aside in a single-minded pursuit of 'development' of crop agriculture.

PROJECT AS IMPLEMENTED

A key point in understanding the polder is that, although there is an encircling polder embankment, there is varied topography in the project area 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 naturally many 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 Chanapara 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 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.

PROJECT PERFORMANCE

The embankment has been plagued with various difficulties almost from the very beginning. The construction was more or less completed by 1985. However floods in 1987 and 1988 created severe problems of public cuts and later on of breaches. During the floods in 1986 and 1987, there were altogether 33 natural breaches and public cuts. Six public cuts were made during the 1988 flood while two natural breaches occurred during the same year. Two public cuts were made at Tangrahata and Madhupur. In fact the people inside the project area generally fear the cut in Tangrahata as the results are usually devastating, the sudden on-rush of water not only sweeping away the growing rice plants in its path but also damaging people's homes and hearths. In 1991 there has again been a cut at Tangrahata during the month of July.

PROJECT IMPACT

The problems of repeated public cuts and natural breaches indicate, and it has been verified to be so, that there is much uncertainty regarding the time and depth of flooding. This uncertainty is now beginning to erode people's confidence in the embankment and the erosion may be responsible for the lack of significant change in agricultural practices during the monsoon.

AGRICULTURE

Local Boro and B. Aman were the major rice crops in the pre-project situation. These have now been replaced largely by HYV Boro and HYV T. Aman. With earlier recession of flood water than previously, the lands around the beels are now available for HYV Boro cultivation with an emphasis on shorter duration varieties. However, not all land around the beels could be so cultivated as a band of land remains under water during the transplanting time for Boro and is thus still cultivated with B. Aman.

Although a part of the land previously under B. Aman, particularly on comparably higher ground, has been put under T. Aman because flood water has been prevented from intruding into the project area, farmers are getting weary of public cuts. Previously as they explain, the certain but slow flooding could do little damage as B. Aman is well-suited to withstand such flooding, while the water could also drain out in a few days. Now, with HYV T. Aman in the field, when public cuts occur, resulting in a sudden on-rush of water, and the water remains standing in the field for far too long for the rice plant to withstand, there are serious losses unless immediate public cuts are made on the other side of the polder. In any case, with the stakes being much higher than previously, farmers are hesitating to grow HYV T. Aman and in some cases, they have reverted back to B. Aman. The social consequences of such "regressive" moves could be quite severe.

On the whole the continuing uncertainties have not allowed the cropping intensity in the project area to rise as much as was expected. It has moved from 157% to only 167% instead of to 235% as had been hoped.

LIVESTOCK

Rising production of paddy has increased the availability of straw for use as cattle

feed. But at the same time the area around the beels which previously could be used as pasture land is no longer available. This has contributed to a less varied and, may be, a less nutritious diet. Before the project, predictions were made about a declining cattle population due to shortage of cattle feed. As the decline can be confirmed on the basis of other available data, the project by reducing supply of naturally available green fodder, has contributed to the decline in cattle population in the area.

FISHERIES

Two kinds of change have taken place. The first is clearly negative. The flood plain fishery and the open fishery in the beels have been severely adversely affected due to the lack of regular flooding. Shallow tubewell irrigation around the beels may also have contributed to the lowering of water depth. As ground water is discharged, it is quite likely that the beel water recharges the ground water aquifer. As a result the beels are much shallower than before.

As a result of all these changes the productivity of the beels/khals has gone down. The decline in fish catch is conservatively estimated to be in the range of 40 - 60% since the pre-project period.

Pond fishery has become more popular than before and one finds signs of this everywhere, from the composition of marketed quantity as vouched for by the fish traders to the ubiquity of the fingerling sellers. Despite such changes, however, the loss in open fishery is not likely to be fully recouped in the near future.

ENVIRONMENT

The construction of the embankment and the consequent changes in the hydrological regimes are the major sources of environmental changes , which have caused other second round effects and resulted in other interventions which have environmental impacts of their own. The impacts on hydrology, agriculture, livestock and fisheries have already been touched upon above. Other environmental impacts include

- aggravation of the ground water recharge problem;

- intensification of flood inundation in areas outside the project area;

- acute shortage of water for drinking and domestic use, particularly during the hottest months of April and May;

- increased incidence of diarrhoeal diseases due to problems of drinking water and elimination of regular annual flushing of accumulated human and animal excreta;

- use of the embankment for social forestry which not only facilitates the stability of the embankment but also has a positive impact on the environment.

SOCIAL AND INSTITUTIONAL ASPECTS

There have been several positive and negative developments of a social and institutional nature taking place in the project area. Not all of these can be explicitly related to the project.

Short term employment has been created during the construction of the embankment or other construction and excavation. Additional employment has been created for unskilled labourers in earth works done for repair and maintenance of the embankment. In some cases, where women have been employed for such works, this has had a positive impact on the income of destitute women.

Long term employment opportunities have been created both during the Boro and the T. Aman periods. Although one may doubt how much of the additional employment is really due to the project during the Boro period, the additional employment due to the switch from B. Aman to HYV T. Aman can be almost wholly ascribed to the project. The incremental employment creation is helping not only the agricultural labourers in general but also migratory labour from ethnic minority areas, including women.

People within the project area appeared to have shown cooperative attitudes towards the protection and maintenance of the embankment particularly in medium and deeply flooded areas along the River Sib.

People also show cooperative attitudes in collectively cutting and later on closing the cuts in places where there is no adequate provision for irrigation inlets. No doubt such cuts undermine the strength of the embankment. This implies that there is a need for provision of pucca irrigation inlets.

Where pucca irrigation inlets have been constructed by the BWDB, many of these structures have been taken over by local influential members of the public, who act as the de facto owners of these structures and extract monopoly rent by charging high rates for water, thus creating social discord.

Social conflicts and tensions have also intensified as a direct result of the project because of the public cuts on the embankment and the conflicts arising between the farmers and fishermen and also between groups of farmers who continue to cultivate B. Aman and those who have switched over to HYV T. Aman. In each case the requirements of depth of water in the field or in and around the beels are different. Some people allege that this is also the reason why some of the regulators are without their control mechanisms or do not appear to operate properly.

Social discord also arises in other cases such as leasing-in of borrow pits. In the few cases where these have been leased out they have gone to local influential people, not to the landless, as was expected in the project plan.

The embankment, main roads and village roads constructed under the project have improved transport and communication facilities which have helped to promote occupational diversity. Poor households have now taken up secondary occupations such as pulling rickshaw vans, timber business, bamboo works and supplying bamboo poles and slips to betel-leaf plantations. Boatmen, on the other hand, have lost out. Boat traffic has fallen, demanding less of their services and therefore reducing their incomes. However, more of the long boats which utilise STW engines are being built. This suggests an income distribution effect in favour of the boat making enterprises and their workers and owners.

Although there is at times a cooperative attitude regarding the maintenance of the embankment against breaches or public cuts,the project has not succeeded in involving local people in the routine operation and maintenance of regulators, irrigation inlets or drainage outlets. There is no local committee for these structures and these are operated at the will of local influential persons.

ECONOMIC IMPACTS

The major economic impacts include a raising of paddy output, part of which can definitely be taken to be a result of project intervention. The gain in agriculture has been offset to a considerable degree by the strong disbenefits in fisheries activities and a fall in livestock income and services.

One observes an almost total lack of any spatial variation in the price of rice. The real price of rice also appears to have remained largely unchanged over the last 5 to 6 years indicating that supply has been keeping pace with demand.

Land prices have moved somewhat upward. But their movement appears to have been influenced by the risk of flood. In double-cropped areas with some risk of flooding due to public cut or breaches, price stagnation is noticeable whereas on higher grounds with good prospects for cash crops the price went up sharply between 1989 and 1991.

KURIGRAM FCI PROJECT (SOUTH UNIT)

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	: c.1971
Scheduled Completion	: ?
Actual Completion	: embankment 1983/4, some structures later
Original Cost Estimate	: ?
Final Cost Estimate	: Tk. 147 million up to 1987
Major Flood Damage	: Continued erosion problem - bank protection works in 1987/88
Repair-rehabilitation	: needed

Comments:

Project appears to have been built piecemeal with whatever resources came to hand. Embankment not complete - one part missing, and breaches and cuts elsewhere. Drainage system silted up.

SUMMARY

The Kurigram Flood Control and Irrigation Project (South Unit) set out as a very ambitious project, including a barrage and pumping plant, drainage and irrigation components, which were not completed as planned. Indeed, the drainage and irrigation components have virtually been abandoned. The project as it now stands, is a failure, although it has made the T.Aman crop slightly more secure against flood damage, particularly in the low and medium lands.

