Government of the People's Republic of Bangladesh

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

BANGLADESH FLOOD ACTION PLAN

FAP 12
FCD/I AGRICULTURAL STUDY 12

RAPID RURAL APPRAISAL OF NAGOR RIVER PROJECT

October 1991

Hunting Technical Services Limited

in association with

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

under assignment to
UNITED KINGDOM
OVERSEAS DEVELOPMENT ADMINISTRATION

Sanyu Consultants Inc.

under assignment to
JAPAN INTERNATIONAL COOPERATION AGENCY

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

The full series is expected to comprise the following reports:

FAP 12

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

Project Impact Evaluation studies of:

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

Rapid Rural Appraisal Studies of:

Protappur Irrigation Project
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 (2 Volumes)
* Final Report (2 Volumes)

FAP 13

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

Note: * Report not yet available

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.

CONTENTS

FIGURES

ABBREVIATIONS AND GLOSSARY

anabranch	Branch of river diverging from main channel
BIDS	Bangladesh Institute of Development Studies
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
CARE	Cooperative for American Relief Everywhere
DTW	Deep tube-well (with positive-displacement pump)
EIP	Early Implementation Project
FAP	Flood Action Plan
FAO	Food and Agricultural Organisation
FCD/I	Flood Control Drainage and Irrigation
FPCO	Flood Plan Coordination Organisation
HYV	High yielding variety (esp. of paddy)
JICA	Japan International Cooperation Agency
khal	Natural channel
khalashi	Cleaner (actually guard) of regulator
LLP	Low Lift Pump (for irrigation from open water body)
LV	Local Variety (esp. of paddy)
madrasah	School for religious education
MBSS	Mahila Bittahin Samabaya Samity
NGO	Non-goverment Organisaton
ODA	United Kingdom Overseas Development Administration
OPTD	Operated area
PP	Project Proforma
PWD	Public Works Datum
Parishad	Committee
Panchayet	Village council
SDE	Sub-Divisional Engineer
STW	Shallow tube-well (with suction pump)

1 INTRODUCTION

1.1 THE FAP 12 STUDY

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

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

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

1.2 RAPID RURAL APPRAISAL

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

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

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

1.3 THE NAGOR RIVER PROJECT

1.3.1 Objectives

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.

1.3.1 Location

The Nagor River Embankment Project is located in the south-west part of Bogra and the south-east part of Naogaon Districts, covering major parts of Singra and Nandigram Upazilas and a small section of Atrai Upazila. The north-eastern part of the Project is in the Barind Tract formed by old alluvium, while the south-western area is part of the Chalan Beel plains which are depressions formed by tectonic activity.

The Project is bounded by the Kaliganj-Katham road in the north, the Bogra-Natore road in the east, the Gur River in the south and the Nagor River in the west. Polder A of Chalan Beel Project is situated on the opposite bank of the Gur and the Nagor Valley Project is located on the opposite bank of the Nagor River. A number of FCD projects have been built on the Nagor basin, including the Upper Nagor River and the Upper Nagor Valley Projects.

1.3.2 Relief and Drainage

The northern half of the project area is part of the relativley high Barind Tract, where flooding is rare. The southern half forms part of the low-lying Chalan Beel, which is susuceptible to floods. This area is naturally drained by the Nagor River, which is in turn drained by the Atrai River to which it is joined, both at the upstream and downstream ends.

The hydrological regime in the Project area is mainly determined by flows from the Nagor River and water levels in the Atrai-Gur rivers. Flash floods from the Nagor River with daily water level rises of 3-4 feet (about a metre) are frequent.

The Nagor floods from the north-west, and drains into the Project area mainly as an overland flow, in a south-easterly direction. Some of the flood water drains out via the Hulhulia Khari and the remaining water flows out through the Natore-Bogra road.

The terrain level in the southern part is in the range of 31-32 feet + PWD. From mid-June to mid-November, the stages in the Gur River are higher, reaching 39 feet + PWD in August-September. This implies that each year, a portion of the low-lying area cannot be drained for five months on average.

1.3.3 Type of Flooding and the 1987/88 Floods

The area is subject to both early flash floods and gradual monsoon floods. The former can occur as early as May, threatening the winter crop that is almost ready for harvest, especially in the lower and central parts of the Project area. The latter begins in June-July

and can continue upto September-October. The flood regime has turned this area into a traditional B.Aman country.

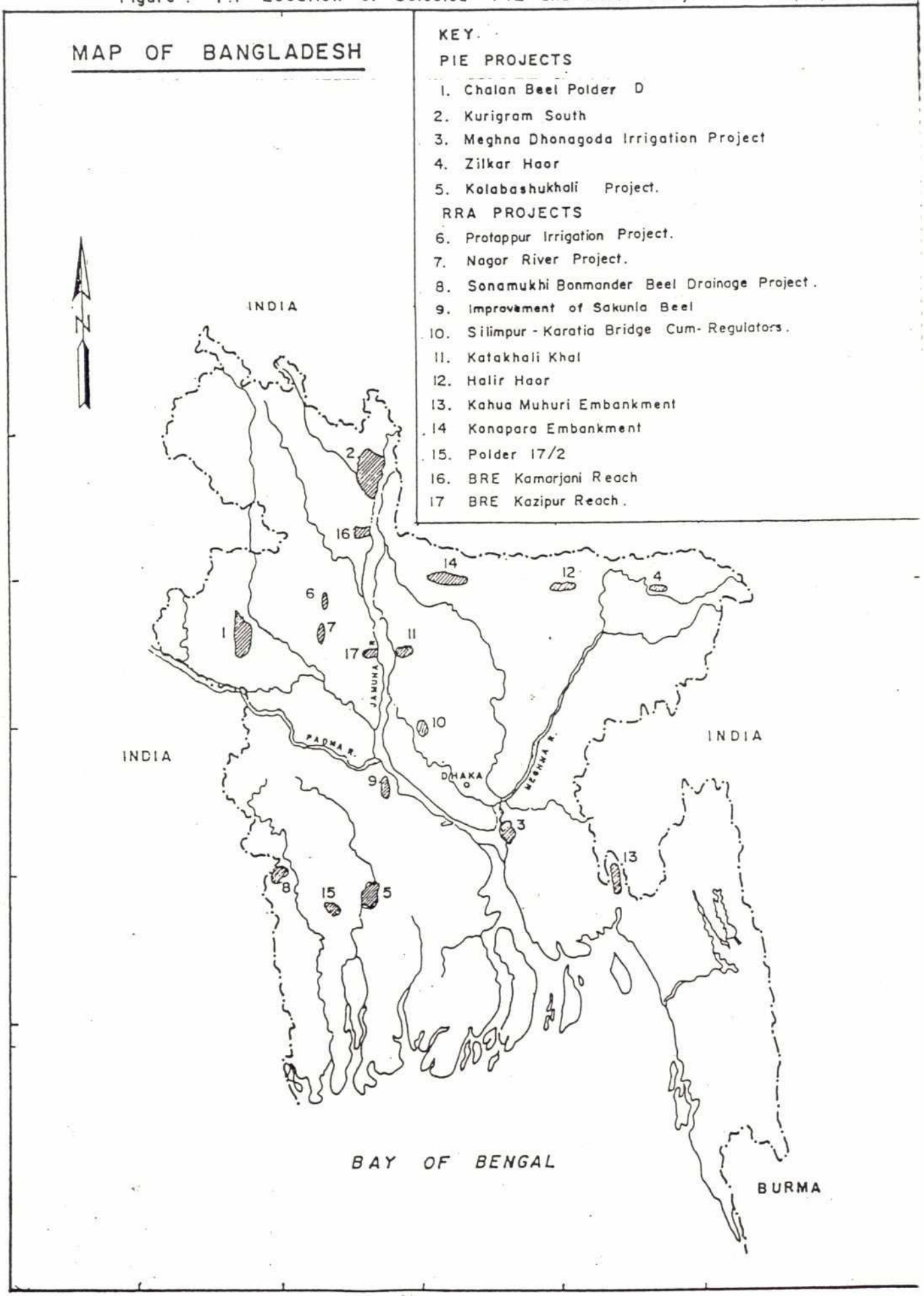
The floods of 1987 and 1988 severely affected the Project area, submerging the embankment at several places and inundating large areas of homestead land.

1.4 RRA ORGANISATION

A six member interdisciplinary team was constituted to undertake a rapid rural appraisal of the Nagor River Project, located in the Upazilas of Singra and Atrai in Rajshahi and Nandigram in Bogra. The team consisted of an agricultural economist, a fisheries expert, an agronomist, an hydrological engineer, a livestock specialist, an environmentalist and a rural institutions specialist. The agronomist was responsible for women's issues in addition to her own discipline-specific responsibilities.

A total of six working days were spent in the field, following a week's preparatory work in Dhaka. At the preparatory stage, a number of documents were consulted to prepare a Project dossier. These included the 1983 Advisory Mission Report on EIP, an Operation and Maintenance study and detailed maps. The team was unable to trace other Project documents such as the technical feasibility report and the Project completion Report.

Figure : 1.1 Location of Selected PIE and RRA Projects 1-4



Source: Consultants

2 DESCRIPTION OF PROJECT AREA

2.1 LOCATION

The Project area lies along the left bank of the Nagor River in the west, and is bounded by the Bogra-Natore road in the east. The northern boundary is formed by the Upper Nagor River Project. It is situated in the Upazilas of Singra and Nandigram, straddling the districts of Natore and Bogra. The north-eastern part of the Project area falls within the Highland and Medium Highland Sub-region of the level Barind Tract Agroecological Region (FAO 1988).

2.2 RELIEF AND DRAINAGE

The south-western part of the Project area forms the eastern-most part of the Chalan Beel depression, referred to in FAO (1988) as the Lower Atrai Basin Agroecological Region, within which no ub-regions are delineated. This area is mainly covered by the soil association classified as AL 223, typically comprising 5 per cent Medium Highland. 65 per cent of Lowland and 25 per cent Medium Lowland. Most of the higher land is concentrated along the north-eastern margin of the notionally benefited area, where the land grades into the adjacent Barind Tract.

Before the Project, flood waters entered the area, mainly from the Atrai, but also from the Nagor itself, from different parts of the Atrai River system. Flooding was usually in stages, resulting in a slow and gradual rise in the flood level. B.Aman flourished in such conditions, although there was a risk of flood damage from early flash floods.

The other problem of some significance was the slow drying up of floods , and drainage congestion that resulted after the rains, with the silting up of local khals centering around the large Hulhulia Khal.

2.3 SOILS

The soils derive their character from the alluvium deposited by the Atrai system, and are uniform Non-calcareous Dark Grey Floodplain Soils. These are dark grey, acidic, heavy clays, which are moderately to deeply flooded. A small area remains wet throughout the year. Soil permeability is slow, especially when wet, and moisture retention capacity is poor.

2.4 TYPE OF FLOODING

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

2.5 1987/88 FLOODS

The Project was completed in 1985-86 and yielded full benefits for one year. It was very badly affected by the 1987 floods, which resulted in severe inundation in the Nagor Valley Project opposite. In order to relieve the building water pressure, people on the opposite

bank cut the embankment on the Nagor Valley Project, and when this proved inadequate, the Nagor River embankment itself was cut at two points. Since then every year, the embankment has been breached or cut.

The 1987 and 1988 floods caused extensive damage to the embankment and structures, requiring sizeable rehabilitation and maintenance works to be undertaken.

2.6 LOCAL AGRICULTURE

Pre-Project agriculture was traditional, with the B.Aman crop the main crop cultivated. In the low lands in the south, local Boro was also grown. The current cropping pattern is heavily dependent on minor irrigation development, which has been extensive. Added protection has been afforded by the Project against early flash floods, which has benefitted the Boro crop. B.Aman however, has now become much more damage prone than before the Project because of regular public cuts and breaches.

2.7 SOCIO-ECONOMIC CONDITIONS

The pre-Project socio-economic condition of the area was very depressed. Cropping intensities were low, since the area was mono-cropped, with a high concentration of landless people in the area. Seasonal out-migration was widespread. Conditions have improved quite significantly with the introduction of HYV and the new irrigation based rice technology. Rapid expansion in mechanised boat transport has also generated additional employment. While the overall socio-economic conditions remain depressed, there nevertheless has been a change for the better. However, no claims are made here to attribute these changes to the Project.

3 ENGINEERING ASPECTS

3.1 LOCATION

The Project area is located predominantly in the Upazila of Singra and partly in Nandigram, in the Districts of Natore and Bogra. It is bounded by the Nagor River in the west and south west, the upper Nagor River Project in the north and the Bogra-Natore road in the east and south-east. The north-eastern half of the Project area is part of the Eastern Barind Tract, and the south-western half is an extension of the Chalan Beel Plain. The Project area is about 15,400 ha (38,000 acres).

3.2 PRE-PROJECT CONDITIONS

The Project area faced two types of problems in the past:

- there were serious problems of early flooding as well as monsoon flooding;
- there was acute drainage congestion in the central part of the Poject area.

Before the Project, flood water could freely enter into the Project area, mainly as over-land flow through the low-lying segment between Kaliganj and the confluence of the Nagor with the Gur River. The flash floods of the Nagor frequently gave a daily rise in water level of more than a metre, causing huge damage to standing crops.

The silting up of the Hulhulia Khal, the main drainage channel of the Project area, and other small drainage channels like Rakhalgachi Khari, Kedarbari Khal, Sonamukhi Khal and Bhulbaria Khal had aggravated the drainage problem, particularly during the post monsoon period. The Damdama drainage channel was also silted up. The Project area has a south-easterly slope and a large volume of flood water followed its natural course through the existing culverts on the Bogra-Natore road and further, following the slope of the flood plain in a south-easterly direction. A part of the lower beel within the Project area however, remained under water.

3.3 PLANNED OBJECTIVES

The main objectives of the Project were:

- protection of crops from early flash floods and monsoon floods;
- elimination of drainage congestion from the Project area;
- reclamation of low-lying area for cultivation and,
- to permit irrigation by LLP and flushing through sluices.

To achieve these objectives, the following types of works were undertaken:

- construction of an embankment (about 27 km) from Kaligonj to Damdama, on the left bank of the Nagor to stop flood water from entering the Project area;

- re-excavation of the existing Hulhulia Khari for a length of about 14 km, to eliminate drainage congestion and allow reclamation of low land;

- construction of drainage cum flushing sluices at the outfall of the drainage channels and thirty 1 ft. (.305 metres) diameter irrigation inlets to fulfil the irrigation requirement.

