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

RAPID RURAL APPRAISAL OF POLDER 17/2

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Hunting Technical Services Limited

in association with

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

The full series is expected to comprise the following reports:

FAP 12

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

Project Impact Evaluation studies of:

*Chalan Beel Polder D
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* 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

Project Summary Sheet

Project Name	: Polder 17/2 (of Coastal Embankment Project)
Project Type	: Flood Control, Drainage and salinity exclusion
Location	
FAP Region	: South-West
District	: Khulna
Area (ha.)	: 3723 ha.(gross), not all within protection of embankment 2792 ha. (net cultivable)
Funding Agency	: GOB, EIP (Netherlands)
Implementing Agency	: BWDB
Construction started	: 1969/70
Scheduled Completion	: 1970/71
Actual Completion	: 1983/84 (Gangrail closure)
Original Cost Estimate	: Tk 11.8 million ?? (initial CEP cost) Tk 9.0 million (closure, 1980 estimate)
Final Cost Estimate	: Tk 11.837 million (initial investment costs, 1970s) Tk 10.64 million (closure, 1982/3 prices), ignores costs of two closure failures in mid-1970's
Major Flood Damage:	: none
Repair/rehabilitation in	: embankment/sluices: c.1985, also nominally in 1988/9

Comments:

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

POLDER 17/2
SUMMARY OF FINDINGS

Project background

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

Engineering assessment

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

Institutional assessment

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

Agriculture

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

Livestock

There has been little Project dependent impact although the advent of shrimp cultivation meant that there was little grazing land available in part of the Polder; now that

Boro cultivation is expanding this trend is likely to continue. However, grazing quality is improved where saline water is excluded.

Fisheries

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

Nutrition

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

Social Impacts

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

Environment

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

Economics

There is a lack of evidence of induced economic growth in the Project area, although the volume of road transport has increased, and the importance of boats has declined. There has been a limited increase in the availability of employment for labourers inside the Project. Overall the negative fisheries impact is only just less than the net gain to agriculture (after subtracting losses to shrimp farming) due to the Project. Much of the agricultural gain is

relatively recent because of the gradual decline in soil salinity levels after saline water is excluded, whereas fisheries impacts happened soon after the closure. Hence the Project has had very small benefits, while much of the costs were incurred many years before these benefits. Not surprisingly, therefore, the project has not even achieved a positive return at a zero discount rate.

LESSONS

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

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

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

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

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

6. Delays in achieving intended project benefits should be incorporated in project appraisal sensitivity analysis. The critical problems in Polder 17/2 were inadequate planning of the Gangrail closure which delayed completion for 12 years, and the slow achievement of agricultural benefits because soil salinity takes time to decline, compared with much more rapidly achieved losses to fisheries - this could have been predicted.

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ABBREVIATIONS AND GLOSSARY

BBS	Bangladesh Bureau of Statistics
BIDS	Bangladesh Institute of Development Studies
BWDB	Bangladesh Water Development Board
BOD	Biological Oxygen Demand
gher	Bunded area of saline water for shrimp cultivation
khalashi	'Cleaner' (actually guard) of regulator/sluice
CEP	Coastal Embankment Project
DOF	Department of Fisheries
EIP	Early Implementation Project(s)
parishad	Elected council (e.g. of Upazila or Union)
EC	Electric Conductivity
XEN	Executive Engineer (BWDB)
EPI	Expanded Programme for Immunization
FAP	Flood Action Plan
FAO	Food and Agriculture Organisation (of the United Nations)
GOB	Government of Bangladesh
IRR	Internal Rate of Return
IDA	International Development Association (World Bank)
JICA	Japan International Cooperation Agency
LV	Local Variety
MPO	Master Plan Organisation
mt.	metric tonne (1,000 kg., 2,204 lb.)
NG	Non-government
optd	Operated area
PWD	Public Works Datum
RHD	Roads and Highways Department
madrasah	School for religious education
STW	Shallow tube-well (with suction pump)
spp.	species (Plural)
SDE	Sub-divisional Engineer (BWDB)
SDO	Sub-divisional Officer
SE	Superintending Engineer (BWDB)
TL	Team Leader
ODA	United Kingdom Overseas Development Administration
UNDP	United Nations Development Programme
UAO	Upazila Agriculture Officer
UNO	Upazila Nirbahi Officer (principal staff officer of Upazila Parishad)
URDO	Upazila Rural Development Officer
panchayet	Village council
WFP	World Food Programme

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 being carried out by a group of international and Bangladeshi consulting organisations led compromising 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) techniques, and RRA is also being used for preliminary reconnaissance of the 5 PIE projects. The present report describes the findings of the RRA of Polder 17/2.

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/interviewing only in easily accessible areas) and socio-economic biases (for example, omitting coverage of women, landless people, and other groups which are difficult to identify, locate or obtain access to).

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

1.3 GENERAL LOCATION

Polder 17/2 was selected for RRA as a representative polder of relatively recent completion in the "semi-saline" zone of Bangladesh. It is located 23-30 km west of Khulna city on the Khulna-Satkhira road. The polder is bounded by this road to the north and by roads to Paikgacha to the west (in both cases the limits comprise naturally higher land). Immediately to the north, and forming part of the north-east boundary is the Bhadra river, while the remaining boundaries are embankments which form the polder running along link channels from the Bhadra and Salta rivers to the Gangrail river. To the south is Polder 17/1, while contiguous with Polder 17/2 is Polder 16/1 to the west. See Figure 1.2 for details of the project features.