Location

The project area, consisting of about 65,000 ha, is bounded on three sides by major water bodies. The Dharla River is in the north, the Brahmaputra on the east and the Teesta on the West and South. The north-west of the project area is bounded by Lalmonirhat Upazila.

Physical Features

The location of the project area at the confluence of relatively minor rivers and the large Brahmaputra River, has an impact on the physical characteristics of the area. The land has a gentle slope of about one foot per mile from the north-west to the south-east. There are occasional undulations with irregular relief due to low pockets. Erosion by the Brahmaputra and Dharla Rivers used to be a major pre-project problem, a tendency that is still retained.

Ecology, Soils and Climate

The soil type is possibly calcareous. The extent of non-calcareous area is not known, but is probably small. The project area has been formed by the deposits of the rivers surrounding it, with the soils varying in colour from light grey to dark grey. There is little variation in the texture of the agricultural soils, which are mostly silt with some fine sand and clay. Soils at the surface show very strong to moderately acid reaction, while those in the sub-soil vary from slightly acidic to moderately alkaline. The area appears to have good agricultural soils with a wide range of capabilities.

Type of Flooding

The Brahmaputra River which forms the eastern fringe of the project area is the largest river in the sub-continent. It has a large number of tributaries, of which the Teesta, the Dharla and the Dudhkumar are the most important. The discharge varies between 130,000 cfs and 2,300,000 cfs. The Brahmaputra, along with the Teesta and the Dharla, serve to drain the project area. They are characterised by unstable beds and banks, with the channels and the shoals tending to change continuously. During the monsoons the rivers used to overspill causing considerable damage to crops and property.

Agriculture

The land area inside the project is 63725 ha and the net cropped area is about 51750 ha. About 40% of the land was flooded almost every year resulting in extensive damage to Aus and Aman crops. Before the project, Broadcast Aus, Transplanted Aman, Boro and jute were the most important crops both in terms of acreage and production.

Increasing agricultural production was the main objective of the project. Due to construction of the embankment the flood level has decreased and land types have changed, bringing a change in crop cultivation and cropping patterns. Cultivation of high yielding paddy varieties has increased manifold. In some areas, three crops are grown (HYV Aus/HYV Boro-HYV Aman - Rabi crops). Due to flood protection, Boro HYV and T. Aman HYV are growing in some of the areas, where it was not possible before the project. This has had an impact on overall cropping intensity, which has increased to 190% from 174% over a ten year period. Much of this change however is attributable to irrigated Boro expansion rather than to the project.

Drainage congestion has resulted in an unintended benefit through increased soil moisture content and better Boro yields (and lower irrigation costs in the winter).

Livestock

The RRA suggests a decline in the cattle population in the project area. However, some increase in the livestock population is indicated by secondary data available. It is difficult to attribute this change to the project. According to Upazila figures, there were around 6 lakh numbers of livestock in 1990 in the Ulipur Upazila. The rate of change of cattle per year is about 1.94% , while that of sheep, chicken and duck are 9.78, 3.18 and 2.22 percent per annum respectively. The rate of increase is comparatively lower in the case of goats, only about 0.10%. The total rate of increase stands at 2.28%. This discrepancy between field observations and secondary data will need to be resolved at the PIE stage.

Fisheries

The overall project impact on fish production as a whole, has been negative. Blockage of the canal mouth on the river side by embankments or sluice gates, has prevented river fish from migrating inland, causing a sharp reduction in fish availability.

River fishermen (in groups of 3 to 4 persons) usually catch big prawns, including some mixed fishes, mainly chela, and occasionally Mystus (4 to 8 kg). They would very much like to move inland with their boats, but are unable to do so because of the embankment and sluice gates, and are therefore unable to sell their catch directly at the market.

Nutrition and Women

It has been nearly ten years since the embankment was completed. There has been some increase in agricultural output, substantial improvement in roads and transport and in overall economic activity. Various NGOs are visibly active in the area. Obviously it is difficult to assess to what extent these changes were due to the project. A high official of the Rangpur Dinajpur Rural Service (RDRS), an NGO operating in the area categorically said that the protection provided by the embankment certainly facilitated their activities. Hence, it may be argued that the increase in overall economic activity in the area can to an extent be ascribed to the protection provided by the project.

There have been some dramatic changes in terms of irrigation, cropping pattern, introduction of high yielding varieties of rice and as a consequence, substantial increase in food production has taken place.

Crop diversification has also been quite impressive in recent years. Vegetables of various kinds, (cauliflowers, tomato, potato) are grown all over the project area. This has contributed towards a more balanced diet by increasing the contribution of such micro nutrients as vitamins A and C, in overall food consumption.

Various NGOs are actively involved in the area. RDRS and Grameen Bank in particular have made quite an impact in improving the condition of the poor, especially women. Women are employed in such diverse activities as afforestation projects and road maintenance, and are provided with loans to carry out petty trading activities, livestock fattening, poultry raising etc. Women's participation in gainful economic activities has thus improved in the project area. Employment of women in official capacities in various NGOs and other offices is also quite visible. In fact, it is common to see women involved in physical work such as planting and maintaining trees, or occupied in more sedentary work such as desk work in various officies.

Social and Institutional Aspects

The region was a labour surplus area with considerable outmigration to the neighbouring districts of Rangpur, Dinajpur, Bogra and Rajshahi, in the months of Bhaishak-Jaistha (April) and again in Kartik and Agrahayan (December). More locally available employment has reduced such outmigration.

Greater protection has been given to roads and physical infra-structure, which in turn has changed living conditions and access, and facilitated marketing facilities, as well as developmental activities by the government and NGOs. Many link roads have been constructed throughout the area connecting the embankment at the initiative of the local authorities, with assistance from the Food for Works programmes and NGOs. The role of RDRS deserves special mention in this regard. RDRS, Proshika, Chhinna Mukul, Grameen bank and other NGO workers and officials admitted that the the project has facilitated development activity through easier access to the far flung areas of the region.

The psychological impact of the project deserves to be highlighted. The community, often the poorest, now have an assured shelter in the event of severe floods, both for themselves, and for their animals and tangible resources.

Environmental Impact

Erosion and sand deposition, (eg. in Lalmonirhat, from the Ratnai regulator to Mogulghat) was observed, and sand and silt deposition occurred as a result of public cuts and breaches.

Lack of proper drainage in many low lying areas, particularly in canals and beels, is causing waterlogging which has encouraged heavy and dense growth of water hyacinth and the fertility of the soil and the overall soil environment has probably worsened.

Economic Aspects

The main economic impact of the project is small, and has been reduced further by the poor state of the structures, many cuts, and widespread drainage congestion problems. The major impact is probably related to an improvement in the physical living environment, and availability of a shelter for animals and humans in the event of floods.

Project Summary Sheet

Project Name	: Meghna-Dhonagoda Irrigation Project
Project Type	: Flood Control, Drainage & Gravity Irrigation
Location	
FAP Region	: South-East
District	: Chandpur
Area (ha.)	: 17,584 ha.(gross), 14,367ha. (irrigable)
Funding Agency	: Asian Development Bank
Implementing Agency	: BWDB
Construction started	: 1978
Scheduled Completion	: 1983
Actual Completion	: 1987
Original Cost Estimate	: US$ 46.0 million
Final Cost Estimate	: US$ 54.9 million
Major Flood Damage:	: 1987, 1988
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.

MEGHNA-DHONAGODA IRRIGATION PROJECT

SUMMARY OF FINDINGS

Introduction

The Meghna-Dhonagoda Irrigation Project (MDIP) is situated in Matlab Upazila of Chandpur District in south-eastern Bangladesh. It has a gross area of 17,584 ha and is located on an island surrounded by the Meghna and Dhonagoda Rivers.

The project area is low lying and pre-project large areas flooded to a depth of 2 to 3 metres every year. Almost all areas experienced some flooding, although soil moisture for agriculture was deficient in the rabi and early kharif seasons.

The project aimed to protect the interior of the island from river flooding and drainage congestion in the monsoon, with a particular aim of encouraging the introduction of HYV Aman, to increase the security of the population, crops and livestock, and to promote irrigation in rabi and early kharif, again facilitating the introduction of HYV paddy varieties.

The project was constructed between 1978 and 1987. It main components are a ring embankment, internal networks of irrigation and drainage canals, and four pumping stations, two for irrigation and two with both irrigation and drainage functions.

The project suffered badly from the 1987 and 1988 floods but since then has met its flood control, and some of its drainage and irrigation objectives. It has promoted substantial agricultural development, offset to some extent by serious losses from the capture fishery.