3.4 PROJECT ACTIVITIES

The Project was officially completed in 1986. The major engineering features of the Project area are shown in Figure 3.1.

(a) Embankment:

It is 27 km in length, with a top width of 12' (3.66 metres) and a side slope of 1:2 for both the C/S and the R/S sides.

(b) Structures:

There are six drainage cum flushing sluices:

i. Rakhalgachi Regulator on Hulhulia Khari - 4 Vents

ii. Kedarbari Regulator on Kederbari Khal - 1 Vent

iii. Sonamukhi Regulator on Sonamukhi Khal - 1 Vent

iv. Bhulbaria Regulator on Bhulbaria Khal - 1 Vent

v. Huseinpur Regulator on Huseinpur Khari - 1 Vent

vi. Damdama Regulator on Damdama Khal - 3 Vents (completed in 1990-91)

vii. There are fourteen irrigation pipe inlets.

3.5 PRESENT CONDITION OF THE PROJECT

3.5.1 Embankment

After the completion of the Project in 1985-86, the embankment remained in good condition and the Project provided full benefit to the area for one year. However, the embankment was severely damaged by the 1987 floods, when it was overtopped at several points. The neighbouring Nagor Valley Project (on the Right bank of the Nagor River just opposite) was submerged due to heavy rainfall, huge leakage through the Somash Para Regulator and over flow of flood water from Raktadaha Lohachara Project. In an attempt to save

UPPER NAGOR RIVER PROJECT

TO BOGRA

Kathom

Dhakar

Dogachha

Majhgram

NANDIGRAM

Bhabanipur

Belghoria

Rudrabaria

Damkuri

Hanpania

Tentulia Bhar

Bishnupur

Polsa

Mirzapur

Chaupukuria

Ekdiltaia

Isahpur

Hossenpur Regulator

Manik Chapra

Eklaspur

Bhulboria Regulator

Barkaya

Village Madha Khola

Sonamukhi Regulator

Datmanik

Ramanonda Khajura

Goalbaria

Kedergari Regulator

Azur Darga Khari

Golgalia

Chowgram Khari

Kaigaon

Soair

Rakholgachi Khal

Pachim Barobari

Bhoga

Hulhulia

Nimakadma

Hulhuli Khari

Karsuti Village

Khorda Chougram

Chougoan

Chak Kadirgachhi

Rokholgachi Regulator

CHALAN BEEL

Uttar Damdama

Damdama Khal Regulator

SINGRA

TO NATORE

NAGOR VALLEY PROJECT

NAGOR RIVER

GUR RIVER

N

LEGEND :—

Embankment

Remaining Project Boundary

River / Khal

Pucca Road

Regulator

Bridge

Earth Road

Foot Path

0 1 2 3 Miles

0 1 2 3 4 5 Km

NAGOR RIVER PROJECT
BOGRA, NATORE

their homesteads, the local people cut the embankment at two locations near Madhokhola village. These cuts had a great impact on the Nagor River Project as the river water level was raised by a few feet within a short period of time. These cuts however did not have the intended effect, so that people from the opposite bank made cuts on the Nagor River Project as well, at two points, to relieve the water pressure. Ever since, public cuts have been taking place every year at these points, resulting in considerable damage to the B.Aman crop in the area.

Indeed, these cuts have posed a serious threat to the very existence of the Project embankment, with the entire Nagor River flow being diverted to the Project area through these openings. This has also caused a back flow of water from the Gur River into the Nagor, for a length of about 2 km from its confluence with the former. The Nagor River bed is very flat and its slope at this reach is only 4 cm/km.[1] This back flow has created a strong current in the Nagor River in the upstream direction, causing severe embankment erosion for a length of about 2 km between Khorsuti and Madhokhola villages. At several points, only the Country side slope of the embankment is left to be eroded, and at many points, more than 50 per cent of the embankment section has disappeared. The remaining portion of the embankment is also in bad shape following the 1987 and 1988 floods. The top width of the embankment was found to be less than the designed width of 12 ft. (3.66 metres) and the side slopes were found to be damaged. The embankment has practically zero set back distance from the river throughout its length.

3.5.2 Public cuts

The public cut downstream of Madhokhola village is about 60 metres long and water from the Nagor Valley Project and back flow from the Gur is entering the Project area through this opening with such velocity that a boat can cross it only with great difficulty. The public cut upstream of Madhokhola is about 30 metres long and the water from the Nagor Valley Project enters the Project area at great velocity.

3.5.3 Drainage problems

The Project is facing acute problems of drainage congestion due to the silting up of various khals and rivers.

a) Hulhulia Khari

This is the main drainage channel of the Project area, having a catchment area of about 55 sq. km. It is silted up and has not been re-excavated as scheduled. Other drainage channels connecting the internal drainage net-work are almost non-existent.

b) Damdama Khal

This khal is draining a part of the Project water near the confluence of Nagor-Gur Rivers. A new regulator has been constructed to have a better control of the drainage water and to stop the back flow from the river. The local people reported that the tail of this khal is almost silted up causing drainage congestion in its catchment area.

---

[1]See EIP (1988) Nagor River Basin Study, p.9.

c) The Nagor River

This river originates from the Karatoa River at Shibganj in Bogra and serves as the main drainage channel for this area. This is no longer a perennial river although the hydrological situation in the Project area is largely influenced by the flows in this river. The river bed has been raised over time by siltation, and even a minor flash flood abruptly raises the water level. The slope of the Nagor bed is only about 3-4 cm/km, which cannot prevent the back flow of the Gur water into the Nagor, through the public cuts.

3.5.4 Irrigation

Fourteen 1 ft. (.3 m.) diameter irrigation inlets were constructed instead of the planned thirty. However, most of the irrigation inlets in the erosion prone section of the embankment have been found to be partly or completely damaged. Within the Project area, a large number of STW and DTW have been installed privately by the farmers. Flushing through the sluices has not been effective, with the silting up of the drainage channels.

3.6 MAINTENANCE PROBLEMS

3.6.1 Embankment

There is severe erosion in the embankment for a length of about 2 km, particularly in the section affected by the back-flow of the Nagor. The remaining portion of the embankment is also in bad shape due to rain cuts, wave action and rat holes. The regular public cuts have been replaced by a dwarf embankment, with the top level just sufficient to protect the Project area from early flash floods. The SDE/BWDB has stated that EIP is reviewing the Project, in the light of the regular public cuts in the context of the overall hydrology of the area, hinting that the Project may be better served by allowing the embankment to be maintained as a submersible one.

3.6.2 Structures

The screws of the vertical lift gates were missing as were the gear boxes. Loose aprons were found to be damaged and displaced, and have become unsuitable for proper operation. No khalashi sheds or khalashis were found, except at the Damdama regulator which was completed only very recently. The gates were found to be leaking, and the Kedergari regulator gates remain open even at the height of the floods. There is very little maintenance work carried out for the regulators. The responsibility for the operation of the gates was taken up by the local people at their own will. It was reported that there was a non-functional regulator committee for each of the regulators. At present, the regulators are not in a position to be properly operated due to non replacement of broken or missing parts.

3.7 RECOMMENDATIONS

The basic cause of the cuts relates to the unplanned developments in the Nagor Basin, which has resulted in a huge sheet of water to be channelled into the lower part of the adjacent Nagor Valley Project, especially during years of above average flooding. The resultant cuts on both banks of the Nagor River clearly have social undertones and consequences, but the fundamental reason is one of poor project conception. This is a glaring example of a project that

has failed because of inadequate consideration given to the overall hydrology of the entire basin. There is little that can be done to salvage this situation. The only alternative is to operate the Project as a submersible embankment. The idea of a full flood embankment has to be abandoned.

4 IMPACT ON AGRICULTURE

4.1 PRE PROJECT SITUATION

4.1.1 Land Level and Land Use

The total Project area is around 15,400 ha (38,000 acres) and falls under two Districts -Bogra and Nator, two Upazilas - Nandigram and Singra and six Unions - Nandigram, Bhatra, Singra, Chowgram, Ramananda Khajura and Chattardighi (Table 4.1.). The area can be categorised as high, medium low and low according to flood levels (Table 4.2.). The major portion of the area is low.

In the high land areas of Nandigram and Bhatra Unions of Bogra district some HYV Boro and T. Aman used to be cultivated. These areas were normally flood free (Table 4.3.). In the medium low land, some HYV Boro was introduced, but B. Aman cultivation was much more common. These areas were susceptible to monsoon flash floods. In the low-lying areas, B. Aman was the only crop cultivated. As standing water in these areas remained for a longer period of time, local Boro was cultivated here, although prone to severe damage from early flooding.

4.1.2 Cropping Pattern and Cropping Intensity

In the high land areas, cultivation of HYV Boro was followed by T. Aman. In the medium-low areas, Boro HYV followed by B. Aman was the dominant cropping pattern, and in the low land areas, Boro LV - B. Aman, and Fallow - B. Aman were the prevalent cropping patterns. The cropping intensity was 118 per cent (Table 4.6).

4.2 PROJECT OBJECTIVES

According to the Project Proforma (PP) the objective was to prevent flash floods to save the Boro crop, and provide greater security to B. Aman from monsoon flood damage.

4.3 POST PROJECT SITUATION

4.3.1 Positive findings

- the Boro crop in the lower part of the Project area has been protected from early flash floods;
- acreage under Boro HYV has increased with greater security available against floods (Table 4.6);
- acreage of potato, wheat and mustard in the Project area has increased (Table 4.6);
- B. Aman in medium lowland has been replaced by T.Aman (Table 4.7);

- switching from ploughing to mechanised cultivation has occurred with rapid expansion in the use of power tillers;

- bittergourd has been introduced in certain parts of the lowlying areas.

4.3.2 Negative Effects

- sudden increase in flood water levels in the Project area during the monsoons, following breaches and public cuts, causes serious damage to B.Aman and T. Aman production. Before the Project, water level used to rise slowly and B. Aman could grow gradually with the flood water;

- B. Aman acreage has decreased (Table 4.6) due to continuous crop failures since 1987 and 1988;

- HYV Boro cultivation is more frequently delayed due to stagnant water remaining in the fields for longer periods of time. Delayed Boro harvest causes delayed B. Aman cultivation, in turn raising susceptibility of the latter to the floods. Farmers are now transplanting more mature and longer seedlings of deep water rice, which are raised on seedbeds;

- yields have decreased due to transplanting of mature seedlings (Table 4.9);

- acreage under local Boro varieties has decreased because of greater water stress. Small and marginal farmers are unable to invest in high cost HYV Boro crops. The number of shallow tube wells in the Project area is higher than before, but the cost of irrigation water is very high (Table 4.10). As there are very few surface sources of irrigation, LLPs are not in use in the Project area, leading to a decrease in local Boro.

4.4 RECOMMENDATIONS

The basic problem relates to whether superior water control can be provided. This is essentially an engineering problem, one which is particularly difficult to solve in the case of this particular Project. The most probable approach is likely to be in terms of allowing the Project to be converted to a submersible embankment (see Chapter 3). The objective here would be to save the Boro crop, especially in the low lands, and allow a predictable pattern of **gradual** monsoon flooding. While the former objective appears to have been met, the latter problem needs to be tackled. The current pattern of sudden inundation causes great physical and mental agony and distress, and results in considerable crop damage in the Project area.

Table 4.1: Project Area and Benefited Area.

District	Upazila	Unions	Project area(ha.) within the Project	Benefitted area (ha.) within the Project
Bogra	Nandigram	Nandigram	3,356	-
		Bhatra	590	-
Nator	Singra	Chatterdighi	2,936	2,349
		Chowgram	3,179	3,039
		Ramananda Khajura	4,545	3,125
		Singra	804	804
		Total	15,410	9,316

Table 4.2: Project Area by Land Level.

Union	Land levels					
	High		Medium		Low	
	%	area (ha.)	%	area (ha.)	%	area (ha.)
Nandigram	100	3356				
Bhatra	100	590				
Chatterdighi			60	4353.75	40	2902.50
Chowgram					100	7857.40
Ramananda Khajura	30	1364	35	3931.76	35	3931.76
Singra					100	1987.00
Total		5310		3352		6748
% of the total area		34.45		21.76		43.79

Table 4.3: Benefited Area by Land Level

Union	Land levels					
	High		Medium		Low	
	%	area (ha)	%	area (ha)	%	area (ha)
Nandigram	Mostly high land, was never flooded before Project					
Bhatra	- Do -					
Chatterdighi	20	470	30	705	50	1,174
Chowgram					100	3,039
Ramananda Khajura			50	1,562	50	1,562
Singra					100	804
Total		470		2,267		6,580
% of the total area		5.0		24.3		70.6

Table 4.4: Crop Calendar

Crop	Pre-Project		Post-Project	
	Sowing	Harvest	Sowing	Harvest
Boro HYV	January	May	January	May
Boro LV	February	May	February	May
B. Aman	April	November	May	December
T. Aman	-	-	July	December
Potato	-	-	November	April
Mustard	-	-	October	March
Wheat	-	-	November	April
Aus	-	-	June	August

Table 4.5: Cropping Pattern

	Medium highland	Low land
Pre Project	Boro HYV-B. Aman	B. Aman
Post Project	Boro HYV-T.Aus-T.Aman Boro HYV-T.Aman	Boro HYV-B.Aman

Table 4.6: Crop Areas 1983-91.
(hectares)

Crops	Cropped area					
	1983-84	1985-86	1987-88	1988-89	1989-90	1990-91
Boro HYV	1,722*	3,358*	4,950	6,819	6,465	6,167
Wheat	-	98	-	273	185	232
Potato	-	12	55	47	47	45
Mustard	-	26	106	193	193	169
B. Aman	5,879	2,572	2,461	3,300	3,300**	2,663
Aus	229	274	281	378	455	355
T. Aman	-	2,189	1,906	2,509	2,191	1,720
Total	7,830	8,528	9,760	14,739	11,192	11,349
Cropping intensity	118	119	139	206	157	159

Source: BBS, Zila series, Nator; Upazila Agriculture office, Singra, Nator.

* = Local and HYV Boro
** = Area of B. Aman and T. Aman

Table 4.7: Crops Grown by Land Level at RRA Interview Sites

Places	% area under each land level	Pre-Project						Post-Project					
		Crop Seasons						Crop seasons					
		Rabi		Kharif I		Kharif II		Rabi		Kharif I		Kharif II	
		Crop	% area	Crop	% area	Crop	% area	Crop	% area	Crop	% area	Crop	% area
Bhoga	M=50	Boro HYV Fallow	25 75	B.Aman	100	→		Boro HYV Mustard Fallow	37.5 6.25 57.25	Fallow B.Aman	50 50	T. Aman →	50
	L=50	Fallow	100	B.Aman	100	→		Boro HYV Fallow	50.0 50.0	B.Aman	100	→	
Chowgram	L=100	Boro HYV Fallow	25 75	B.Aman	100	→		Boro HYV Fallow	50 50	B.Aman	100	→	
Basantapur	M = 12.5	Fallow	100	B.Aman	100	→		Boro HYV Fallow	75 25	Jute Fallow	10.0 90.0	→	
	L = 87.5	Fallow	100	B.Aman	100	→		Boro HYV Fallow	25 75	B.Aman	100	→	
Bhulbaria	L=100	Fallow	100	B.Aman Fallow	75 25	→		Boro HYV Mustard Wheat Pulse	80 10 5 5	B.Aman	100	→	
Goalbaria	L=100	Fallow	100	B.Aman	100	→		Boro HYV Wheat Mustard Fallow	50 5 5 40	B.Aman	100	→	
Koigram	M = 100	Fallow	100	B.Aman	100	→		Boro HYV Fallow	75 25	Aus	100	→	
Nima Kadma	L=100	Boro HYV Fallow	87.75 12.25	B.Aman	100	→		Boro HYV Mustard Wheat	50 25 25	B.Aman	100	→	
Hulhulia	L=100	Boro HYV Fallow	25 75	B.Aman	100	→		Boro HYV Fallow	62.5 37.5	B.Aman	100	→	
Teerabaria	M = 37.5	Fallow	100	B.Aman Fallow	75 25	→ Fallow	25	Fallow	100	B.Aman	100	→	
	L = 62.5	Fallow	100	B.Aman Fallow	75 25	→ Fallow	25	Boro HYV Fallow	50 50	B.Aman	100	→	

Source: Farmer interviews

Note: M = Medium, L = Low, → = Previous season's crop continued

Table 4.8: Crop Area Destroyed by Flood in 1987 and 1988 (hectares)

Unions	Benefitted area	1987		1988	
		Damaged crop area	%	Damaged crop area	%
Chatterdighi	5807.00	721	30.68	1,046	44.55
Chowgram	7510.75	815	26.82	947	31.15
Ramananda khajura	7723.10	974	31.17	1,192	38.15
Singra	1987.00	301	37.40	253	32.12

Source: Upazila Agriculture Office, Singra, Natore

Table 4.9: Crop Yields in the Project Area 1985-91.

Crops	Yield (md/ac)							pre to post Project % change in yield according to sources	
	1985-86	1987-88	1988-89	1989-90	1990-91	1984-85	1990-91	Upazila	Farmers
Boro HYV	48	51	51	42	62	60	60	+29.20	+0.0
LV	24	24	24	21	27	24	36	+12.50	+50.0
Wheat	15	-	18	18	21	24	30	+40.00	+50.0
Potato HYV	150	200	225	250	208	-	100	+38.70	+100.0
LV	75	90	95	95	75	-	-	0.00	-
Mustard HYV	12	12	14	12	11	-	12	-8.33	+100.0
LV	9	-	9	9	6	-	-	-33.33	-
B.Aman	27	27	24	21	18	30	24	-33.33	-20.0
Aus HYV	33	42	42	39	24	42	36	-27.27	-14.3
LV	18	-	21	18	12	30	24	-33.33	-20.0
T.Aman HYV	-	-	45	45	42	-	54	+100	+100.0
LV	-	-	27	24	24	-	30	+100	+100.0

Source: Farmers' interview.

1 md. = 37.3 kg.; 1 acre = .4046 ha.

Table 4.10: Input Costs in the Project Area.

Inputs	Means	Unit	Average cost (Tk./Unit)
Tillage	Bullock Tractor/power tiller	2 round tilling/bigha 2 round tilling/bigha	100.0 120.0
Fertilizer	Urea TSP MP	Kg. Kg. Kg.	5.5 6.5 6.5
Seed	-	Kg.	10.0 (paddy) 22.0 (Mustard) 12.0 (Wheat)
Irrigation	STW	Acre	3000.0
Labour	-	Day	50.0 (season) 35.0 (off-season)

Source: Farmer interviews

1 bigha = 0.14 ha.

Table 4.11: Cost of Crop Production in the Project Area.

Crops	Input used							% area cultivation by power tiller		Production cost (Tk./ac.)
	Tillage	Fertilizer (kg./ac.)			Seed (kg./ac.)	Irrigation (Tk./acre)	Labour	Pre	Post	
		Urea	TSP	MP						
Boro HYV	3	110	50	30	30.0	3,000	60			7,305
B. Aman	3	20	7	-	24.0	-	30			1,445
T. Aman	4	30	15	15	24.0	-	36			2,100
Mustard	3	80	60	40	4.5	600	72	0	65	4,669
Potato	3	90	30	15	60.0	900	72			5,767
Wheat	3	100	60	40	60.0	600	30			3,210

Source : Farmer interviews

1 acre = .4046 ha.

5 IMPACT ON LIVESTOCK

5.1 PRE-PROJECT SITUATION

Agriculture was the main occupation of the people in the Project area and about 76 per cent of the total households in Singra Upazila and 83 per cent of the total households in Nandigram Upazila were engaged in agriculture. Like other parts of the country, livestock was an integral part of the farming system practiced in the area. It was kept as a supporting activity to crop production and as a secondary source of income for the household. In general, each household maintained a few animals. Important animals in the area were cattle, goats, chicken and ducks. Some buffaloes were kept in the north-eastern part of the Project area. A few sheep were also kept, but horses were rare in the area. According to the Census of Agriculture and Livestock 1983/84 (BBS 1986) about 50 per cent of all households and 60 per cent of all farm households in Singra Upazila, and 62 per cent of all households and 72 per cent of farm households in Nandigram Upazila owned cattle (Table 5.1). However, about 78 per cent of all farm households in Singra and 89 per cent of all farm households in Nandigram Upazila owned poultry (Table 5.2). In the low lying areas, livestock ownership tended to be small.

Cattle were the most important type of livestock in the Project area. In general, cows were not used as a source of draught power. In fact, there was no shortage of draught power in the area.

Paddy straw and grasses were the main feedstuffs for cattle. However, a small quantity of oilcakes, rice bran and salt were fed along with straw, by more well to do farmers. B. Aman was the main source of paddy straw. Roadside grasses, weeds from crop fields and fallow lands were the main sources of green feedstuffs. It was predominantly a B. Aman area, and the land remained fallow for about 6 months of the year. However, pulses, which were also grown in the area, were used as a supplementary feed.

Goats, the second important ruminant in the area, were kept by all types of households. About 42 per cent of all farm households in the Singra Upazila and 53 per cent in Nandigram Upazila owned goats. Sheep were not important as a domestic animal in the area. Most of households kept one or two goats as scavenging animals. No special attention was given to their feeding and maintenance.

Chickens and ducks were quite common in the Project area. About 78 per cent of all farm households in the Singra Upazila and 89 per cent in Nandigram Upazila possessed poultry (Table 5.2). However, ducks were kept mainly in the low lying areas, where the habitat was more suitable. Both chickens and ducks were kept in small numbers as scavenging birds.

Diseases like Ranikhet (Newcastle disease) and fowl cholera were quite common and took a heavy toll every year.

5.2 OBJECTIVE

The main objective of the Project was to protect the land from flood water intrusion from the Nagor River and thereby protect the Boro crop from flood damage at the mature stage, and the B. Aman crop at the young stage. However, the possible impact of the Project on livestock was overlooked or not considered. The Project should have included an objective

Table 5.1: Cattle and Buffalo Population in Selected Upazilas and its Distribution According to Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Singra Upazila					
No. of Households	16,864.00	9,882.00	3,546.00	30,292.00	9,431.00
% of Households	42.40	24.90	8.90	76.30	23.70
Household with Cattle and Buffalo	6,566.00	8,423.00	3,402.00	18,391.00	745.00
% of Household with Cattle and Buffalo	38.90	85.20	95.90	60.10	7.90
No. of Cattle + Buffalo	16,454.00	30,977.00	21,870.00	69,301.00	1,510.00
No. of cattle and Buffalo per household	0.97	3.13	6.17	2.29	0.16
Net cultivable area (ac.) per household	0.94	4.11	11.77	3.24	-
Nandigarm Upazila					
No. of Households	9,598 .00	5,912.00	1,653.00	17,163.00	3,491.00
% of Households	46.50	28.60	8.00	83.10	16.90
Household with Cattle and Buffalo	5,147.00	5,545.00	1,623.00	12,315.00	426.00
% of Household with cattle and Buffalo	53.60	93.80	98.20	71.80	12.20
No. of Cattle and Buffalo	13,458.00	23,079.00	12,752.00	49,289.00	828.00
No. of cattle and Buffalo per household	1.40	3.90	7.71	2.87	0.24
Net cultivable area (ac.) per household	1.01	4.01	11.16	3.02	-

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

Table 5.2: Goats and Sheep and Poultry Population in Selected Upazilas and their Distribution According to Farm size.

Item	Small Farm	Medium Farm	Large Farm	All Farm Households	Non-farm Households
Singra Upazila					
No. of households	16,864.00	9,882.00	3,546.00	30,292.00	9,431.00
Households with goat and sheep	6,074.00	4,751.00	1,911.00	12,736.00	1,804.00
% of Households with goats and sheep	36.00	48.10	53.90	42.00	19.10
No. of goats and sheep	17,457.00	18,025.00	9,437.00	44,919.00	4,532.00
No. of goats+sheep per household	1.04	1.82	2.66	1.48	0.48
Households with poultry	12,003.00	8,364.00	3,158.00	23,525.00	4,732.00
% of households with poultry	71.20	84.60	89.10	77.70	50.10
No. of poultry	79,742.00	77,464.00	42,173.00	1,99,379.00	26,360.00
No. of poultry per household	7.70	7.80	11.90	6.60	2.80
Nandigarm Upazila					
No. of households	9,598.00	5,912.00	1,653.00	17,163.00	3,491.00
Households with goat and sheep	4,539.00	3,492.00	1,053.00	9,084.00	1,015.00
% of Households with goats and sheep	47.3 0	59.10	63.70	52.90	29.10
No. of goats and sheep	16,230.00	.16,025.00	6,268.00	38,523.00	2,924.00
No. of goats+sheep per household	1.69	2.71	3.79	2.24	0.84
Household with poultry	8,154.00	5,498.00	1,555.00	15,207.00	2,299.00
% of household with poultry	85.00	93.00	94.10	88.60	65.90
No. of poultry	67,251.00	66,093.00	28,100.00	1,61,444.00	14,033.00
No. of poultry per household	7.00	11.20	17.00	9.40	4.00

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

to improve feed resources for livestock through introduction of forage crops and crop diversification programmes, in order to overcome possible negative impacts of the Project.

5.3 PROJECT IMPACT

5.3.1 Impact on Feed Resources

A number of Project impacts on livestock, mostly negative, can be recognised:

i. Area under HYV Boro and T.Aman has increased, increasing straw output, but the B. Aman area has declined substantially, so that overall straw production has sufferred.

ii. There are indications that the goat and sheep population in the Project area has increased by 15-20 per cent and 5-10 per cent respectively in the last 10 years. However, in some areas, particularly in the low lying areas, goats and sheep are kept on for 6 months. In July, when flood water submerges the area, farmers sell off their goats and sheep due to difficulties in feeding and management. The increase in the goat and sheep population are due to a number of factors:

- increased availability of grass on the road sides, embankment slopes, due to a decrease in the cattle population;
- goat and sheep require little upkeep;
- some NGOs particularly the Grameen Bank, are providing credit to the poor and landless groups for livestock rearing.

iii. Availability of green feedstuff for ruminants has significantly declined as the area under fallow dwindled, following expansion in HYV Boro and T.Aman. Normally, after harvest of B. Aman, most of the land in the area used to remain fallow before the Project. During weeding a large quantity of animal feed could be salvaged, which was a major source of green feedstuff. This source has now dissappeared.

iv. Quality of paddy straw varies with the paddy variety. B. Aman straw has the highest digestibility and palatability, followed by T. Aman. Boro local variety has low digestibility and palatability. HYV varieties have even lower digestibility and palatability than the local varieties. With the increased cultivation of HYV varieties, particularly HYV Boro which has now become the predominant crop in the area, the overall quality of paddy straw in terms of digestibility and palatability has significantly decreased.

v. Before the Project, pulses were grown in the medium land and mustard seeds were cultivated in the high land. Some pulse plants were fed to the cattle as green feed, and the rest were ripened and used as human food. But after the Project, the cropping pattern in the area has changed. Cultivation of HYV Boro has increased, which practically replaced pulses and oilseeds. The reduction in pulses and oilseed output has led to decreased availability of green plants

as well as nutritious crop by-products like pulse straw, pulse bran, oilcakes for cattle.

5.3.2 Livestock population

a) Cattle Population

Available information indicates that there has been a significant decrease in the cattle population in the Project area. Farmers have indicated that the decreased cattle population may be as high as 75-80 per cent. In a few villages, we found no cattle at all. However, after careful cross checking, it appears that the cattle population in the Project area may have decreased by 50-60 per cent over the last 10 years. This decrease in cattle number may be due to the following reasons:

- whenever there is any financial difficulty due to crop failure or other reasons, the farmers sell off their cattle to overcome the crisis. However, many of those farmers could not replace their animals again;

- shortage of animal feeds caused by reduction of area under fallow, and change in cropping patterns;

- reduced calving rate and replacement of stock;

- farmers have indicated that the cost of maintenance of bullocks for draft power is higher than cultivation by power tillers;

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

b) Buffalo Population

Available information indicates that the number of buffaloes in the area has decreased by 20-25 per cent. This decrease may be due to shortage of feeds, reduced calving rate and high maintenance costs. Introduction of power tillers has reduced the requirement for buffaloes for land preparation.