Design and Construction

MDIP had been in operation for four years at the time of this study, and had suffered embankment breaches in both of the first two years. These breaches caused major flood damage to irrigation structures and ruined substantial areas of farmland by sand deposition.

Although the 1987 and 1988 floods were the highest in recent history and caused devastation throughout Bangladesh, the damage to MDIP was not caused by overtopping but by structural failure of the main flood embankment. From documentary evidence and on-site inspection during the study, it appears that the structures and earthworks, as built, contain many defects of design and construction. In particular, the original design was modified to make the embankment narrower, and both the soil investigation under the embankment, and compaction of the embankment earthwork, appear to have been unsatisfactory. Although the intention of the design modifications was to reduce land requirements and hold down costs, with hindsight they were a serious error which caused immense losses in 1987-88 and continues to prevent the project from producing its full benefits.

On a more positive note, the experience of 1989 and 1990 shows that the main embankment is adequate to withstand a "normal" flood. Although there were serious problems with quality of construction of the main pumping stations, their capacity is adequate and in 1989 and 1990 their operation has been efficient, with no evidence of serious drainage congestion or waterlogging within the embankment.

The embankment has improved road communication around the perimeter of the project, with benefits for passenger journey times, but it does not meet the needs for moving farm inputs and marketed outputs, and the planned interior road system has not been implemented. At the same time the previous water transport system within the project area has been disrupted by design changes which resulted in the main embankment being constructed without navigation locks or transhipment facilities. The result has been a large increase in transportation costs at the same time as the need for freight transport has increased.

Operation and Maintenance

The operation and maintenance of the project is unsatisfactory, with widespread evidence of inadequate maintenance although the project is only four years old. An O&M manual was prepared by the design consultants, but has not been implemented.

None of the planned hierarchy of project committees for managing operation and maintenance are functioning, and there are widespread complaints that the population of the area was not consulted during design and construction. In at least some areas, however, the local people have proved able to develop their own institutions for patchwork rehabilitation of the damaged irrigation system and for managing irrigation. The attitude of the people in these areas towards solving system problems is far more positive than in the areas where BWDB manages the system.

BWDB has neither fixed nor levied a water charge. In consequence funds are lacking for system maintenance, and farmers are encouraged to adopt cropping patterns which are unnecessarily demanding in terms of water supply.

Agriculture

Where the irrigation system is functioning, whether under BWDB or local management, there is a strong benefit from increased production of HYV paddy. Pre-project seasonal cropping sequences with only one paddy crop, usually local Aman or Aus/Aman, plus low water demand rabi crops, have been replaced by sequences containing two or three paddy crops. Cropping intensity is 220 per cent, in excess of the target of 193 per cent. Nearly 60 per cent of paddy area is planted to HYV, including almost all the Boro, and mean yields are estimated at about 4 tonnes/ha., equal to the design estimate. The project area has changed from foodgrain deficit to foodgrain surplus.

There has also been increased production of sugarcane and rabi vegetables, but other non-paddy crops previously grown in Rabi and Kharif I have largely been displaced by paddy. In the case of jute there is a special problem due to loss of retting facilities.

Agricultural wage rates and employment opportunities for day labourers have increased strongly in the irrigated areas, due to the higher cropping intensity and reduced seasonal differences in cropping pattern. There is a bottleneck in supply of draught power to match the increased cropping intensity in the irrigated areas, but this will probably prove temporary.

There are nevertheless causes for concern in the agricultural situation. Over a quarter of the irrigable area is not yet receiving irrigation benefits because the flood-damaged structures have not been replaced, and from observation irrigation is not available to all land theoretically commanded because of construction defects and poor maintenance. The

agricultural extension services in the project area are weak, with additional support requiring to be provided by BWDB extension staff. Other causes for concern include long-term soil fertility and salinity status under continuous paddy cultivation and without natural flooding.

A large number of cooperatives are functioning well as a result of demand for farm inputs and marketing of output.

Livestock

Availability of green fodder and protein feedstuffs for cattle has been reduced, following the reduction in fallow area and substitution of paddy for non-paddy crops. In consequence the greatly increased quantities of low-digestibility crop residues cannot be effectively used. Possible solutions are the dissemination of low-technology ammonia straw treatment, and intensive cultivation of small areas of high-yielding green forages.

Fisheries

The highly productive capture fisheries which previously existed in the project area have been very seriously damaged by the enclosure of the project area to improve monsoon season agricultural conditions. In particular, the fisheries in the interior waters have been almost destroyed, and there has also been serious damage to the river fisheries due to loss of spawning areas. Fishermen have been forced into other occupations, and the purchasing power of those remaining has been reduced. A definitive estimate of the value of output lost is not possible from the RRA data, but losses are probably a significant fraction of the net value of added monsoon season agricultural production.

There has been an improvement in conditions for culture fishery, and some successful initiatives have been sponsored by the Department of Fisheries, but these are unlikely to offset the value of lost capture fisheries and at present appear to mainly benefit landowners, not former capture fishermen.

Environment

The number of tubewells for drinking water has increased, due to freeing of sites from seasonal flooding. Homestead forestry has increased due to improved growing conditions for trees, and there is scope for afforestation of the main embankments.

There is some cause for concern over project impact on environmental health. A sanitation problem (pollution of enclosed waters) is starting to appear and health workers fear that increased fly and mosquito populations may cause infectious disease outbreaks and reintroduction of malaria.

There has been a reduction in numbers of migratory birds, and the rodent population appears to have increased.

Nutrition

Foodgrain security has markedly improved, the project having become a grain-surplus area, and most people can now eat rice, the staple of choice, throughout the year. The availability and variety of rabi vegetables has improved due to the longer duration of flood-free growing conditions.

Social Attitudes

Although many problems are complained of, in the irrigated areas public opinion is firmly in favour of the project. The main complaints are of lack of consultation by BWDB regarding design, construction and operation of the project, and of lengthy procedures and inadequate amounts of compensation for land acquired for project purposes.

Impact on Women

No evidence was found for either positive or negative effects on the role and status of women. The standard of living of women in cultivating and agricultural labour households appears to have risen in line with the general rise in incomes.

Economic Impacts

Although there has been a major benefit in terms of additional agricultural output, in value terms this has been partly offset by the displacement of high-value crops grown before the project, especially in Rabi. It is possible that this is partly due to an over-reaction towards paddy cultivation fostered by the absence of water charges.

There has been an increase in per capita income for farmers in the irrigated areas, and a large increase in real earnings and employment opportunities for agricultural labourers. Farm employment has been increased by about 60 per cent. Land values have increased, at least partly due to project-induced production increases and flood protection, and there has been an increase in the general level of economic activity, especially marketing of agricultural inputs and outputs.

Major economic disbenefits have been identified stemming from loss of capture fisheries, disruption of the internal transportation system, and flood damage due to embankment breaches. The fishery losses, which are associated with the safeguarding of monsoon season agriculture, are especially severe. Taken in conjunction with the high cost of flood control and the greater relative ease of increasing Boro production, they suggest a need for reassessment of strategies aimed at increasing Aus and, especially, Aman production.

ZILKAR HAOR PROJECT

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)
Funding Agency	: NTAP/SIDA
Implementing Agency	: BWDB
Construction started	: 1983/84
Scheduled Completion	: 1986/87
Actual Completion	: 1986/87
Original Cost Estimate	: Tk 49.9 million
Final Cost Estimate	: Tk ?
Major Flood Damage:	: 1988
Repair/rehabilitation in	: 1988/89

Major works still required for completion/rehabilitation:

All works have been completed. There is however strong local demand for enlarging the size of regulators or to provide additional facilities to remove drainage congestion, which needs to be examined.

SUMMARY

The Zilkar Haor project actually encompasses two haors, Haparu Haor and Zilkar Haor, each being a sub-project within the overall project framework. The Zilkar Haor subproject is protected by a submersible embankment in the north, to prevent early monsoon flash floods which used to destroy the Boro crop in the field. The Haparu Haor area is protected by a full flood embankment which is meant to provide year round protection from both pre-monsoon and monsoon floods. While flood protection is the main element of the project, the drainage and irrigation components are quite important. The project is located in Kotwali Thana in Sylhet Upazila, bordering on the Sylhet-Sunamganj highway in the South. The project was completed in 1987, and despite some problems, notably related to drainage, has succeeded in yielding very significant benefits.

Engineering

Pre-monsoon flash floods have been effectively controlled in both the haors. Haparu Haor faces severe drainage congestion in the lower regions, so that remedial measures need to be adopted to stop infiltration of water into the project area through the structures, and creation of additional drainage facilities.