5.3.3 Cattle Health

The physical condition of cattle and buffaloes in the Project area has deteriorated, apparently due to scarcity of nutritious feed and increased parasitic infestation. Moreover, animals are getting more and more HYV Boro straw as their main source of feed. Only a limited number of farmers provide oilcakes and rice bran to their cattle. It has been observed that feeding paddy straw, particularly Boro straw alone, causes gradual emaciation of the cattle.

Available information indicates that the incidence of parasitic diseases, particularly round worm and fluke infestation in adult cattle has increased. This may be due to shallow water levels in the low lying areas and in beels, which act as breeding grounds for snails, the intermediate host of flukes. Occurrence of Foot and Mouth disease in cattle are more

common during the. Cases of anthrax and Black Quarter are frequent during the monsoon period or just after the first onset of the rains.

5.4.4 Use of cowdung

There is an acute shortage of domestic fuel in the rural areas. The farmers reported that during the dry season, organic manure (cow dung) is used primarily as domestic fuel. But in the wet season, when drying of cowdung is difficult, it is used mainly as manure in the the fields. However, as the scarcity of domestic fuel intensifies with the depletion of firewood resources, farmers are tending to rely more and more on cowdung as a source of fuel, rather then as organic manure for their fields. This may have a long term effect on soil fertility.

5.5 1987/1988 FLOOD DAMAGE

There are no accurate statistics on the extent of damage to livestock caused by the 1987 and 1988 floods. According to farmers and officials, there were no dry places in the Project area, so that people took temporary shelter on the embankment with their livestock and property. However, later on, many farmers had to sell off their cattle and goats due to acute shortage of feed.

5.6 RECOMMENDATIONS

In general FCD/I projects tend to have an adverse effect on livestock feed resources through a reduction in the grazing area, and changes in the cropping pattern. This has led to deterioration of livestock health and productivity. The following measures could be taken to overcome the adverse impacts and improve livestock production in the area:

i. A programme could be initiated to cultivate high biomass yielding forage crops such as Napier Para grass on the slopes of embankments and roadsides, which will not only produce green feedstuffs but also reduce soil erosion. Para grass may be planted on the lower part of the embankment slopes and on the borrow pits. Normally Para grass has better growth on wet land. On the top side of the road and embankment, some fruit trees like jackfruit, mango, or fodder trees like Ipil-ipil could be planted, whose leaves would be a source of nutritious feed for goats, and these would also yield fruit and fuelwood.

ii. Some cultivable fallow land could be used for food and forage crop (maize, sorghum, khesari, cowpea etc.) in order to reduce the feed shortage. An extensive extension and motivational drive would be required for this purpose.

iii. Posibilities of expanding cultivation of pulses and oilseeds need to be examined. This would serve to enhance both the nutritional status of the people and would also improve feed availability.

iv. During selection of HYV paddy, some consideration should be given to straw quality because straw of some HYVs has higher digestibility than that of others.

6 FISHERIES

6.1 PRE-PROJECT SITUATION

Very little factual information was available concerning the fisheries of the Nagor River and associated beels inside the Project area, prior to 1983/84 when construction of the embankment and regulators was started. Project documentation contained virtually no references to fisheries. A report by the 1983 EIP Advisory Mission, which served as an appraisal study, did note the existence of a number of fishermen's cooperatives but failed to give any other consideration to the likely consequences of the Project to such fishermen. In addition, it does not appear that any attempt was made to assess possible fisheries losses for inclusion in the cost/benefit calculations.

In order to maintain continuity and facilitate comparison, the Fisheries Department continues to publish its annual fish production statistics on the basis of the old district boundaries, which were changed after the last reorganisation of divisional and district administration boundaries. Prior to these boundary changes, the Nagor River Project lay wholly within the old Bogra District and data are therefore included, in Table 6.1, showing the trend of change in fish production for this area between 1983/84 and 1988/89. These figures show a steep decline in riverine production, to barely 30 per cent of the pre-Project 1983/84 level, whereas the other fisheries continue to hold up.

The results of a pond survey carried out in 1983 by the Fisheries Department in the old Bogra and Rajshahi Districts, are also shown in Table 6.2. These indicate that derelict ponds in the general area comprised from 23 per cent to 35 per cent of all ponds in the pre-Project year. Unfortunately the data on pond numbers, status and areas have not been updated on a comparable basis, although more recent figures are also provided in Table 6.3 which suggest that the proportion of non-cultivated ponds in the Project area was probably much higher than the District average. This conclusion was supported by a number of pond owners who confirmed that ponds in low to medium high land were, and indeed still are regularly overtopped by flood water. These owners can crop only such fish as remain in the ponds after the flood waters have receded, and the costs of restocking and re-excavation in such circumstances are not justifiable.

Accounts seem to differ as to the seasonality of the Nagor River, some reports stating that it was always non-perennial whereas statements from fishermen at Matikata village were positive that the river flowed throughout the year prior to the Project but nowadays dries up during the winter months. This suggests that other developments upstream from the Project area are affecting river flow.

6.2 PROJECT OBJECTIVES

The almost total lack of reference to fisheries in Project documentation and the alleged failure by BWDB to engage in any pre-Project consultation with fisheries authorities, implies that there were no objectives for fisheries development. However, the 1983 EIP advisory mission did note the existence of fishermen's cooperatives, and because both BWDB and the EIP donors were already well aware, from earlier experience, of the damage caused to fisheries by such flood control works as were proposed, it seems inexcusable that yet again both were willing, quite

Table 6.1: Nagor River FCD Project RRA: Fish Production Trends - Bogra Old District

	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1. **Riverine Catches**						
Major Carp	53	56	16	19	27	
Other Carp	-	42	33	13	7	
Catfish	50	69	27	18	31	
Hilsa	35	4	7	7	7	
Shrimp	60	78	10	7	13	
Miscellaneous	1,993	2,607	784	627	531	
Total	2,191	2,856	877	691	616	N.A.
2. Beel Fisheries	1,710	845	1,013	1,108	1,930	1,863
3. Flood lands	3,823	10,780	10,924	6,723	6,728	7,557
4. Ponds	4,179	3,922	3,719	4,031	4,517	4,571
Grand total	11,903	18,403	16,533	12,553	13,791	N.A.

Source: Fisheries Department, Annual Fish Catch Statistics Bulletins, 1983/84 to 1987/88 inclusive, and partial, provisional data for 1988/89.

Table 6.2: Nagor River FCD Project RRA: District Fish Pond Survey Data, 1983

Pond Status	Bogra District			Rajshahi District		
	No.	Area (acre)	Prodn. (mt.)	No.	Area (acre)	Prodn. (mt.)
Cultured	7,964	7,254	3,409	23,239	11,155	5,243
Cultivable	8,445	4,724	647	32,753	16,401	2,247
Derelict	8,875	2,051	123	16,631	9,009	541
Total	25,284	14,029	4,179	72,623	36,565	8,031
Derelict (%)	35.1	14.6		22.9	24.6	
Cultivated Ponds productivity	1161 kg./ha. (470 kg./acre)					

Source: Fisheries Department, National Fish Catch Statistics, 1983/84

Table 6.3: **Nagor River FCD Project RRA Fish Farming and Capture Fisheries Data in the General Area - 1990**

	Bogra District (New)		Singra Upazila	
1. Fish Farming	No.	Area (acres)	No.	Area (acres)
Public (Khas) ponds	2,050	2,377	358	720
Private ponds	10,409	6,993	2,256	3,266
Derelict ponds	3,649	2,412	1,369	1,531
Cultivated fish ponds	8,810	6,408	1,245	2,455
Derelict ponds (%)	29.3	25.7	52.4	38.4
Cultivated pond productivity	969 kg./ha.		1510 kg./ha.	
2. Estimated Catch	mt.		mt.	
Ponds	2,514		1,500	
Beels	4,608		1,500	
Rivers	1,257		2,000	
Total	8,379		5,000	
3. Fishing Effort	mt.		mt.	
Fishing Villages	137		14	
Fishing Families	3,387		150	
Fishing Cooperatives	79		12	
Cooperative membership	9,593		2,136	

Sources: Bogra District Fisheries Office and Singra upazila Fisheries Office.

deliberately, to destroy the livelihoods of a significant section of the population without even a mention of any proposals for mitigation or compensation.

6.3 RRA DATA SOURCES

Visits were made to the Project area from June 26th to July 2nd. Interviews and less formal discussions were held with administrative and technical staff at Singra Upazila Headquarters, with full-time professional fishermen, fish pond owners, part time fishermen and fish sellers. Other data on fish production and fish farming developments were obtained from Fisheries Dept. Head Quarters in Dhaka, the District Fisheries Office in Bogra and Singra Upazila Fisheries Office.

6.4 POSITIVE EFFECTS ON FISHERIES

Capture fisheries in the beel and low lying flooded areas appear to have benefitted, in that the general decline in fish stock size and production which has been occurring elsewhere in the country does not seem to have happened here. However, it is clear that the reason for this apparently favourable outcome is that the Nagor River embankment has been breached every year from 1987 to the present, so that the fishable flooded area remains virtually unchanged from pre-Project times. Doubtless, the impact would have been much less favourable had the Project succeeded in preventing such flooding.

There is some evidence of growing interest in fish farming in the medium high areas where ponds are being reexcavated and surrounded by high bunds to exclude flood water and thus enable the owners to restock with high quality carp fingerlings. This development could be enhanced and spread into lower areas if flooding could be prevented, as was the original intention for the Project.

The growing interest in fish farming is reflected in an expansion of carp hatchery and nursery capacity in the surrounding area. The Project area includes one such development, at Chaugaon where 4 entrepreneurs now lease a complex of 14 khas ponds totalling some 30 acres in extent. These ponds are used to ongrow hatchery and wild caught carp fry for subsequent sale as fingerlings to pond owners. Annual sales are said to be about 20 million fingerlings worth Tk 6 million. Chaugaon is a large and ancient man-made raised island in surrounding lower floodland. It was once the site of a fortified palace, now in ruins, and remained slightly above the highest water level even during the 1988 flood. However, it is probable that this development, and the growing interest in fish farming is due more to the increasing scarcity of fish and high prices in the urban markets, rather than to any Project related benefits.

6.5 NEGATIVE EFFECTS

The Project planners failed to take into account the cumulative effect of drainage congestion in the neighbouring Nagor Valley Project which resulted, according to the April 1990 report of the EIP Operation and Maintenance Mission, in farmers from the Nagor Valley Project area cutting the bunds on both banks of the Nagor River in order to reduce flood levels in Nagor Valley. BWDB failure to address that problem or to fully repair the Nagor River Project embankment has been compounded by social conflict in the area involving a strong group whose

interests include fishing, and who are against restoration of the breached embankments, regardless of the damage caused to crops inside the Nagor River Project area.

As was made clear by river fishermen from both Matikuta and Arazi Temukh areas, changes in the pattern of river flow have adversely affected both catch quantities and species composition. In particular major carp species, such as Katla and Rui, if they can be caught at all are nowadays very scarce and of only very small size compared with the past. Minor carps, such as Chela (Salmostoma spp) and Nandil (Labeo nandina) have virtually disappeared whilst Bheda (Nandus nandus), a formerly plentiful river perch is also much reduced. It is nowadays only possible or worthwhile to fish in the Nagor River during June, July and August, and catches are less than half the pre-Project quantity, although fish prices have increased to compensate. Nevertheless about half of the Hindu fishing population of Matikuta village (more than 100 families pre-Project) have migrated away from the area in search of other forms of employment. They have been replaced by some 47 Muslim fishermen and their families who have entered the fishery in recent years despite the apparently poor returns.

6.6 LESSONS

As has also been observed in other Projects studied during the FAP 12 evaluation programme, it is quite unacceptable that FCD type Projects which have multi-sectoral impacts can be planned, approved and implemented without any prior consultation with the various agencies responsible for each sector or, for that matter, with any of the potential beneficiaries or disbenefitted people concerned. Without exception, all the fishermen and pond owners interviewed stated that their first intimation was after the start of construction when the whole matter was fait accompli.

As regards fisheries, it is essential that in future the aims for such Projects and their effects on fish resources and fishing communities are carefully planned after full consultation and monitored throughout the implementation period. The Fisheries Department should be represented in each Project management team.

7 SOCIAL AND INSTITUTIONAL ASPECTS

7.1 PRE-PROJECT SITUATION

7.1.1 Population, Occupation and Land Ownership Pattern

According to the 1981 Census, the area had a population density of 424 per sq. km., as against the national average of 605. The literacy rate was 22 per cent as against 23.5 per cent for the nation as a whole. Agriculture was the main occupation of the villagers. Fishing and boat plying were other important occupations.

The land ownership pattern in the two Upazilas is presented in Tables 7.1 and 7.2 with the equivalent data for Bangladesh in Table 7.3. The percentage of landless households is lower in these Upazilas than the national average. The tables also show that land ownership is more highly concentrated amongst the medium and rich farmers here, compared to Bangladesh as a whole.

7.1.2 Rural Power Structure

The traditional rural elite appears to have come into conflict, or atleast competition, with an emerging profit oriented group of input dealers and owners of power tillers and STWs. The village Panchayet and Union Parishad members however remained in the hands of the traditionally powerful families, the Mollahs, Sardars and Pramaniks. An earlier EIP study also found evidence of conflict between the traditional elite and the emerging profit-oriented one.

7.1.3 Labour In-migration

The area was traditionally a labour scarce region. There was in-migration of labour during the Aman harvesting season from the districts of Rangpur, Kurigram, Pabna and Kushtia. Wages were paid both in cash and in kind. Generally agricultural labourers were provided with 2-3 meals per day. Female agricultural wage labourers were not common.

7.1.4 Share Cropping and Moneylending

Sharecropping was common. Moneylenders charged rates of interest at 100 per cent over a season (six months). Advance sale of crops (dadon) was practiced by the poorer cultivators. This is a cash for paddy transaction, made to avoid having to charge explicit interest prohibited in Islam.

7.1.5 Educational Institutions

There were many educational institutions in the Upazilas. This can be seen from Table 7.4. It may be noted that Madrasah education was more popular in Nandigram, suggesting a more conservative outlook.