Agriculture

The main impact of the project is supposed to be on agricultural production through flood loss reduction and cropping pattern changes. The impact on the Zilkar Haor sub-project appears to have been as planned. The (traditional) Boro crop has now been protected. This has marked a great improvement over the previous situation when 50-80 percent of the crop could be lost in any one year. A more secure environment has also begun to stimulate investments in low lift pumps and an irrigated Boro crop.

The impact on Haparu Haor is less straightforward. There is an acute drainage problem here which has considerably reduced benefits. Large parts of the project area remain inundated, preventing both Aus-Aman cultivation (the traditional pre-project crops) as well as Boro cultivation. The net impact however is positive.

Fisheries

No planned objective related to fisheries was laid down in the project documents. During the field visit, the following benefits and disbenefits were recorded: fish production has declined in Zilkar, where the perennial water area has been drastically reduced. In Haparu, there has been a large increase in fish output, with open fisheries giving way to capture fisheries. However these trends have been accompanied by several changes: fish species composition appears to have changed, especially in Haparu; fishing time has decreased, as fishing activity has now become concentrated within 1.5 to 2 months compared to 4 to 5 months of fishing time before the project. There appear to be fewer traders, and consumption is likely to have decreased due to erosion of a community resource.

Livestock

No planned objective was recorded in terms of the impact on livestock. On the positive side, rice bran production has increased, while the grazing area could have been reduced by as much as 25-30 percent, with the expansion of the area under rice. Straw quality has also

deteriorated due to the reduction of the T.Aman area. These effects have resulted in lower milk output and fewer cattle.

Non-Farm Activities

Very few non-farm activities were reported. Local NGO officials have suggested that their work has been facilitated by the project, and group savings behaviour has improved. This could conceivably stimulate non-farm activity. There is significant potential for employment generation through embankment maintenance work and expansion of road transport. On the negative side, boat transport has been adversely affected.

Women

The project has had very little impact on women.

Social and Institutional Aspects

The FCD project has generated a number of positive impacts: seasonal outmigration has been reduced, road communication has improved. Increased benefits have created greater awareness of the need for cooperation for maintenance and operation of embankments and structures. There have however been reports of conflicts of interest between fishing and farming, especially with the timing of draining of water from the beels. The overall social impact is encouraging.

Environmental Issues

On the positive side, the intensity and area of inundation has decreased, and there is less marshy land now, creating a potential for planting of trees for fruit and timber. On the negative side, water hyacinth infestation has increased; beels are receiving silt at a lower rate than before; erosion by the Surma River continues unabated, and adjacent areas suffer from greater depth of flooding; borrow pits have become a breeding ground for water hyacinth and mosquitoes.

Nutrition

Increased agricultural growth and a better crop mix are expected to improve nutritional standards. Decreased livestock and fish products will mean a diet even more restricted in terms of choice.

Economic Aspects

While RRA is not suitable for accurate quantification of benefits and costs, a rough and ready calculation of net agricultural impacts (benefits) and project costs, suggests a financial BCR of around 1.9. This tends to support the overall qualitative impression of Zilkar Haor Project as one that has achieved a modest level of success.

Project Summary Sheet

Project Name : Kolabashukhali (KBK) Project

Project Type : Flood Control (saline exclusion) and Drainage

Location

FAP Region : South-West
District : Khulna and Jessore

Area (ha.) : 25,466 ha.(gross),
18,623 ha. (irrigable)

Funding Agency : IDA (World Bank)

Implementing Agency : BWDB

Construction started : 1975

Scheduled Completion : 1983

Actual Completion : 1983

Original Cost Estimate : US$ 6.20 million / Tk 93.0 million

Final Cost Estimate : US$ 4.03 million / Tk 88.1 million

Major Flood Damage: : 1988

Repair/rehabilitation in : 1990/91

Major works still required for completion/rehabilitation:

Resectioning/retirement of sections of embankment.

Construction/upgrading of internal road system.

KOLABASHUKHALI PROJECT

SUMMARY OF FINDINGS

Introduction

The Kolabashukhali (KBK) Project is a combined flood control and drainage project located on the border of Jessore and Khulna Districts in south-western Bangladesh. The Project area is a tidal river island approximately 25,500 ha in area, surrounded by four rivers, the Atrai, the Nabaganga, the Chitra and the Atharobanki.

Much of the interior is low lying and pre-project was flooded both daily and seasonally by water penetrating through the khals. In the dry season saline water advanced northwards, and irrigation with river water was only possible at the northern extremity of the island. As a result before the project a large area was uncultivated and the rest could only grow a single crop of deep water Aman.

The project aimed to control both daily and seasonal flooding, while permitting irrigation to continue. It was aimed to facilitate cultivation in areas which had previously been too deeply flooded and to promote a move from B. Aman and Aus/Aman crops to T. Aman.

The project has succeeded in its primary aims, and delivered a substantial part of its intended agricultural benefits, but these have been offset by a severe negative impact on fisheries, estimated at 40 percent of the value of the increased crop production.

Engineering Design, Maintenance and Operation

There is still drainage congestion during heavy rainfall due to:

a) the inadequate number and capacity of the drainage facilities;
b) failure to develop a fully interconnected drainage canal system;
c) failure to maintain the drainage canals and structures.

Operation of the sluices, both for drainage and irrigation needs, is not well coordinated with agricultural requirements.

The project shares, with many others in the region and throughout Bangladesh, the problems of :

a) river bank erosion, which will require continuing attention to bank protection to avoid breaches of the embankment;

b) riverbed siltation, which results in raised water levels and may require embankment raising in the future.

Institutions

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.

There is no high level 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.

There has been no coordination between the development institutions responsible for the project: BWDB, BRDB, BADC, DAE.

Agriculture

The project has fulfilled its primary aims by creating a large increase in crop production through :

a) increased cultivable land in low-lying areas;
b) increased cropping intensity due to reduction of deep flooding;
c) reduction of salinity;
d) increased security against water level fluctuation.

Where irrigation is available and soil is suitable, the land benefits from (c) and (d) are extended through facilitation of HYV boro cultivation. This was not a major planned objective.

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

a) imperfect monsoon season water control in low lying areas;
b) shortage of rabi season water supply in higher areas.

There is some evidence that, as in other embankment projects, soil fertility has declined since the project was completed, with corresponding reduction in crop fields.

There has been little change in cropping pattern compared with pre project, and in particular there has been little increase in T. Aman due to water control problems in low lying areas, but local Boro area has decreased as a result of lower residual moisture in the higher areas.

There has been an increase in weed growth, particularly in the monsoon season, leading to increased weeding labour requirements (up to 30%).

Livestock

The loss of natural fodder from low lying areas has been largely compensated by the increased availability of crop by products, but this leaves the livestock population vulnerable in case of crop failure.

Fisheries

Beel drainage and blockage of fish migration routes to and from the rivers have caused a major decline in fish stock size and species composition in both the beels and rivers with consequent 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.

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.

Over and above normal inflationary effects on fish prices, the reduction of fish catches, coupled with continued population growth, has led to a large increase in unsatisfied demand and up to 10 fold fish price increases, which must give rise to concern about nutritional effects on lower income groups.

Environment

Reduction of water and salinity in lowlying areas has made possible the introduction of previously excluded crop and tree varieties including jack fruit, mango, papaya, sugar cane and bananas.

Crop damage due to water hyacinth has been substantially reduced, though it still occurs.

Due to the stagnant condition of shallow water bodies in the project area, the snail population has increased resulting in increased incidence of liver fluke in cattle.

Women

The impact on women in farm households has been to increase their workload, but this is against a background of previous severe underemployment.

Social and Distributional Issues

Where previous private land rights existed in land which is now better drained, the title holders have been able to make a beneficial shift from mainly fishing to mixed fishing and agriculture. However, the initial distribution of newly drained khas lands has tended to be inequitable, favouring already wealthy groups.

The project allows more reliable year-round road communication within the polder, leading to improved social, education and health-care facilities, and improved transportation for passengers and goods, but it has adversely affected internal boat transport in the dry season.

Marginal farmers have benefited through increased agricultural work on their own holdings and also through increased self employment opportunities due to enhanced economic activity in the project area.

Economics

Land values have increased, particularly for those lower areas where more than one crop can now be cultivated reliably.

Standards of living for most of the farming population have improved due to the project, though the livelihood of farmers in low-lying areas remains risky due to fluctuating

water levels. Most of the full time professional fishermen, both on the main rivers and on the khals and beels, have had their incomes severely reduced (by up to 75 percent).

Recommendations

Engineering

The entire drainage canal network of KBK should be re-excavated and extended.

A hydrological reassessment of the KBK drainage system should be made, to determine its capacity and the flows it is required to handle. If present complaints of inadequate drainage are substantiated, new drainage facilities should be constructed. A provisional identification of suitable sites is as follows:

Bhuzniar Khal	-	drainage/flushing sluice
Benda Khal	-	" " "
Kola Khal	-	" " "
Dead Chitra (E. end)	-	" " "

The dead Chitra should be re-excavated and its western end connected to the new Bombhag Khal regulator.

The existing BWDB-constructed road from Gazirhat to Terokhada should be rehabilitated to provide an all-season link between the eastern and western sides of the project, and to link the Kalia area road system with that south of Terokhada.

Early attention should be given to repair and maintenance of damaged and leaking sluices. In particular the Lohargati sluice, at present abandoned and inoperable, should be rehabilitated.

Sluices originally designed for one-way operation (drainage only or flushing only) should be modified to permit safe two-way operation, since this type of operation is already taking place.

Better hydrological studies are required before all FCD/I projects, to avoid problems of inadequately sized structures and siltation of waterways.

Adequate budgetary provision should be made for O&M of KBK and all similar projects.

Planning of New FCD Projects

The scope for and benefits to irrigation in saline-exclusion polders, including KBK, using impounded water and/or minor irrigation techniques, should be investigated. If an impoundment strategy is found feasible and economically justifiable for KBK, it should be the subject of a second phase of development.

For new FCD/I projects where an impoundment strategy is adopted:

a) it should preferably be incorporated at the earliest planning stage, rather than added later when resistance from people already farming the reclaimed land is likely;

b) reservoirs should be sized and operated as far as possible to provide a permanent stock of fish for local consumption and to assist in restocking other waters.

The planning stage of all FCD/I projects should include a thorough benchmark survey of the agricultural, fishery, livestock and socio-economic conditions in the project area.

Institutions

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 improved conditions. Preferably in new FCD/I projects such reorganisation should occur at the time of completion and should include an integrated structure for the entire project.

An institutional structure 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:

a) reorganised sluice committees representing all sections of the community with an interest in sluice operation; and

b) a project-level committee on which Upazila Chairmen and senior BWDB representatives would sit.

The structure could also contain intermediate levels if these were found necessary.

Coordination must be improved between BWDB and other government and quasi-government bodies concerned with development in polder areas. These include DAE, BRDB, BADC, R&H, ...

Agriculture

An agricultural adaptive research programme is required to find crop varieties which will exploit the post-project conditions more efficiently than the existing traditional varieties of the Khulna area.

Social Issues

Pre-project socio-economic studies should give particular attention to the roles of all family members (not only adult males). In the South-West Region and any other regions where there is significant out-migration they should examine the possible special needs of single-parent families.

More positive encouragement should be given to bona fide groups of landless people to apply for allocation of khas lands reclaimed for cultivation under FCD/I projects. The same principle applies to fishermen's groups which may apply for khas water bodies. NGOs may have an extremely useful role in promoting such group applications.

Fisheries

The Fisheries Department should actively encourage private sector involvement in carp

hatchery/nursery facilities in or near KBK. Additionally, a freshwater shrimp hatchery should be established as near as possible to the project to encourage the developing freshwater shrimp industry. It is considered that technical and some financial assistance will be needed for shrimp hatchery development.

Environment

A programme of forestry strip plantation of roadsides and canal banks in KBK with economically useful species should be initiated as soon as possible.

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: :

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.
Reexcavation of approx. 12 km. of main drainage channels.
Rehabilitation of Khalashi sheds.

PROTAPPUR IRRIGATION PROJECT

SUMMARY OF FINDINGS

Introduction

The Protappur Project is a combined flood control, drainage and irrigation (FCDI) project covering a gross area of 9200 ha in Kahalu Upazila, some 16 km west of Bogra. The project area is part of the Barind Tract of north-west Bangladesh, an area of relatively high ground with well defined slopes which cause rain water to drain fairly quickly to the rivers.

The main problems the Project was intended to correct were:

- Flash floods during the pre-monsoon period resulting from heavy rainfall in the upper catchment of the Nagar River;

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

The project involved construction in the mid 1970s of a 10 km flood protection embankment along the east bank of the Nagar River, and of a series of regulators with movable gates on drainage channels within the Project area. The drainage channels themselves were also deepened.

The flood control components of the project aimed to prevent damage to the maturing Aus Crops and to the newly transplanted Aman Crop. This objective was broadly achieved for the first 12 years of the project, but in recent years poor maintenance has resulted in damage to the embankment, which was under rehabilitation of the time of the RRA.

The irrigation and drainage components aimed to promote a shift from local to HYV T. Aman in the monsoon season. This has also taken place, but there has also been a notable growth of HYV Boro, and to a lesser extent other rabi crops, with irrigation supplied by deep and shallow tubewells. As a result the most important agricultural developments in the area are not affected by the Project.

Engineering, Operation and Maintenance

The regulators, especially those in the low lying areas, have been successful in preventing over-drainage of those areas, but their effectiveness has been reduced by inadequate maintenance.

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

Retention of monsoon water and prevention of over drainage are likely to have contributed significantly to groundwater recharge.

Uncontrolled operation of regulators has been adversely affecting both irrigation and drainage since a few years after completion of the project.

The size of channels is not well adjusted to the flows of water they must carry or retain for irrigation purposes.

Institutions

There was public involvement in the operation of several of the regulators in the early years of the project, but later influential people assumed control of the regulators to their own advantage. There are signs of social conflict due to this conversion of public into private property by a few wealthy persons.

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

The project was initiated on public demand, articulated through the agricultural cooperative societies, but the mismanagement and disrepair of the regulators have caused public apathy towards the project.

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

Agriculture

Crop security has improved due to the embankment, which is successful in preventing flash floods from the Nagar River.

There is still a problem of rainwater congestion which causes crop damage in the lowest areas, due to defects in the design, maintenance and operation of the regulators.

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

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

The agricultural impact of the project is confined to the monsoon season and is overshadowed by the growth of dry season cropping with tubewell irrigation. This raises important issues of agricultural development strategy.

Livestock

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

Fisheries

On timing grounds, it is unlikely that the recent growth of pond fish culture in the project area is directly related to project impact.

The project has helped to create the economic climate for fishery development, by increasing disposable income both for fishery investment and fish consumption.

Fish ponds remain at risk from overtopping by rainwater floods in the lower areas of the project.

Environment

The project effect in increasing the area of HYVs may be leading to fertiliser and pesticide residues in surface water, especially in the lower part of the project, which may have an adverse effect on fisheries and may lead to pesticides entering the human food chain.

Project impact on groundwater recharge may have prevented falls in groundwater level detrimental to shallow drinking water tubewells. This is a benefit in itself and is also likely to have reduced incidence of diarrhoeal diseases.

Women

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

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

Nutrition

There is no food grain scarcity, and the position of the project area as a net surplus region for foodgrains has been strengthened by the project.

The beneficial linkage between project agricultural impact and fishery investment may in time reverse the present declining trend in per capita protein consumption.

Economics

The project has raised farm incomes by assisting the move from local T.Aman to HYV T.Aman, but the effect could probably have been achieved without the project by use of tubewells for supplementary monsoon season irrigation.

There has been a small increase in real wages for farm labour, due partly to the project's effect on introduction of HYV Aman.

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

NAGOR RIVER PROJECT

Project Summary Sheet

Project Name	Nagor River Project
Project Type	FCD
Location	
	FAP Region : North-west **District :**Bogra-Natore
Area (ha.)	15,400 ha (gross) 9,312 ha (net)
Funding Agency	**EIP**
Implementing Agency	BWDB
Construction Started	1983/84
Scheduled Completion	1985/86
Actual Completion	1986
Original Cost Estimate	270.6 lakhs (taka)
Final Cost Estimate	
Major Flood Damage	1987
Repair/Rehabilitation	1988/89

Major works still required for completion/rehabilitation:

Excavation of the Hulhulia Khal and repair/maintenance of regulators (except the one at Domdoma) has become urgent.

SUMMARY

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

Objectives

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

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

Location

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

Hydrology

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

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

The public cuts which remain open for most of the monsoon period despite the limited annual repair, alleviate the impact on river flow by allowing some escape, but in doing this the lower Nagor is effectively reversed. From the confluence with the Atrai-Gur anabranch at Karsati village, the Nagor flows rapidly upstream to the first left bank cut, where it is joined by outflow from the Nagor Valley project on the opposite bank. This has caused serious bank erosion in the area.