Table 7.1: Land Ownership by Size of Owned Land Singra Upazila

Type of ownership	All House-holds	House-holds owning no land	Number of Households owning land								
			0.01-0.04 acre	0.05-0.49 acre	0.50-0.99 acre	1.00-4.99 acre	2.50-4.49 acre	5.00-7.49 acre	7.50-14.99 acre	15.00-24.99 acre	25.00 acre and above
Total holding	39,723	0.62% 250	13.8% 5495	21.71% 8625	9.99% 3905	21.99% 8738	15.44% 6135	7.86% 3016	6.71% 2667	1.64% 654	0.39% 158
Holdings with no Homestead area	410	41	94	73	45	70	46	22	12	6	1
Holdings with Homestead but no cultivated area	8,256	155	4,444	2,788	288	344	141	42	50	11	2
Holdings with Homestead and cult (OPTD) area upto .50 acre	6,743	27	644	4,364	1,071	434	126	39	33	7	3
Holdings with Homestead and cult (OPTD) area -51 to 1.00 acre	4,298	15	206	756	1,012	1,520	84	26	16	1	2
Holdings with Homestead and cult (OPTD) area > 1.00 acre	20,007	12	107	644	829	6,370	5,743	2,967	2,556	629	150

Source : District Agriculture census, Natore, 1983-1984

Table 7.2: Land Ownership by Size of Owned Land Nandigram Upazila, Bogra

Type of ownership	All House-holds	House-holds owning no land	Number of Households owning land								
			0.01-0.04 acre	0.05-0.49 acre	0.50-0.99 acre	1.00-4.99 acre	2.50-4.49 acre	5.00-7.49 acre	7.50-14.99 acre	15.00-24.99 acre	25.00 acre and above
Total holding	20,654	6.57% 1,358	8.33% 1,762	16.90% 3,492	9.77% 2,018	23.47% 4,848	18.07% 3,734	8.69% 1,795	6.20% 1,282	1.39% 288	0.37% 77
Holdings with no Homestead area	473	127	49	88	38	82	62	17	9	0	1
Holdings with Homestead but no cultivated area	2,517	691	1,029	573	75	73	50	11	10	4	1
Holdings with Homestead and cult (OPTD) area upto -50 acre	3,536	334	464	1,910	472	249	48	29	13	12	5
Holdings with Homestead and cult (OPTD) area -51 to 1.00 acre	2,416	119	135	426	881	775	57	9	7	3	4
Holdings with Homestead and cult (OPTD) area > 1.00 acre	11,712	87	85	495	552	3,669	3,517	1,729	1,243	269	66

Source : District Agriculture Census, Bogra, 1983-1984

Table 7.3: Land Ownership by size of Owned Land, Bangladesh

Type of ownership	All House-holds	House-holds owning no land	Number of Households owning land								
			0.01-0.04 acre	0.05-0.49 acre	0.50-0.99 acre	1.00-2.49 acre	2.50-4.99 acre	5.00-7.49 acre	7.50-14.99 acre	15.00-24.99 acre	25.00 acre and above
Total holding	13,817,646	8.67% 1,198,156	9.44% 1,305,266	28.19% 3,895,449	12.01 1,660,082	21.55% 2,978,992	11.56% 1,597,588	4.70% 649,992	3.00% 415,346	.64% 89,047	0.20% 27,728
Holdings with no Homestead area	276,977	93,539	35,078	58,794	21,723	38,484	17,081	6,979	4,034	870	395
Holdings with Homestead but no cultivated area	2,713,969	748,965	924,388	820,816	75,573	91,235	31,994	12,217	6,654	1,464	663
Holdings with Homestead and cult (OPTD) area upto -50 acre	3,898,181	229,866	279,932	2,439,098	564,441	263,774	78,228	25,474	13,287	2,402	1,679
Holdings with Homestead and cult (OPTD) area - 51 to 1.00 acre	1,702,652	57,475	38,363	291,145	688,360	559,593	43,727	14,269	7,366	1,288	1,066
Holdings with Homestead and cult (OPTD) area > 1.00 acre	5,225,867	68,311	27,505	285,596	309,985	2,025,906	1,426,558	591,053	384,005	83,023	23,925

Source: The Bangladesh census of Agriculture and Livestock, 1983-1984

Table 7.4: Educational Institutions

Upazila	Primary school	High/Junior school	College	Madrasha
Singra	123	30	02	17
Nandigram	54	18	01	19

Source: Upazila Education Office, Singra

7.1.6 Communications

Given the flood prone and low-lying beel area, road infra-structure in the region was poorly developed. Boats were the main means of transport during the monsoon months, both for domestic and commercial purposes. In the dry season mud-roads and bullock carts were the main means of transport. Mechanized country boats equipped with STW engines were a later development, introduced after the introduction of irrigated agriculture.

7.2 OBJECTIVES OF THE PROJECT

There was no explicit objective for improving social and rural service institutions. Never theless, there was an expectation that due to the construction of embankments and the re-excavation of the Hulhulia Khal, communication infra-structure, educational institutions, farmers co-operatives, marketing facilities, etc will emerge for the overall development of the Project area.

7.3 IMPACT OF THE PROJECT

Schools and co-operatives have been set up. CARE, Grameen Bank, BRDB, North West Development Programme, have expanded their activities. Primary school student enrolment has risen to 17,964 in 1991 from 16,392 in 1986. Two more colleges have been established, one at Sukasgari and another at Kaliganj in 1991. Two more primary schools were set up, one at Sukasgari and another at Anandanagar, in 1990. Brikoya Junior High School was established in 1990. The number of co-operative societies in Singra Upazila as of June 1991 is as follows:

Table 7.5: Cooperatives Operating in the Project Area

Name of the Cooperatives	No. of Cooperatives
Union multipurpose co-operatives	12
Farmers' co-operatives (BRDB)	443
Fishermen's co-operatives	13
MBSS co-operatives	31
BSS co-operatives	52
Weavers' co-operatives	46
Poultry co-operatives	4
Truck Drivers' co-operatives	1
Rickshaw pullers' co-operatives	1
Mechanized Boat owner's	1
Pond	1
Savings and lending	1
Pen, brass, bellmetal	1
Total	609

Source: BRDB

These developments however, cannot really be attributed to the Project.

Strong social conflicts have been witnessed, with public cuts at two points on the embankment. The nature of the conflict is complex and is tied to the overall engineering-hydrological situation. At the lay level, the conflict takes the shape of antagonisms between paddy growers and fish cultivators. The story in brief, is that during the 1987 floods, there was a severe breach on the embankment. A fish pocket or fish ladder developed at the vicinity of the breach, where a large quantity of fish could be caught soon after the monsoons, worth around Tk. 3-400,000 annually. The 'fishermen' who exploit this resource and who keep the cuts open are from the other side of the embankment and are actually big landholders who have no land within the Project.

7.4 RECOMMENDATIONS

There is a need to involve government and NGO agencies to fully exploit the potential of the embankment as a forestry resource and a source of employment to both distressed men and women and formulating a policy for social forestry.

The solution to the social problem may need a more careful reexamination of the hydrology of the Nagor Basin, and in particular, of the adjacent Nagor Valley Project. The first public cut was a direct result of the 1987 floods which inundated homestead areas in the Nagor Valley, opposite to where the cut was made.

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, like feeder roads etc. should be planned in association with the Water Board.

8 IMPACT ON WOMEN

8.1 PRE-PROJECT SITUATION

The Nagor River Project area was one of the most depressed regions in the country. The high incidence of poverty and outmigration meant that women fared no better than in other rural areas of Bangladesh. There was an acute scarcity in employment opportunities available, irrespective of gender. The activities of most women were confined to the homestead, though some women also worked in the field, taking part in sowing, transplanting and weeding of paddy fields during the peak periods.

8.2 PROJECT OBJECTIVES

There were no explicit Project objectives concerning women. However, it is implicit that increased agricultural production and better road communication will create a more conducive atmosphere for rural industries and other activities, and that this may generate job opportunities for both men and women.

8.3 POST PROJECT SITUATION

The Project has been successful in fulfilling one of its objectives, i.e. preventing early monsoon flash floods. The Boro HYV and LV are now secure, so that acreage and production have increased. These have created increased work opportunities for women agricultural labour (Table 8.1). However, the landowners are still able to hire female labour at a cheaper rate (Tk. 20/day compared to Tk. 35/day for a male labourer). CARE has 15 women workers who are taking part in the maintenance of internal roads. BRAC workers are planting trees on the feeder roads. CARE has employed guards for these trees, so that cattle or people will not destroy the plants. This is a new job introduced after the Project. BRDB lends money to the Women's Societies in the Project area. In the four unions under the Project, there are 26 Women's Societies having 1296 members. In the post Project situation the amount of money lent has decreased in some areas and increased in others (Table 8.2). These loans are given to the individual women for livestock raising and fattening, rice husking and for purchasing cut pieces of cloth. Women are able to obtain a modest return from the use of these loans. Most of these loans have already been paid off, and with the profits they are continuing to expand their activities.

Female literacy has increased in some areas, but appears to have declined in the lowland areas due to greater poverty there. There are no schools for girls in the Project area. They have to go to school with the boys in the same school. Moreover, these schools are far from their homes, making the journey difficult during the monsoon, when boats are the only means of communication.

Age of marriage appears to have gone up from 12/13 to 18/19. Rate of divorce is low. Number of children per new family (10 years old) is 2 to 3 compared to the 7 to 10 children per old family (20 years old).

It is difficult to attribute the changes noted here to the Project, since these are likely to be inseparably woven into influences originating from the economy and society at large.

8.4 RECOMMENDATIONS

There ought to be a definite quota for women labourers in Project O&M. Further, there is some scope for generating work for women by utilising the potential for social forestry on the embankments and embankment maintenance and repair. These aspects have received very little attention from both the BWDB and local government and NGO leaders.

Table 8.1: Change in Activities of Women in Project Area

Activities	Pre Project		Post Project		Same
	Increased	Decreased	Increased	Decreased	
1. On farm agriculture					
- Sowing	√		√		
- Transplanting	√		√		
- Harvesting		√			
2. Post Harvest Activities					
- Threshing rice	-		-		
- Parboiling rice	√		√		
- Drying rice	√		√		
- Milling	√		√		
3. Earth work	√				√
4. Afforestation		√	√		
5. Livestock raising on loan	√			√	
6. Tailoring		√	√		

Source: RRA Interviews

Table 8.2: Loan Given by BRDB to the BMSS

Unions	Number of Society	Number of Members	Amount (Tk.) of Loan		% charge in loan	Amount (Tk.) Paid off	
			1984-85	1990-91		1984-85	1990-91
Singra	21	1,087	3,18,000	1,10,000	-65.0	3,18,000	-
Chowgram	3	128	40,000	39,000	-2.5	40,000	-
Ramananda Khajura	2	81	7,000	38,000	+442.9	7,000	-

Source: BRDB

Table 8.3: Sex Ratio and Literacy Rate of Females in the Project Area.

Unions	Male/Female Ratio		Literacy Rate	
	Pre	Post	Pre	Post
Chatterdighi	1:1	1:1	5.38	5.71
Chowgram	1.05:1	1.1:1	7.31	6.69
Ramananda Khajura	1.01:1	1.02:1	5.00	6.20
Singra	1.18:1	1.2:1	6.90	7.10

Source: Bangladesh Population Census, 1981 and farmers interview.

9 IMPACT ON NUTRITION AND HEALTH

9.1 PRE PROJECT SITUATION

The pre-Project nutritional status was very weak, characterised by widespread hunger and malnutrition. Even by the low nutritional standards of the country, this area was particularly depressed. It was mono-cropped, almost entirely dependent on B.Aman. Some local Boro used to be cultivated in the low lying regions.

9.2 PROJECT OBJECTIVE

There was no explicit mention in the Project proposal for any change in nutritional status of the villagers within the Project area. However, increased foodgrain production was expected to improve the nutritional standards.

9.3 POST PROJECT SITUATION

There has been a distinct improvement in the nutritional status of the people of the area. However, increases in calorie consumption has largely occurred due to greater consumption of cereals. Availability and consumption of meat milk, eggs and fish does not show a uniform trend, though a majority of locations reported declining fish and milk consumption, and increasing meat and egg consumption (Table 9.1).

Table 9.1 Change in Nutritional Status of the People of the Project Area

Unions	Food item	Change in consumption rate	Per cent people half fed	Months of Stress
Chatterdighi	Fish	Decreased		
	Meat	Increased	30	Feb. - Mar.
	Milk	Increased		
	Egg	Increased		
	Rice	Increased		Oct. - Nov.
Chowgram	Fish	Decreased		
	Meat	Increased		Feb. - Mar.
	Milk	Decreased	10	
	Egg	Increased		
	Rice	Decreased		
Ramananda Khajura	Fish	Decreased		
	Meat	Increased	9	Feb. - Mar.
	Milk	Decreased		
	Egg	Increased		
	Rice	Increased		Oct. - Nov.
Singra	Fish	Increased		
	Meat	Decreased		
	Milk	Decreased	25	Oct. - Nov.
	Egg	Increased		
	Rice	Decreased		

Source: Farmer interviews

The incidence of disease appears to have declined (Table 9.2) in the Project area. In the low lying areas, there seems to be a greater incidence of intestinal complaints, which may be related to prolonged standing water that remains in the fields (Table 9.3).

The positive change noted above is unlikely to have much to do with the Project, and is likely to have arisen from certain autonomous changes of critical significance. These include widespread cultivation of irrigated HYV Boro (unrelated to the Project except marginally) and developments, especially in the boat transport sector.

Table 9.2: Change in Disease Incidence Amongst the People in the Project Area

Diseases	Incidence of diseases in unions			
	Chatterdighi	Chowgram	Ramananda Khajura	Singra
Cholera	Decreased	Decreased	Decreased	Decreased
Small pox	Decreased	Decreased	Decreased	Decreased
Diarrhoea	Decreased	Increased	Decreased	Increased
Skin diseases	Decreased	Decreased	Decreased	Decreased
Malaria	Decreased	Decreased	Decreased	Decreased
Other fevers	Decreased	Decreased	Decreased	Decreased

Source: Farmer Interviews.