Agriculture

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

Livestock

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

Fisheries

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

Social and Institutional Issues

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

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

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

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

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

There appears to be no systematic method for record keeping and storing of relevant

project documents in the Water Board offices. All too frequently, consultants have to rely on the highly personalised knowledge of individuals for critical information. It is strongly urged that steps be taken to remedy this situation in the interest of efficient project evaluation.

Communications/Shelter

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

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

Operation and Maintenance

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

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

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

Environmental Issues

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

Economic Impact

The overall economic impact of the project is negative.

SONAMUKHI-BONMANDER BEEL DRAINAGE PROJECT

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 : ?

Final Cost Estimate : Tk. 116.25 lakhs

Major Flood Damage: : ?

Repair/rehabilitation :

A sixteen km long khal, the Amrakhali, was re-excavated in 1990 in the project area and has had significant influence on the improvement of drainage.

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). The boundary of the project area as given in the approved PP is the Kobadak river in the east and in the north, the Jessore-Benapole road and railway in the south, and the Kodla (or Kodalia) river in the west. In the north and the west, the boundary is also defined by the international border between Bangladesh and India.

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

i. 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;

ii. 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;

iii. 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:

a) Removal of drainage congestion;

b) Prevention of damage to crops from monsoon flood; and

c) Reclamation of low-lying areas for cultivation.

PROJECT AS IMPLEMENTED

To achieve the objectives the following engineering features were implemented:

a) Five drainage sluices of 1 - 3 ventage.

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

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

b) Six bridges were constructed in connection with the project.

Four bridges are inside the project area: Keralkhali bridge, Khaskhali bridge, Sialghona bridge and Kulpala bridge, and two are outside the project area: Ulashi bridge and Jadunathpur bridge.

c) Embankment : 2 km

d) Excavation/improvement of drainage 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.

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

PROJECT PERFORMANCE AND IMPACTS

Performance

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

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

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

Agriculture

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

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

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

Fisheries

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

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

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

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

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

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

Livestock and Poultry

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

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

Environmental Aspects

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

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

Social and Institutional Aspects

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

a) Social and Institutional Impacts

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

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

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

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

b) Impacts on Women

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

c) Impacts on Nutrition and Health

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

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

SAKUNIA BEEL

Project Summary Sheet

Project Name	: Improvement of Sakunia Beel in P.S. Kotwali & Nagarkanda
Project Type	: Flood Control and Drainage
Location	
FAP Region	: South-Central (in South West Regional Study)
District	: Faridpur
Area (ha.)	: 5700 ha. (gross), 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 196.0 lakh
Final Cost Estimate	: Tk 121.12 lakh
Major Flood Damage:	: 1988
Repair/rehabilitation in	: 1990-91

Major works still required for completion/rehabilitation:

Repair of embankment section damaged and breached by 1988 flood. Repair of cracked/failed wing wall of Bilnalia regulator. Re-excavation of some sections of drainage khals.

IMPROVEMENT OF SAKUNIA BEEL

SUMMARY OF FINDINGS

Introduction

The project to improve Sakunia Beel is a flood control and drainage project located in Faridpur District in the south-centre of Bangladesh.

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

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

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

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

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

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

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

Engineering

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

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

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

The drainage objective of the project has not been fully realized, and uncertainty of HYV paddy production in the Boro season still prevails in the Sakunia Beel areas.

The project was launched on the basis of inadequate designs in relation to capacity of regulators and provision for drainage requirements.

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

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

Agriculture

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

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

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

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

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

i. decrease in depths of water in the monsoon;

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

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

Livestock

The cattle population has declined due to a shortage of cattle feeds, especially green feed stuff, and also due to distress sales of cattle caused occasionally by crop damage.

The incidence of parasitic diseases of cattle such as liver flukes has increased due to an apparent increase in the snail population.

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

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

Fisheries

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

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

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

i. Reduction of flood risk of cultured fisheries;

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

Nutrition

The nutritional status of the diet has declined due to:

i. decrease in fish availability;
ii. decrease in traditional sources of protein such as pulses.

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

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

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

ii. increase in wheat production within the project area.

Social Impact

The embankment acting as a road, created social and economic infrastructure in the southern portion of the project area, which facilitated movement of goods and services to and from these areas. It has also promoted diverse occupations such as rickshaw vans, machine repair facilities, petty trades, etc.

However, the development of village roads has not been adequate to compensate for the decline in boat transport after the project.

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

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

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

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

Economic Impact

The level of employment has increased:

i. as a result of construction of embankment and excavation/re-excavation of drainage channels;

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

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

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

SILIMPUR-KARATIA REGULATOR CUM BRIDGES

Project Summary Sheet

Project Name : Silimpur-Karatia Regulator Cum Bridges

Project Type : Flood Control, Drainage, and Irrigation

Location

FAP Region : North-Central
District : Tangail

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

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

Implementing Agency : BWDB

Construction started : 1982

Scheduled Completion : 1983

Actual Completion : 1983/84

Original Cost Estimate : Tk.2.4 million

Final Cost Estimate : Tk.6.36 million

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

Repair-rehabilitation: maintenance comprises periodic resectioning of embankment.

Comments:

"Project" largely ineffective, irrigation is all by groundwater, gates have rarely been closed, and floodwater can enter from another river which remains open.

SUMMARY

Introduction

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

Hydrology

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

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

There are very few ponds in the area.

Operation of the Structures

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

Agriculture

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

Fisheries

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

Livestock

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

Non-Farm Activity

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

Communications

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

Social Conflict

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

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

Observations and Recommendations

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

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

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

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

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

KATAKHALI KHAL PROJECT

Project Summary Sheet

Project Name	: Regulator-cum-bridge on Katakhali Khal
Project Type	: Flood Control and Drainage
Location	
FAP Region	: North-Central
District	: Jamalpur
Area (ha.)	: 2660 ha. (gross, but larger area slightly influenced), 2226 ha. (net cultivable)
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
Final Cost Estimate	: Tk 9.5 million
Major Flood Damage	: 1988
Repair/rehabilitation in	: not yet

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.

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.

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:

1. 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

2. 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:

1. There would be an increased area under T. Aman, and higher yields; and

2. 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.

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)

a) Embankment crest elevation +54.6 ft. PWD
b) Embankment crest width 14 ft. (4.3m)
c) Cross dam width 14 ft. (4.3m) and crest elevation +57.2 ft. PWD
d) 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.

a) Regulator at Taltala Beel = 1 vent
b) Regulator at Katakhali Khal = 3 vents

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

a) Box sluice at Kendua
b) Box sluice at Birtara Kharapara
c) Box sluice at Birtara Dholapara
d) Pipe sluice at Barsara of Mahadan union
e) Pipe sluice at Diarkrishna of Satpoa union

The two main flushing-cum-drainage regulators at Katakhali Khal and Taltala Beel were 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 even corrected to reflect the actual structure constructed. Moreover there are actually three box sluices instead of two in the original proposal and 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 the least one might expect given that 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% 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.

The PCR (BWDB, 1986) claims that there are also four pipe outlets, but there is no budget line for this item, nor were any found by the team.

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 was 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.

The project has enabled T. Aman to replace B. Aman on medium-high land, and even HYV Aman to be grown. However, much of the agricultural growth in the area has resulted from growth in HYV Boro cultivation with groundwater irrigation. This has also occurred in nearby non-project areas, and has happened despite flood and drainage problems inside the project. The regulators and sluices have helped locally to improve drainage, but the change mainly results from the introduction of irrigation. Silting up of the beels has increased the cultivable area (for Boro). It may be that flood protection has meant that local soil erosion has not been washed out of the project, but this cannot be proved.

Open-water fish production has been decimated with the separation of the beels from the rivers during the early flood period, but fish cultivation in ponds and 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. Overall, however, the project cannot be judged to be very successful as the agricultural benefits are modest and the fisheries losses substantial.

HALIR HAOR

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

SUMMARY

Project description

Halir Haor is a submersible embankment project in Sunamganj District. It was taken over from local bodies by BWDB sometime between 1976/77 and 1983/84, and has an embankment length of 53 km. Two regulators were built in 1984-87 under SSDFCP (IDA credit 955-BD) to improve drainage and reduce recurrent maintenance of annual cuts. The aim of the project was to safeguard the Boro harvest by preventing floods before 15 May of more than 20' PWD. The benefited area is about 8,000-8,700 ha in total.

Engineering assessment

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

Institutional assessment

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

Agriculture

There is one crop per year, mostly local Boro. Following the project the cultivated area has increased by 6% of the total area, and now 5% of the area is under HYV Boro. Before the project Boro yields were on average considerably lower than was theoretically possible because of frequent early flood losses. The project still does not protect Boro completely. For example in 1990 early flooding led to a total loss, but on average yields are estimated to be about 19% higher with the project than pre-project (or without the project), because of somewhat better flood protection. Overall these changes result in about one third more paddy being produced on average, but output still fluctuates.

Livestock

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

Fish

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

Environment

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

Nutrition

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

Women

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

Socio-economic

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

Floods

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

Economic re-assessment

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

SOME KEY LESSONS

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

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

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

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

KAHUA - MUHURI EMBANKMENT PROJECT

Project Summary Sheet

Project Name	: Kahua-Muhuri Embankment Project
Project Type	: Flood Control, Drainage and Irrigation
Location	
FAP Region	: South-East
District	: Feni
Area (ha.)	: 2638 (Gross) 2024 (net cultivable)
Funding Agency	: Not available
Implementing Agency	: EPWAPDA, BWDB
Construction Started	: Not available
Scheduled Completion	: Not available
Actual Completion	: Not available
Original Cost	: Not available
Final Cost Estimate	: Not available
Major Flood Damage	: Not available
Repair/rehabilitation	: Not available

BACKGROUND

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

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

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

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

- to drain off excess water from the Muhuri to protect the project area from flood and thereby save T. Aman from flood damage; and

- to facilitate irrigation for HYV Boro cultivation.

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

PROJECT STATUS

The flood control embankments encircling the project area (of 2638 ha.) were constructed in different phases. Resectioning is carried out every year. Due to the highly meandering nature of the Muhuri, severe scouring occurs every year in different places,

decreasing the set back distance in such places to virtually nil. Moreover, local people cut the embankment to install low lift pumps or to permit gravity irrigation. Later, they seal these cuts with loose sandy soil which undermines the strength of the embankment. As a result, the embankment is breached quite easily during the following monsoon and flood water enters through those breaches damaging the T. Aman crop. Along with the flood water comes the silt, heavily laden with sand from the hills raising land levels and reducing fertility. During the next Boro season, the gap remains unfilled and when pre-monsoon flash floods occur the Boro crop is also damaged.

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

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

PROJECT PERFORMANCE AND IMPACTS

Agriculture

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

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

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

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

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

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

Livestock

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

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

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

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

Fisheries

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

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

Environment

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

There are problems of environmental hygiene in many places. Waterlogging in small pockets creates ideal grounds for mosquito breeding and consequently one hears complaints about increased infestation of mosquitoes. Although one finds hand tubewells being used for drinking water, ponds are still used for all other types of washing. It is not surprising that the incidence of skin diseases is rather high.

Women

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

Social and Institutional Aspects

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

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

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

KONAPARA EMBANKMENT PROJECT

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

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.

SUMMARY

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

Project Area

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

Structures

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

Pre-Project Agriculture

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

Post-Project Agriculture

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

Other Impacts

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

of other areas:

1. Communication has improved, facilitating haulage to markets and access to schools;
2. More local employment has been generated reducing out-migration;
3. Incomes and nutritional status have improved;
4. Protection from floods has led to more fruit trees in the area;
5. Small stock and poultry has increased;
6. Pond fish culture has increased significantly.

Negative impacts have also been recorded:

1. Capture fisheries have declined as migratory routes have been blocked;
2. Grazing land has decreased but fodder availability has increased with expanded Aman production. The former is probably due to more intensive cultivation under irrigation, and cannot therefore be attributed to the project. The latter is a project effect. The net effect has been a reduction in the livestock population.
3. Adjacent areas have been strongly disbenefitted, leading to acute social tensions.
4. There are areas of drainage congestion and sand deposition, causing environmental damage.

Recommendations/Observations

1. The project is incomplete in design. This needs closer examination. At present it is just an embankment that does not seem to begin and end in any logical place.
2. The embankment is in very poor shape although completely resectioned in 1989. Complete lack of O&M is evident.
3. Inappropriate placing of drainage outlets has been reported. These need to be lowered to facilitate its function.
4. There is huge potential in the field of social forestry on the embankment, which has gone largely unnoticed. Similarly, there is considerable scope for fish cultivation in flood-free water bodies, but this is constrained by legal tangles about ownership rights.

POLDER 17/2

Project Summary Sheet

Project Name	: Polder 17/2 (of Coastal Embankment Project)
Project Type	: Flood Control, Drainage and salinity exclusion
Location	
FAP Region	: South-West
District	: Khulna
Area (ha.)	: 3723 ha.(gross), not all within protection of embankment 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-1970's
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.

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.

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.

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. In pre-project conditions, therefore, crops could not be grown in much of the area during the winter because of salinity levels. Instead 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 benefit was expected to be from exclusion of saline water and from securing the Aman harvest.

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 are 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. 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 could not be regarded as complete in terms of the original design and so it was not fully effective. During the same first ten years of the project seasonal commercial shrimp cultivation expanded rapidly in the project area, changing radically the water management aims of land users.

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 slightly 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.

Agriculture has benefited: higher land is now largely salinity free and higher yields are achieved along with higher cropping intensities - particularly a growth in vegetable production. On lower land there is now a conflict of interest which was less acute before the closure: shrimp cultivation is still profitable, particularly to the shrimp gher management, but if saline intrusion is ended the land can eventually go under HYV Boro - which ensures that a higher percentage of the profits go into the small landowner's pocket (although the cost of buying water is high).

BRAHMAPUTRA RIGHT EMBANKMENT

Project Summary Sheet

Project Name	: Brahmaputra Right Embankment, Kamarjani Reach
Project Type	: Flood Control and Drainage
Location	
FAP Region	: North-West
District	: Gaibanda
Area (ha.)	: 10,000 ha.(gross) (Kamarjani Reach)
Funding Agency	: IDA
Implementing Agency	: BWDB
Construction started	: 1963 original 1974 rehabilitation
Scheduled Completion	:
Actual Completion	: 1970 original 1975 rehabilitation
Original Cost Estimate	: Tk.78.95 million (1963-70) for the entire BRE
Final Cost Estimate	: Tk.395.8 million (1974-85) for the entire BRE
Major Flood Damage	: 1984
Repair/rehabilitation	: Major work in 1974-85 period, frequent erosion and construction of retired embankments, particularly since rehabilitation.

BRAHMAPUTRA RIGHT EMBANKMENT - KAMARJANI REACH

SUMMARY OF FINDINGS

Introduction

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

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

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

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

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

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

Engineering

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

The BRE has however aggravated drainage congestion problems in the monsoon through the reduction of drainage provision/outlets in the retired embankment and through silting up of Khals and rivers (eg. the canal from Matherhat bridge down to Sarai sluice gate

near Kamarjani Bazar). In years of heavy and continuous rains, water congestion stays for weeks and causes damage to crop production as follows:

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

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

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

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

There has been indiscriminate construction of Kutcha village roads under FFW programmes, but because there are virtually no drainage provisions or culverts in these roads, localised drainage congestion and sand washing occurs during heavy rainfall.

Agriculture

Total foodgrain output in the dry and pre-monsoon season has gone up about three times compared to the pre-project situation. This incremental output is not entirely due to the project. A large part of HYV Boro rice output is due to the expansion of mechanized irrigation. The major sources of rice output growth are:

i. replacement of the traditional Aus rice area by HYV Boro rice, in locations which have access to mechanized irrigation, mainly STWs and DTWs;

ii. replacement of traditional Boro rice area by HYV Boro rice;

iii. HYV boro production from additional area brought under cultivation as a result of drying up of beels;

iv. Wheat production from early drained land.

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

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

The protection of high, and medium high lands from normal flood has provided opportunities for intensifying vegetable production. The vegetables are consumed locally and also transported elsewhere on a commercial basis. Homeyard vegetable production by women

has been increased, especially in areas where NGOs have programmes.

Livestock

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

i. increased cost of keeping large animals;

ii. shortage of feeds, especially green grasses, rice straw and pulses bran;

iii. decrease of grazing land in char areas.

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

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

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

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

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

Fisheries

Open water fish production in beels and khals has decreased as a result of :

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

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

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

The prevalence of rain water through surface run-off from the north and west of the project area causes inundation in low and medium low areas, as a result of which pond fish culture has not been possible in these areas.

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

Environment

The BRE has caused a decline in soil fertility in the project area due to prevention of alluvial silts, which used to be carried by the flood water before the construction of the embankment.

It has however also proved to be a barrier to sand deposition, which in effect has helped rice production.

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

Social Aspects

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

The BRE, as well as the internal village roads, has facilitated the development activities of GOs and NGOs in the project area.

There has been a significant loss of land (homestead and cultivable) due to the construction of retired embankments on several occasions.