Table 9.3: Sources of Water for Drinking and Other Purposes

Unions	Sources of drinking water and water for other works			Months when water become unusable/ water stress
	Drinking	Washing	Bathing	
Challerdighi	Tubewell	Pond and open water	Open water and pond	December
Chowgram	Tubewell	Open water and pond	Open water and Pond	March-April
Ramananda Khajura	Tubewell	Tubewell	Tubewell	March-April
Singra	Tubewell	Open water and pond	Open water and Pond	December

Source : Farmer interviews.

10. ENVIRONMENTAL EVALUATION

10.1 PRE-PROJECT SITUATION

The Nagor River Project area is part of Polder 3 in the Bogra Early Implementation Project (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). It is therefore, similar to the Protappur which is the subject of another FAP 12 RRA report. The FAP 12 post-evaluation, however, is primarily concerned with the south-west half of the Project area, as this is deemed to be the benefited area.

The south west differs markedly from the north east. It forms the eastern most part of the Chalan Beel depression, here mapped by FAO (1988) as the Lower Atrai Basin Agroecological Region, within which no subregions are delineated. The area concerned is occupied by a single soil association : Al 223. -This typically comprises only 5 percent Medium Highland and is dominated by the Lowland agroecological division, which covers about 65 percent; about 25 percent is Medium Lowland, with the remainder (5 percent) occupied by homesteads and permanent water. Most of the higher land occurs along the north-east margin of the benefited area, where the land grades into the adjacent Barind Tract.

The soils are formed predominantly in alluvium deposited by the Atrai river system and are relatively uniform Non-calcareous Dark Grey Floodplain soils. These are dark grey, heavy, acidic clays which pre-Project were moderately to deeply flooded, but with only very small areas in the lowest, central parts remaining wet throughout the year. Soil permeability is slow, especially once the soils are wet and cracks close up, and moisture capacity is low.

It is reported by local people that In the pre-Project era, flood waters entered the area, mainly from the Atrai but also down the Nagor itself, but came from several different directions and parts of the Atrai system. Consequently flooding was usually in stages, resulting in a relatively slow rise in flood level. B. Aman flourished in such conditions, as the crop could keep pace with the flood. However, early flash floods could occur and damage or destroy the B. Aman.

The other major problem was the slow drying out and drainage after the rains, as siltation infilled the local khals, which centre on the Hulhulia khal. This delayed rabi crops such as khesari and mustard, although not significantly affecting the increasing areas of tubewell-irrigated HYV Boro. The latter, however, was susceptible to early flash floods. A social problem cited by FAO (1988) was the dominance of large land owners.

Older local people reported that many years ago wildlife, and especially birdlife, was much more profuse. However, the rapid population growth of recent decades must have reduced natural fauna and flora to a low base-level by the time the Project started, apart from fish and aquatic weeds.

There are problems with environmental post-evaluation in the benefited area of the Nagor River Project:

i. First, the date for the start of the Project is debatable, as bunding along the Nagor in this area had started in 1979 and although fragmented it appears to have achieved some success, notably in encouraging B. Aman. The Project

itself dates from the redesign and construction of the embankment in 1986, the year which therefore, has to be the baseline for post-evaluation.

ii. The Project at present is largely a failure, due to public cuts in the embankment and the lack of any drainage congestion relief. It is clearly important to evaluate what has happened as a result of the Project, rather than what should have happened.

iii. It is not possible to evaluate the environmental impacts of the Nagor River Project in isolation from the Projects upstream of it in the Atrai Basin as a whole.

10.2 PROJECT OBJECTIVES

Neither the EIP (1983) Project Report nor the Nagor River Basin Study (EIP,1988) dealt directly with environmental matters. However, given the all-embracing scope of the environmental impact, much of the findings of EIP (1988) in particular are extremely relevant, From post-Project experience and these findings based upon that, it is extremely apparent that the EIP programme as a whole should have been subjected to a detailed Environmental Impact Assessment (EIP) many years ago.

10.3 APPROACH AND SOURCES OF INFORMATION

The approach to the environmental component of rapid rural appraisal (RRA) is based on simple scaling checklists for each of the three main categories of environmental issue: physical, biological, human (Table 10.1-10.3). This in effect consists of post-evaluation screening and scoping, aimed at:

- identification of Project activities that have caused significant impacts (screening);
- identification of significant environmental issues arising from the Project (scoping);
- assessment of the need for more detailed environmental post-evaluation (environmental audit) of this or similar projects.

An attempt is made at scaling the degree of impact as follows:

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

Impacts thus scaled may be positive (+) or negative (-).

This simple scaling assessment of impacts is intended to be indicative rather than quantitative, suggesting those environmental issues which should receive more attention in any subsequent more detailed environmental post-evaluation.

Rapid scoping of the full range of potential FCD/I environmental issues identified in Chapter 7 of the FAP 12 Methodology Report allowed the selection of those issues relevant to the Nagor River Project. Impacts relating to these are summarised in concerns those affecting ecological (i.e. physical and biological) issues. The human issues are mostly discussed in more depth in other chapters of this report, although summarised here in Table 10.3.

An important consideration in the environmental evaluation of FCD/I projects in Bangladesh is their **external** impacts - impacts resulting from the Project outside the Project area. These are particularly important in the Nagor River Project because, as noted, it is impossible to evaluate its environmental impacts in isolation. External impacts are evaluated in both immediately adjacent and down stream areas. Where no external assessment is given, it is assumed to be negligible.

The Project Report (EIP,1983) and especially the Nagor River Basin Study (EIP, 1988) are valuable sources of environmentally-related data, while FAO (1988) Reports 2 and 5 provide pre-Project agroecological background. No data exist relating to biological data, except for fish-catch data (Chapter 6).

All other information and data were acquired by the RRA approach of interviews with villagers and government officials and by direct field observation. Equally important for the environmental evaluation have been the findings of the other disciplines within the RRA team.

10.4 PHYSICAL ENVIRONMENTAL IMPACTS

Physical issues have been subdivided into water-related and land-related; other physical issues such as climate and atmosphere have not been affected by the Project.

10.4.1 Physical Impacts (Water)

(a) River Flow

River flow parameters include the discharge, velocity, timing and duration of flows. In the lower reaches of the Nagor River, immediately adjacent to the Project area, the Project combines with the other Atrai Basin FCD/I projects to cause a severe negative impact on river flow. The embankments of the two projects impede the previously diffuse flow of the Atrai system, now already greatly concentrated by the other upstream FCD/I projects. In retrospect, it seems inconceivable that so many polder projects should have been not only planned but actually constructed in isolation, rather than adopting the integrated approach so obviously essential.

The Nagor River Project has suffered more than most as a result. The Project at present is an almost total failure, because the embankment was designed for the historical 1:20 year flood along the relevant stretch of river. EIP (1988) show that given the planned and now largely completed bunding and poldering of much of the rest of the Atrai Basin, nearly all of it upstream of the Project area, then embankments at Singhra would need to be at least three, and possibly six, metres higher to meet 1:20 year conditions in the Atrai Basin as a whole.

In practice, this implies that the Nagor river Project can at best be protected, on a 1:20 year basis, only by a submersible embankment. Given successful embanking in the upstream polders, the present embankment would be threatened almost every year. The 1988 floods which led to the public cuts in the Nagor River embankments would have been infinitely worse in the area if the Chalan Beel Polder C embankment had not failed, flooding over half the polder. To add to this forbidding perspective, EIP (1988) calculated that the 1987 flood was only a 1:15 year flood ! Figure 10.1 illustrates the events of 1987.

The public cuts, which remain open despite occasional attempts at 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 Kharsuti village, the Nagor flows rapidly upstream to the first left-bank cut. Here it is joined by out flow from the Nagor Valley project on the opposite bank, through the right-bank cut made directly opposite. This, as will be seen below, gives rise to numerous other negative impacts.

There is then a relatively dead stretch of river for the two kilometres or so upstream to the second cuts, which are here not placed opposite to each other. Water entering the Nagor itself, which is ponded to a high level by the backflow from the Atrai-Gur and outflow from the Nagor Valley area. Downstream flow in the Nagor above the second left-bank cut is slow and impeded by these high levels and the restricted outlet provided by the cut.

The major negative impact on river flow is essential on external impact. However, it gives rise to many secondary and tertiary impacts within the Project area, noted below. There are no rivers within the Project area, the khals being considered as part of the wetland and waterbodies in (g) and (h) below, with which they are for much of the year merged.

The negative external impact affects the adjacent river flows. Downstream of the Gur anabranch confluence, the Project's impact becomes insignificant, as flow has been diverted upstream.

(b) River Quality

Salinity is not a factor in the Nagor River and any pollution of the river by agrochemicals or sewage is adequately diluted by the huge flows funnelled into it from the Atrai Basin.

The chief quality concern, therefore, is sediment. In proportion to the amount of water in the lower Nagor, the amount of sediment is perhaps no higher than pre-Project, so that turbidity may be much the same. What is different is the dominantly coarse (sandy) sediment that now enters the Nagor in an upstream direction from the fast-flowing Gur waters. The Atrai-Gur waters carry a bedload of fine sand, with a mean diameter of about 0.1 mm. compared to the much finer silty bedload of the Nagor. This represents a moderate negative impact on the quality of the lower Nagor, with important secondary impacts noted in section

(c) River Morphology

It is evident that the changes in river flow that have resulted from the Project, in combination with the other upstream Atrai Projects, must affect river morphology. The key parameters of bank erosion, scour and siltation are all negatively affected, giving rise to a major negative impact overall.

Bank erosion is fierce in the Nagor stretch between the Gur anabranch confluence and the first public cuts. The embankment has no set-back, so that here bank erosion means bund erosion. Two locations are particularly severely affected:

- the village opposite Karsati and the confluence is desperately trying to protect its banks with timbers and large branches, as it is exposed to the full onslaught of the Gur waters as they surge upstream, undeterred by the meagre Nagor gradient of 4 cm/km. It seems inevitable that the houses now propped up above this bank will disappear into the Nagor in the near future;

- the two downstream cuts in the Nagor embankment occur where the river loops to the left. For a stretch of several hundred meters the left-bank embankment immediately downstream of the cut is severely damaged by bank erosion, as it is attacked by the upstream surge of Gur water heading into the left-bank cut; the situation is exacerbated by the poor design of the embankment on too tight a turn and by subsequent inadequate construction. It seems safe to assume that it the embankment was not cut during high-flood years, then the river would break through itself at much the same point (as seems to have happened after the one attempt at repair the cut).

The powerful upstream current in the river between the Gur anabranch confluence and the first cut must also be scouring and deepening the river bed in this stretch. On the other hand, both downstream of the confluence and especially upstream of the first cut, siltation must be occurring, a view expressed strongly by riverside villagers who consider it a major negative result of the projet. Flow of the Nagor River, which is heavily silt-laden in the summer, is very sluggish in these stretches, as noted in (a) above.

(d) Flooding

The Project was designed to have a substantial positive effect within the area on flood levels, timing, rate of rise and duration, and in its first year is reported to have achieved much of this. Unfortunately the next year was 1987 and since that time the Project has achieved little in the way of flood control, partly because other Projects were being completed upstream in the Atrai Basin and increasingly concentrating Atrai system flows, thus raising river levels and precluding any flood attenuation by flood plain dispersal.

The latter factor is presumably much the more important. Without increased discharge and levels to control with from upstream Atrai, it seems logical that the virtually complete Nagor embankment would provide more protection and control than did the largely incomplete bund during 1979-85 or than existed prior to any embankment at all, pre-1979.

Despite the two relatively small gaps through which they must pass, the Nagor and especially the Atrai-Gur waters are said to raise flood-levels at rates that outpace the B.Aman crop. This can only mean that very much larger amounts of water are coming down the Atrai than previously, for it to enter the area so quickly through the cuts.

The failure to complete the khal-excavation component of the Project to relieve drainage congestion means that flood duration is prolonged, since the designed escape through the Rekhalgachi regulator at the Hulhulia Khal outfall into the Nagor is not efficiently fed by the silted-up khal network. At present this congestion does not last long enough to delay HYV Boro, probably because of the outlets provided by culverts and bridges on the

Singhra-Bogra road that forms the area's eastern boundary,In addition, the ponded water can be used for low-lift irrigation and for prolonged fishing.

On balance, however, the effect on flooding within the Project area remains a major negative impact, because of the important secondary impact on the B. Aman crop.

External impacts have been similarly negative, especially in the virtually adjacent Nagor Valley scheme. In 1987, this impact threatened to be catastrophic, until the Nagor Valley people in desperation cut the two Nagor bunds. At the time of RRA in 1991, the Nagor Valley area seemed as deeply and widely flooded as the Nagor River Project, with, presumably, similar effects on B.Aman. The cuts release water, but not quickly enough for the inflows from upstream. However, this is a combined impact of the Nagor Project embankment and upstream poldering on the Atrai.

The floods within the Nagor River Project area, as noted, also pass on, albeit slowly, downstream into the Bogra Polder 4. Since this is also a flood-protection area, there must be some negative impact.

Finally, within the Nagor River course itself, adjacent to the Project area, the strong currents induced by the first cut are reported to damage rice on the char lands, the extent of which is presumably less due to the higher river levels. The Project probably has a negligible influence further downstream.

Overall, the external impact on flooding is rated as moderately negative.

(e) Groundwater Levels

This is an important issue because of the rapid spread of shallow tabewell irrigation in the Project area, especially for HYV Boro. The apparent overall slight increase in the volume and duration of flooding probably has a minor positive impact, both within and externally.

(f) Groundwater Quality

It seems unlikely that in its present condition the Project has significantly accelerated population growth or use of agrochemicals. The former would increase indiscriminate sewage but this would in any case be unlikely to foul groundwater, due to natural filtration. The use of agrochemicals has increased and may affect the groundwater. However, this is largely due to tubewell irrigation of HYV Boro and no water quality data exist to confirm such a trend, which is unlikely given the vast amount of percolating rain water. Monitoring is needed, here as elsewhere, to clarify such trends.

(g) Wetland and Waterbodies Extent and Recharge

Practically the entire benefitted area is at present a continuous waterbody during the flood season, something the Project was to have controlled but has not, due to the cuts. Only the village "islands" interrupt the water, in which very little B. Aman can now be cultivated.

During the dry season, the land dries out almost completely, although 100-150 ha. of beel are said to persist in central parts until mid-winter. The khals remain shallow and ill-defined due to siltation, having not been excavated.