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

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

Now that some work opportunities for women are available, due to increased rice production, earth work, road maintenance, and some NGO income generating programmes for women, specially distressed women from poorer households, appeared to be eager to work outside their homes to supplement household income.

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

Availability of drinking water from tubewells has increased due to :

i. availability of inundation free locations for tubewell installation;

ii. increased availability and distribution of tubewells through Government

agencies and the open market.

Economic Impact

The level of employment has increased through:

i. a significant increase in HYV Boro rice production. Such increased employment increased income of agricultural wage labour households to some extent, although the wage rates appeared to be lower than elsewhere;

ii. earth filling of major breaches and public cuts of the embankment.

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

Recommendations

Rigorous River morphological studies should be executed to protect the area from river erosion which is causing the series of retirements to the embankment.

Linear Housing Construction must be discouraged to prevent deterioration of the embankment.

Landless settlers should be rehabilitated within the boundary of the land acquired by BWDB for the embankment under rules and regulations such as :

i. earth raising for homesteads would be done by beneficiaries under the guidance of BWDB;
ii. some rents would be paid by the beneficiaries;
iii. O&M of the relevant reaches of embankment would be done by the beneficiaries;
iv. social forestry along the embankment would be undertaken by the beneficiaries.

The newly created islands (char land) should be allocated to the actual owners of the land, where title to such land can be established.

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

Dredging of the Brahmaputra should be considered to divert the flow channel from the embankment.

Given the serious river erosion and the instability of the embankment, more provision of sluices or drainage outlets is recommended only if proper economic feasibility studies support such high cost technical interventions. Although paradoxical, public cuts and subsequent repair of the embankment may be a low-cost but feasible sub-optimal technical solution.

An extended programme for improving livestock production should be supported.

There are many informal cooperative societies in the project area. Their activities are limited to credit distribution and crop storage and marketing. A provision should be made to involve NGOs/BRDB/Co-op. or any other development agencies to work in this area to activate these informal groups and build up more formal groups for social economic development in the project area.

More government and non-government programmes should be sponsored for sustainable development with respect to women and nutrition.

Now that the project area is controlled from flooding a crop diversification programme should be promoted.

Fisheries extension services should be strengthened in order to encourage pond fish culture, especially in high and medium high land areas.

In newly created char land and sand deposited land, agricultural extension work for crops such as groundnuts and sweet potatoes should be strengthened.

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

BRAHMAPUTRA RIGHT EMBANKMENT

Project Summary Sheet

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

BRAHMAPUTRA RIGHT EMBANKMENT, KAZIPUR REACH

SUMMARY OF FINDINGS

Introduction

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

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

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

Kazipur reach is in an unstable section of the BRE. There are frequent breaches and embankment retirements and because the land slopes away from the embankment inland the breaches severely affect a large area.

During the pre-project period the whole area used to be submerged due to onrush of flood water from the Brahmaputra river causing damage to B. Aus, B. Aman and Jute crops.

The construction of BRE was expected to provide protection from floods and permit a shift from local paddy to transplanted paddy varieties to boost agricultural production.

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

Engineering

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

In recent years, since the 1984 breaches of BRE, the primary objective of flood control has not been achieved. Moreover, the severity and uncertainty of floods has increased manifold, damaging life and properties probably on a larger scale than in the pre-project situation.

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

There were many sluices/regulators in the original 135 miles embankment. Their absence in the retired embankment has meant serious reduction in drainage provisions, although in the Kazipur section no complaint about drainage congestion was heard.

Agriculture

As expected in the PP, the BRE did successfully change the B. Aus/Jute-B. Aman - minor rabi crops cropping pattern into a B. Aus/Jute - T. Aman pattern in the initial years and then into Irrigated Boro - T. Aman, when HYV of paddy was introduced together with the provision of mechanized irrigation in the early seventies. The RRA experience suggests that only a small proportion of the increase in HYV Boro paddy production is due to the project, because any early flood or heavy rainfall would have damaged this crop at the ripening stage. However the embankment breaches since 1984 have again caused uncertain and serious flood inundation in 3 out of every 5 years, making T. Aman production almost impossible. In years of early floods such as 1990, about 10-15% of HYV boro paddy was also damaged. Consequently, the area is now almost characterized as a single cropped area, (i.e. irrigated HYV Boro paddy) except in areas where flood water recedes early and oilseeds such as mustard are still grown as a second crop.

In the pre-project situation B. Aman used to be followed by minor rabi crops such as pulses and oilseeds. In the post-BRE period there has been a significant reduction in the production of these crops. For example, mustard production has decreased by 30-40% of the pre-project level.

Increased rice production from HYV Boro and T. Aman was made possible by the BRE up to 1983 and had some positive impacts on the nutritional status of the people through increased per capita consumption. This favourable trend has now been reversed.

The reemerged risk of annual flooding due to breaches and overtopping has seriously reduced the scope of crop diversification, which requires a controlled water regime.

Since 1984, there has been very little input intensification for T. Aman, or other kharif crops such as jute and sugar cane.

As a positive response to the negative impact of the BRE, the regular phenomenon of T. Aman damage due to inundation since 1984 has led to increased input intensification for irrigated HYV Boro production because in a large part of the Kazipur area this has turned out to be the only rice crop.

Livestock

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

a. shortage of green grass and straw feed staff for most periods of the year;

b. abrupt and severe inundation makes animal keeping difficult;

c. increased incidence of cattle diseases.

The duck population seems to have moderately increased in recent years.

Fisheries

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

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

b. reduction of wild spawn collection in the river;

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

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

Environment

Long term inundation (4 to 5 months) without any crop in the fields as a result of breach of embankments helps growth of aquatic plants, which in turn increases soil fertility. This is an improvement over the pre-project situation because during pre-project inundation soil fertility added by the aquatic plants was used by the deep water B. Aman crop.

Increased rice production has increased rat infestation.

The increased sand deposition due to sudden on-rush of flood water through breaches has taken vast tracts of land out of cultivation in areas such as Kazipur, Meghai and Jhunkail.

Nutrition

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

Social Impact

Improvement of the road network simultaneously with the construction of the original and retired embankment and an increase in the volume of rice production promoted low-cost but robust road transport such as rickshaws and rickshaw vans.

Improved communication through road networks facilitated GO and NGO income generating activities, especially for distressed women.

The number of people engaged in boat manufacturing and boat plying has increased in response to increased inundation in recent years. Country boats are increasingly being fitted with small scale low cost engines. But this should be seen as another "positive response to the negative impact of the BRE".

The embankment has been used to provide temporary or permanent shelters for flood affected people and animals.

To the extent that the intensity of river erosion has been enhanced by the construction of the embankment, the extent of landlessness in terms of numbers of landless people and abruptness of being dispossessed from land, has increased tremendously. The obvious consequence of this intractable natural phenomenon is that these people have been distressed overnight and their poverty and resourcelessness have pushed them to take up any kind of activities just to survive. The two eventual manifestations of the increased landlessness are that:

a. the extent of outmigration of labour from the area has increased;

b. the level of income inequality has increased due to many people being dispossessed from land and competing for scarce resources and opportunities for survival.

The level of confidence of people in the efficacy of the BRE has been diminished to a minimum and this has a number of negative implications, as follows:

a) peoples' participation in O&M of the existing BRE is highly unlikely;

b) peoples' cooperation in sacrificing land and allowing construction of retired embankments has been minimal;

c) there is no long-term investment in land, tree plantations, housing or business installations in the vicinity of the embankment. Major public investments, (i.e. Kazipur hospital) are now in great danger.

Economic Impact

The BRE has had some positive impacts on employment creation through:

a. direct employment for the construction of 135 miles of original embankment;

b. as a consequence of constructing the series of retired embankments, additional employment for earthwork has been created. The number of people permanently employed in watching, inspection and repair and maintenance of the embankment has also increased in recent years. However, because the embankment has not lasted, much of the employment that has been created due to the construction of the embankment has turned out to be unproductive;

c. to the extent that total rice output has increased due to the change in cropping patterns, crop sector employment of farm labour has also increased.

During the post-BRE period, non-farm economic activities seem to have increased in the following subsectors:

a. petty trades in food-grains, fertilizers and oil-fuel for irrigation equipment;

b. support services such as drilling of irrigation pumps, mechanics' services for repair of irrigation pumps, and supplies of spare parts;

c. The number of people (men,women and children) engaged in handloom weaving seems to have increased, but whether or not the total volume of handloom production has increased or decreased during the post-project period was not clear.

The continual river erosion has significantly reduced the size of the benefitted area but at the same time increased the cost of embankment retirement and maintenance. This indicates that the BCR and IRR calculations for the BRE as given in the PP must have been overestimated.

Lessons

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

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