In practice, the Project has not had a significant impact on the khals and temporary beels, although it was intended to. Outside the area, in Bogra area 4 and Nagor Valley, there might be a minor positive impact on wetland and waterbodies recharge, due to water passed or ponded respectively by the Project.

(h) Wetland and Waterbodies Quality

From the discussion in (g) it is apparent that the Project has not affected this issue significantly.

10.4.2 Physical Impacts (Land)

(a) Soil Fertility

Soil fertility has not been significantly affected. The extent and depth of flooding have not changed much, so that blue-green algae and aquatic weeds probably maintain previous levels, the latter possibly compensating for the substantial decline B.Aman crop residues.

The farmers still receive their silt in the flood, although this in fact contributes insignificantly to soil fertility in the short term. More important in this respect, is the infertile fine sand deposited from Atrai-Gur water - see (b) below.

This last indicates a minor negative impact overall within the area.

(b) Soil Physical Characteristics

The main change here due to the Project is the deposition of fine sand sediments by the fast-moving Atrai-Gur wasters, which previously were deposited elsewhere. These form an unfavourable sandy topsoil in which low cation exchange capacity limits fertility potential and provides a poor physical medium for plant growth. Some 200-500 ha. are said by farmers to be seriously affected in this way. Overall, this means a minor negative impact.

(c) Soil Moisture Status

Although the floods perhaps persist slightly longer, they do so as shallow water which is difficult to lift or pump, rather than in well-defined khals. Thus there seems to be little change within the area.

(d) Soil Erosion

Apart from the bank erosion already noted, there is also a degree of incipient gullying of the embankment due to poor construction and inadequate maintenance.

(e) Land Capability

Land capability has deteriorated very significantly, since pre-Project a considerable amount of B. Aman was possible. The Project to date has not greatly influenced land capability in rabi. The increased flooding in adjacent areas, especially Nagor Valley, probably means a moderate negative impact on land capability, for the same reasons as above.

(f) Land Availability

Land availability has similarly suffered a major negative impact, because the rapid early flooding precludes use of land which pre-Project was widely cropped. A moderate negative external impact will arise, especially in Nagor Valley, due to increased flooding there.

10.5 BIOLOGICAL ENVIRONMENTAL IMPACTS

Biological environmental issues affected by the Nagor River Project can be divided into fauna and flora issues. Most have suffered no significant impacts but are briefly examined because of the popular awareness of such issues.

10.5.1 Biological Impacts (Fauna)

(a) Bird Communities/Habitats

The decline in bird communities and their habitats was more or less complete pre-Project and any further deterioration is a function of human population density rather than of the Project. The absence of important bird habitats such as wetland or forests in 1976 means that the Project's slight impact on population growth (Section 10.6.2) is not sufficient to cause a significant indirect impact on birdlife.

(b) Fish Communities/Habitats

The Project has not greatly affected the fish communities or their habitats, because the volume of river water entering the area is the same as or possibly more than pre-Project. However, the move out of the area up-river for spawning must be inhibited by the two small gaps that provide egress. Possibly the strong inflow current facilitates location of the gaps. Local people report a decline in fish but attribute it to the rapid growth in numbers of fishermen. A slight negative impact is assumed.

(c) Other Macro-fauna Communities/Habitats

The same comments apply as for (a) above: already by 1976 the intensive occupation and utilisation of the land had reduced mammals, reptiles, amphibians, etc. to almost the very low populations found today. The continued imperceptible decline during the Project's life has not been significantly accelerated by the Project, in part because it started from too low a base-level.

The lack of historical data for this and most other biological issues in Bangladesh is unfortunate, as it prevents any attempt to plot the decline of the country's wildlife and habitats. This would have enabled the Project's impact on these issues to be shown in a true perspective.

(d) Micro-fauna Communities/Habitats

This issue has already been touched upon in Section 10.4.2 (a), where it was noted that no significant change had occurred with respect to the incidence of blue-green algae, one of the major microbiota elements in Bangladesh. In the total absence of data, it is assumed that other microbiota remain similarly insignificantly affected by the Project.

10.5.2 Biological Impacts (Flora)

(a) Trees

The populations in the area have not been affected by the Project, although the embankments provide an excellent opportunity for afforestation (as seen in other FAP 12 study areas such as Chalan Beel D).

(b) Other Terrestrial Vegetation

The same comments apply as to (a) and (c) in Section 10.5.1.

(c) Aquatic Vegetation

The communities and habitats of aquatic vegetation have remained largely unchanged during the Project, as the flooded area seems to be much the same.

10.6 HUMAN ENVIRONMENTAL IMPACTS

Some of the most important environmental impacts of the Protappur Project are those affecting the human environment. However, many of these are covered in other chapters of this report. Here they are presented in Table 10.3 and are briefly summarised below.

Human impacts can be conveniently grouped into five sub-categories: human use, social, economic, institutional, and cultural.

10.6.1 Human Use Impacts

(a) Crop Cultivation

As shown in Chapter 4, the general loss of B. Aman has not been balanced any major benefit. The very considerable growth in HYV Boro does not relate to the Project. The result is a major negative impact.

Externally, in Nagor Valley area, a similar situation seems to have resulted on a moderate scale.

(b) Livestock

Some increase in small stock is reported (Chapter 5), along with benefits from use of the embankment for grazing and security from the floods.

(c) Fisheries

A slight negative impact may have occurred, as declining fish-catches are reported. This may, however, reflect overfishing as increasing numbers of people became involved on a part-time basis.

(d) Afforestation

No impact, but an opportunity to plant the embankments is being missed, which would enhance tree fauna, provide fuelwood and/or fodder, and provide protection against erosion.

(e) Agro-industrial Activities

No significant impact. An increase in rice mills reflects the success of HYV Boro irrigated by tubewells.

(f) Transport and Communications

No real impact, although riverside villages complain of rapid river siltation impeding river navigation. The roads that the embankment should have protected are under water still in kharif. Access along the embankment is provided for pedestrians, but is cut in the places mentioned earlier, and in certain stretches is now extremely unsafe while the river is high.

Surprisingly, boatmen on the Nagor did not think that the duration of navigability had extended, despite the larger amount of water in the river at high flows. A major revolution in river transport has been achieved through the advent of "shallow" boats, often using STW engines extricated from the fields during the floods. However, they do not seem to take much advantage of the cuts to expand their trade into the flooded areas on either side, although such navigation presents no major difficulties.

(g) Domestic Water Supply

The assumed Project impact on maintaining groundwater levels may have had a minor positive impact (and possibly greater) on domestic water (Section 10.4.1) supplies from shallow drinking water tubewells.

(h) Sanitation

Flooding continues to allow flushing of surface water in which indiscriminate sewage has accumulated, it did pre-Project, so there is no real impact.

(i) Recreation

Not affected.

(j) Energy

No significant impact, since the increased number of rice mills and other agro-industrial activities is not a Project effect (the Project is estimated to have caused a net decline in paddy output, see Chapter 11).

10.6.2 Social Impacts

(a) Human carrying Capacity

The effect of the Project in reducing the B. Aman crop, along with land capability and availability, must be to reduce significantly the human carrying capacity. Fortunately, the

much greater increase in irrigated HYV Boro masks this impact. A similar impact must occur in the Nagor River Project.

The slight decline in fisheries is assumed to be balanced by the slight improvement in livestock, within the Project area.

(b) Demography

The Project itself has probably not significantly influenced demographic structure and trends, except as in (a) above, and as noted this not inhibited population growth or structure, due to other compensating factors.

(c) Gender

No significant impact.

(d) Age

No real impact, unless the increased agricultural activity takes children out of school too early.

(e) Health and Nutrition

Minor positive impact due to the maintenance of a clean drinking water supply from the shallow tubewells - see Chapter 9.

(f) Disruption, Safety and Survival

The Project has created a major negative impact in these respect, when taken in combination with upstream development in the Atrai Basin. This is strikingly illustrated by the findings of EIP (1988), quoted in Section 10.4.1 (a).

Should the completed upstream Projects remain intact during the next 1:20 year flood, river levels in the lower Nagor would overtop the bunds with an enormous amount of water, equivalent to higher river levels of at last three metres and probably much more.

Such an event would threaten not only severe disruption, but safety and survival also. Much more frequent floods, under these circumstances almost every year, would cause continual social disruption. The stability of the embankment is a particular threat, with villages such as that opposite Karsati already in imminent danger of destruction. Anyone walking, fishing or grazing livestock on certain stretches of the embankment is risking his life while river flows are only normally high.

Should the Nagor River embankment remain as quasi-intact as at present, it would have a considerable negative ponding effect in Nagor Valley in the event of a major flood from upstream Atrai, as in 1987.

Even so, it would absorb a lot of the flood, again as in 1987, and pass large amounts of it under or over the Singhra-Bogra road into Bogra Polder 4.

Both offsite and on-site, therefore, the Project threatens a major negative impact on social disruption and safety.

(g) Land Ownership

Not affected.

(h) Equity

A moderate negative impact results because generally it is the poorer farmers who relied heavily on B. Aman. Larger land-owners and farmers have been able to take advantage of STW and HYV Boro to more than compensate for lost B.Aman. This has increased the discrepancy in social equity. A similar but lesser impact is likely to occur in adjacent Nagor Valley, in part contributed to by the Nagor River Project.

(i) Social Cohesion

The Project has imposed significant strains upon social cohesion, both within the area and between the occupants of the adjacent Nagor River and Nagor Valley Projects. At its worst, in the 1987 floods when the embankments were breached, this involved armed man and a considerable amount of threats and bitterness between the two project populations, especially those living near the river.

In calmer retrospect, there is much more understanding and even sympathy on the part of the Nagor River villagers for their neighbours' situation, and their resentment has been diverted to the BWDB for failing to restore the bund. However, it is clear that when 1987 conditions, or worse (as is likely), recur then social antipathy will return and could become extremely serious in what may be a life or death situation.

The internal dislocation in social cohesion, within the benefited area, is the often-encountered wrangle between farmers and fishermen. The difference in Nagor River is that in recent years the fishermen have had the upper hand, in that they are said to have initiated at least the second cut, and have successfully kept both cuts open. Local farmers claim that this is because they are backed by local landowners who supply their capital, and concentrate their own cropping efforts on the much higher returns of irrigated HYV Boro.

(j) Social Attitudes

As is apparent from (i) there is substantial public discontent, primarily on the part of farmers, due to the Project and its failure. There is a strong feeling, vehemently expressed in some villages, that BWDB had ignored their opinions and given no opportunity for them to be expressed. Public participation both before and after project construction seems to have been negligible and this must be regarded as a serious weakness in project planning and operation. The Project, after all, is for the people and they have vital local knowledge and understanding that should have been harnessed.

Essentially, the villagers, at least in the farming villages, want :

- the bund repaired and strengthened ;

- at least two of the regulators replaced by much bigger structures, as they are regarded as totally inadequate;

- excavation of the Hulhulia khal system, as originally planned.

It can be assumed that the impact on social attitudes in adjacent area are no less negatively affected, especially in Nagor Valley area following the near-disastrous episode of 1987.

It is chastening to consider what social attitudes in all these downstream areas might be if they were aware of the findings of the EIP (1988) study and the threat that these imply of future catastrophes worse than 1987.

10.6.3 Economic Impacts

The three main potential economic impacts of the Project on the people are incomes, employment and land values. These have all received at least moderately negative impacts, and possibly major (Chapter 11). In all three cases, the impacts arise primarily from the loss of much of the B. Aman crop. Nor has rural credit benefited from the Project as perhaps it ought to have done, if better provision had been made for it. The same remarks apply, but on a lesser scale, outside the area where the Project has contributed to similar trends.

10.6.4 Institutional Impacts

Institutional activity by both BWDB and Singra Upazila seems to have been limited and ineffective (Chapter 3). As a result, the substantial public resentment of the government institutions concerned. Both issues, therefore, have suffered moderate negative impacts, presumably outside the area as well as within it.

10.6.5 Cultural Impacts

It is difficult to see that the Project has significantly influenced cultural heritage and continuity or scenic qualities in the Project area. There are no particular historical, archaeological or more recent cultural sites. within the area. On the opposite bank of the Nagor but upstream of the flooded area is the summer residence used by Rabindranath Tagore, Bangladesh's most famous poet, but this is not affected by the Project.

The overall quality of life has clearly suffered due to the Project's inadequacies, directly because of the loss of much of the B. Aman crop but perhaps more seriously because of the threat of future catastrophe resulting from the Project's downstream location. Local awareness of this situation has not been awakened, so it is largely an invisible and unfelt threat at present, but there must be some instinctive awareness in people living so closely with the land, the rivers and the floods, when they hear of the Projects constructed upstream of them.

10.7 ENVIRONMENTAL SCREENING

The primary Project activities were flood protection, and drainage. The scoping exercise in Sections 10.4 - 10.6 shows that these have not been achieved and in fact the

threat of catastrophic flooding is now much greater in part due to the Project's conception in isolation.

The environmental screening of Project activities implicit in section 10.4-10.6 shows, therefore, that the component of most immediate concern is flood protection.

10.8 CONCLUSIONS

The Nagor River Project, along with all other Projects in the Atrai Basin, is in need of immediate, detailed and above all integrated review. This assemblage of individually designed FCD/I projects has created as inherently unstable macro-environmental situation. The dangers of project planning in isolation in Bangladesh are very clearly illustrated by this project, which thus indicates the failings of the FCD/I approach in the past and which must be avoided in the future.

As a result of this mis-planning, project design was wholly inadequate and is now even more so, as further projects have been completed upstream. In effect, security and even safety in the Nagor River area now depends upon failures in upstream projects, just as it did in 1987 but on a lesser scale.

Inevitably, therefore, the Project has failed, with the following main environmental imparts within the so-called benefitted area, most of which are echoed in the adjoining Nagor Valley area where the Nagor River Project has had a negative influence:

i. creation of a very grave risk of catastrophic flooding even in much less then 1:20 year conditions;

ii. increase in rapidity of flooding early in the season, precluding the traditional B. Aman crop;

iii. decline in land capability and availability, due to (ii);

iv. a similar decline in human carrying capacity and in incomes, employment and land values;

v. a failure in institutional effectiveness, especially in relation to public participation.

The fundamental causes for all these lie in the major external negative impacts on river flow in the Nagor and consequent effects on river morphology and the quality of its bed-load.

Table 10.1: Physical Environmental Impacts.

Biological Issues	Degree of Environmental Impact	
	Project Area Impacts	External Impacts
WATER		
a. River Flow	-	-3
b. River Quality	-	-2
c. River Morphology	-	-3
d. Flooding	-3	-2
e. Groundwater Levels/Recharge	+1	+1
f. Groundwater Quality	0	0
g. Wetland and Waterbodies Extend/Recharge	0	+1
h. Wetland and Waterbodies Quality	0	0
LAND		
a. Soil Fertility	-1	0
b. Soil Physical Characteristics	-1	0
c. Soil Moisture Status	0	0
d. Soil Erosion	-1	0
e. Land Capability	-3	-2
f. Land Availability	-3	-2

Table 10.2: Biological Environmental Impacts

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

Table 10.3: Human Environmental Impacts

Human Issues	Degree of Environmental Impact	
	Project Area Impacts	External Impacts
HUMAN USE		
a. Crop Cultivation	-3	-2
b. Livestock	-1	0
c. Fisheries	-1	0
d. Afforestation	0	0
e. Agro-industrial	0	0
f. Transport Communications	0	0
g. Domestic Water Supply	+1	0
h. Sanitation	0	0
i. Recreation	0	0
j. Energy	0	0
SOCIAL		
a. Human Carrying Capacity	-3	-2
b. Demography	0	0
c. Gender	0	0
d. Age	0	0
e. Health and Nutrition	+1	0
f. Disruption, Safety and Survival	-3	-3
g. Land Ownership	0	0
h. Equity	-2	-1
i. Social Cohesion	-3	-3
j. Social Attitudes	-2	0
ECONOMIC		
a. Incomes	-2	-1
b. Employment	-2	-1
c. Land Values	-2	-1
d. Credit Availability	0	0
INSTITUTIONAL		
a. Institutional Activity/Effectiveness	-2	-2
b. Public Participation	-2	-2
CULTURAL		
a. Historical/Archaeological Sites	0	0
b. Cultural Continuity	0	0
c. Aesthetics	0	0
d. Lifestyle (Quality of life)	-2	-1

11 AN OVERALL ECONOMIC ASSESSMENT

11.1 INTRODUCTION

The Nagor River Project is conceptually very weak and has failed to yield the intended benefits. The Water Board engages in repair work at the points of breach/cuts and builds a dwarf embankment to stop the early flash floods from causing damage to the Boro crop at harvest. These dwarf embankments are not intended to withstand the monsoon floods and are easily breached. Frequently, some local people will expedite the process by cutting the embankment as the flood level rises.

It has already been indicated (Chapter 4) that the Boro crop has been secured by the Project from damage. This is particularly true for the low lying areas of Singra and Chougram Unions. However, since there is no protection from sudden monsoon flooding resulting from breaches, the traditional B. Aman crop is largely destroyed. It is only in the higher reaches of the benefitted area, primarily concentrated in the Ramananda Khajura Union, that flood protection has resulted in a shift from B. Aman to T. Aman (both local and HYV). While the agricultural impacts are the most important and easy to trace, other impacts, e.g. on fisheries and livestock, the environment and non-farm activity, needs to be recognised.

11.2 PROJECT COSTS

The original cost estimate of the Project was Tk.270.6 lakhs, but subsequent cost escalations (by a factor of 1.51 overall) resulted in a total financial expenditure of Tk.409.6 lakhs (see PCR). The period of construction of the Project was from 1983-84 to 1985-86.

The breakdown of actual costs by items is not available, so that the proportions available from the original estimates were used to arrive at it. It was also assumed that cost escalation across items was in the same proportion as for overall costs. Similarly, the breakdown of costs by year could not be traced, so that costs were assumed to be in 1984-85 prices. Total estimated Project economic costs are indicated in Table 10.1. Total capital cost of the Project in economic terms (1991 prices) was Tk.563.3 lakhs. In addition, substantial costs were incurred for rehabilitation work and O&M. The economic value of these costs, sustained over the period 1987-88 to 1990-91, was Tk.65.7 lakhs (1991 prices).

11.3 NET BENEFITS TO AGRICULTURE

The total benefited area of the Project is 9,316 ha. or 60.4 per cent of the total Project area, the former being defined as the area that was subject to serious inundation by flood water. Of this 6,580 ha. (70.6 per cent) are low or deeply flooded, 2291 (29 per cent) are prone to medium flooding and 470 ha. are high (5 per cent).

The low land area was entirely single cropped (traditional B. Aman) before the Project, although frequently damaged by monsoon flooding. The embankment was supposed to save the B. Aman crop from damage, but instead the breaches have made it virtually impossible to cultivate B. Aman at all. The rapid inflow of water causes extensive damage to the seedlings, which can survive normal gradual flooding but not sudden inundation. As far as B. Aman is concerned, the Project has virtually destroyed this crop. On the other hand,

greater security has been imparted to the Boro crop which has certainly improved acreage and production. It is not possible to entirely attribute the rapid increase in Boro (HYV) acreage over the last ten years to the FCD project (Table 4.3). It is basically part of the general trend led by minor irrigation development, but certainly aided by the greater security imparted by the Project.

Table 11.1: Project Economic Costs
(Lakh Takas)

	Estimated Actual Costs (1984-85 prices)	Inflation Factor (%)	Costs 1991 prices	Economic costs
Embankment	156.3	110.3	328.2	233.0
Regulators	43.5	54.5	67.2	46.6
Other Structures	44.2	54.5	68.3	56.0
Admin+HQ	164.6	68.7	277.7	227.7
Total	408.6		741.4	563.3

Note: Conversion factors are derived from FPCO (1991). Indices used to inflate cost items are a) the agricultural wage rate index, b) the construction cost index and c) the Consumer Price Index (for middle income groups).

In the pre-Project situation, 25 per cent of the low (cultivable) land was under Boro (HYV), which has now gone upto 50 per cent. At most, half of this increase in acreage in HYV can be attributed to greater security resulting from the Project[1]. Thus the increased Boro HYV acreage due to the Project is estimated at 1645 ha. B. Aman on the other hand, covered 100 per cent of the low land area, but is now routinely destroyed. We have assumed 80 per cent of the area is completely damaged.

Before the Project, the medium land (2267 ha.) was almost entirely under B. Aman, which in some areas was preceded by irrigated Boro (HYV). The medium low land in Ramananda Khajura union (1563 ha.) has been replaced by T. Aman (25 per cent HYV and 75 per cent LIV). In the remaining medium land (705 ha.), B. Aman has been badly affected.

[1] This is an arbitrary assumption, probably biased upwards.

Table 11.2: Impact on Agricultural Production

Crop	Change in			Gross Econ. Value Tk. million
	Area (ha.)	Yield (mt./ha.)	Production (mt.)	
LOW LAND				
Boro (HYV)	(+) 1645	3.4	(+) 5660	32.5
B. Aman	(-) 5263	1.7	(-) 8701	(-) 49.9
MEDIUM LAND				
T. Aman	1563	0.5[1/]	(+) 722	4.1
B. Aman	352	1.7	(-) 583	(-) 3.3
Total			(-) 2902	(-) 16.6

Source: Consultants' estimates

Note: 1/ Incremental yield due to a shift from B. Aman to T. Aman.

As much as 80 per cent of the traditional B. Aman crop is likely to be routinely lost because of sudden inundation.

We have estimated the change in production due to the Project in the preceding table. This suggests a loss of 2902 mt. of paddy incurred per annum. Assuming a (1991) economic price of Tk.5737 per ton, the gross disbenefit is of the order of Tk. 16.6 million. If the costs of cultivation are deducted, the magnitude of loss would be around Tk. 10 million per year.

Table 11.3 : Hypothetical Situation of Production if Project Operated as Intended

Land Type	Area (ha.)	Production (mt.)		Change
		With	Without	
Low	6580			
Boro (HYV)	3290	11321	5660 /1	5660
B. Aman	6580	10877	5438 /2	5438
Medium	2267			
T. Aman	1134	2294	-	2294
B. Aman	1134	1874	1124/3	750
Total		26366	12223	14143

Source: Consultants estimates

/1 Assumed that without project, Boro HYV would cover half the area covered with project.
/2 Assumed that average yields would be doubled in the with project situation;
/3 Assumed that average yields would improve by 60 per cent with project.

Table 11.4: Costs and Returns from Agriculture if Project was Successful
(Tk. millions)

Land Type/Crop	With Project			Without Project		
	Production	Cost	Change	Production	Cost	Change
Low						
Boro (HYV)	91.2	59.4	31.8	45.6	29.7	15.9
B. Aman	87.7	23.5	64.2	43.8	23.5	20.3
Medium						
T. Aman	18.5	5.9	12.6	0.0	0.0	-
B. Aman	15.1	4.0	11.1	9.1	4.0	5.1
Total	212.5	92.8	119.7	98.5	57.2	41.3

Tables 11.3 and 11.4 show the hypothetical situation with regard to benefits if the Project were to operate as originally intended.

11.3 OTHER IMPACTS

11.3.1 Livestock

The impact on livestock is quite difficult to assess because of the complex factors affecting the feed and shelter situation, as well as the economics of livestock holdings (see Chapter 5). The most important factors leading to a more than 50 per cent decline in the cattle population are (a) loss of fallow land to Boro, (b) increased competition from power tillers, (c) reduced feed availability, and (d) difficulty in keeping cattle under flooded conditions. It is thus very difficult to isolate project impact. It is our opinion, however, that the autonomous declining trend has been strengthened by the Project. While we are unable to quantify this impact, we would assign a single negative sign to denote "small" impact on cattle, attributable to the Project, on an ordinal scale of one, two and three representing small, moderate and large impacts (+ or -).

The goat and sheep populations have increased by 15-20 per cent and 10-15 per cent respectively in the last ten years, in part due to reduced competition from cattle for grazing area. This change cannot be attributed to the Project, except in very indirect terms. The same can be said about the chicken and duck populations, which too appear to have increased.

11.3.2 Fisheries

Unlike in more "successful" FCD projects, the usual highly adverse impact on capture fisheries does not appear to have occurred here. On the other hand, pond fisheries development has received a slight impetus, although much of the potential remains unrealised. A single negative sign can be inserted to take this effect into account.

11.3.3 Social Conflict

The Project has given rise to serious social tensions in the area arising from conflicting interests (fish vs paddy) and water congestion in the adjacent Nagor Valley Project, leading to public cuts and severe crop damage. A satisfactory solution to this problem has not yet emerged. Given the critical importance of this problem for project success or failure, we assess the Project's social impact as strongly negative.

11.3.4 Women and Nutrition

Women's employment and income as well as the general nutritional status appears to have improved in the Project area, compared to the pre-Project situation. However, the link with the Project is very tenuous. Much of the improvement is related to the (autonomous) expansion in Boro HYV led by introduction of tubewells.

11.3.5 Communication and Navigation

In common with most FCD projects, communication in the Nagor River Project area has improved, especially between Domdoma and Khorsuti, which have been linked by the embankment. The public cuts at Khorsuti and Saddanagar have reduced the potential benefits that would have otherwise accrued.

Unlike most FCD projects, boat navigation has not been adversely hit. Indeed boat transport has increased in importance over the years, boosted by the introduction of shallow tubewell engines.

For both road communication and navigation, we would be tempted to assign a small positive impact to the Project.

11.3.6 Employment

Since the potential for agricultural growth could not be realised, with net production turning out to be negative, agricultural employment could not have increased. Whatever increases that have taken place are primarily related to non-Project developments (e.g. Boro HYV expansion). Project related employment increased though Boro expansion has been small.

The only other sector where significant employment generation has taken place is in boat transport. As already noted in the previous sub-section, the Project has not had an adverse impact on navigation, (a) because of the cuts and (b) as the area is not closed.

Agricultural employment due to the Project is likely to have gone down (one negative sign), while the Project effect on navigation can be described as being neutral.

11.5 CONCLUSION AND OBSERVATION

A glance at the table, below will testify to the severe negative impact of the Nagor River Project. The basic concept of the Project is unsound and it would be very difficult to recommission it as originally planned.

Table 5: Assessment of Project Impact by Area of Impact.

Area Impacted	Value
1. Agriculture (Tk. million)	- 16.6
2. Livestock	
- Cattle	- ve
- Other	No change
3. Fisheries	- ve
4. Social Conflict	- - - ve
5. Women/Nutrition	No change
6. Communication/Navigation	+ ve
7. Employment	
- Agricultural	- ve
- Other	No change

Note: Except for Agriculture, all impacts have been given ordinal values.

11.5 RECOMMENDATIONS/SUGGESTIONS

i. The solution to the social problem will need a more careful reexamination of the hydrology of the Nagor Basin, and in particular, of the adjacent Nagor Valley Project. The first public cut was a direct result of the 1987 floods which inundated homestead areas in the Nagor Valley, opposite to where the cut was made, as the existing 2 vent regulator adjacent to the cut could not cope with the huge volume of flood water to be drained out from Nagor Valley Project. A regulator with adequate capacity may help at this point. It is likely however, that the Project will basically have to be converted to a submersible embankment, allowing gradual and **predictable** inundation instead of the sudden and costly flooding that has become routine in the area.

ii. 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, like feeder roads etc. should be planned in association with the Water Board to avoid local drainage congestion within the Project area.

iii. There appears to be no systematic method for record keeping and storing of relevant project documents in the Water Board and other government 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 and O&M services.

iv. 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 it extend its sphere of activity to include the embankment.

REFERENCES

BBS (1985) **Bangladesh Population Census 1981,** Bangladesh Bureau of Statistics, Dhaka.

BBS (1989) **Zila Series, Natore,** Bangladesh Bureau of Statistics, Dhaka.

BBS (1989) **Bangladesh Census of Agriculture and Livestock,** Bangladesh Bureau of Statistics, Dhaka.

EIP (1983) **Project Report : Nagar River Embankment Project,** BWDB, Dhaka.

EIP (1983) **Advisory Minimum Report,** Early Implementatin Project, BWDB, Dhaka.

EIP (1988) **Nagar River Basic Study,** BWDB, Dhaka.

FAO (1988) **Land Resources Appraisal of Bangladesh for Agriculture Development,** Agroecological Region of Bangladsh, UNDP, FAO.