All of the polder lies within Dumuria Upazila which is under Khulna District. It forms one of the many polders constructed under the Coastal Embankment Project in the late 1960s and early 1970s. Polder 17/2 is located towards the northern limit of the zone of saline water intrusion. Much of the land in the region is low lying and is crossed by numerous tidal creeks. During the dry season these carried saline water with the tidal cycle and without embankments the land was frequently inundated with saline water, even higher land being affected by spring tides. However, during the monsoon the large volume of rainfall and flow in the rivers from further north result in the water in the khal-river network being fresh although the level still fluctuates with the tides. In pre-project conditions, therefore, crops could not be grown in much of the area during the winter because of salinity levels. Instead the main crop was transplanted Aman which could be grown during the fresh water period but at the risk of being flooded by unusual tides. At the same time homesteads and village roads were quite frequently affected by flooding.

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

1.4 PROJECT HISTORY

Polder 17/2 comprises at the time of evaluation 6.5 miles (10.5 km) of embankment under the responsibility of BWDB, five drainage sluices, and a number of closures of channels which flowed into the polder, particularly the Gangrail closure. Because the polder effectively comprises two projects a brief history of the works is necessary.

The embankment and structures were completed in 1970-71 (local information and dates inscribed in sluices). However, severe problems were encountered in closing the Gangrail: the initial attempt at the time of Independence failed, and two further attempts in 1975 and 1977 at a slightly different location also failed due to slips in the earth dam - further details are given in EIP (1980). Finally the Gangrail closure was taken up as an EIP scheme in 1980-1 and was completed in 1982-3. Hence for over half of the period since embankment completion up to 1991 the Project could not be regarded as complete in terms of the original design and so it was not fully effective (see Section 2.3).

The original coastal polders were treated as a single project, so separate Project Proformas are not available. However, a 1978 recasting of the expected polder 17/2 cost which gives the actual costs of the Project was obtained from BWDB Khulna. This gives a

net benefited cultivated area of 8000 acres (3238 ha) and claims a benefit of 15 maunds per acre of additional paddy (1.4 tonnes per ha). A benefit-cost ratio of approximately 9:1 was calculated in this document for a total polder cost of Tk 11.837 million. This would appear to be a financial not an economic assessment and the base date is unclear but is presumably 1970-71 - the time of construction.

The EIP recommendation summary (EIP, 1980) discusses the technical standard of the original embankment and that proposed for the (successful) closure (See Section 2.3). This appraisal noted that the aim of the closure was to exclude saline water and thus explicitly meant "the end of the shrimp culture and salt water fishing in the area" (EIP, 1980). This report discusses the problem of the distribution of profits from shrimp cultivation and notes that "It is our impression that the profits of the shrimp business do not flow to the rightful owners of the land, but into the pockets of a few big entrepreneurs ... Further investigations by the EIP Sociologist will be necessary if the Project is considered for execution" (EIP, 1980, p8-7).

The EIP assessment was based on estimates of low pre-closure crop yields (T Aman 12 md/acre = 1.1 mt/ha) which would become much higher (25 md/acre = 2.3 mt/ha) after the closure. This is at variance with data in the EIP post-evaluation (Nabiul Islam, 1988) and with data in Section 4.4. Moreover no allowance for the time taken for salinity levels to decline after the ending of shrimp farming appeared to have been made in the benefit calculation.

More importantly, the estimated loss of annual net benefits (presumably at economic prices) from shrimp and salt water fishing were estimated at Tk 68 lakh at presumably 1980 prices based on a report by BWDB, yet the same appraisal document states that "The BWDB report estimates these negative benefits at Tk 64 lakh and Tk 4 lakh respectively. These estimates are almost certainly too low and need to be verified." (EIP, 1980, p8-8). Yet the closure went ahead presumably on the basis of these estimates. As will be shown by this post-evaluation these estimates were very low. More realistic assessment of the returns to shrimp would probably have turned a relatively small benefit-cost ratio of 1.2:1 into an uneconomic proposition, but in any case for some rather obvious reasons the Gangrail closure failed in its aim of destroying the shrimp farming industry in Polder 17/2.

Following the EIP closure this component of the polder was subject to an evaluation (equivalent to an RRA) in 1988 (Nabiul Islam, 1988). This reported a gross area of 9000 acres (3642 ha), and net benefited area of 8400 acres (3400 ha), but identified the major benefit as an increase in the area under paddy (Aman) rather than any substantial increase in yields. In addition Nabiul Islam (1988) drew attention to the importance of shrimp cultivation, which nevertheless had declined in the area. Since the completion of the closure the area under shrimp cultivation had reportedly declined from some 3400 acres (4000 acres in EIP (1980)) to some 1350 acres. However, the area of shrimp found in this study in 1991 is between these two estimates at about 2300 acres (Table 6.2), and still results in conflicts of interest between small farmers and shrimp cultivators.

One further point is the insistence in all project documents that areas between the Bhadra river and Khulna-Satkhira road were benefited by the Project. While BWDB has recently dredged this river it is not to serve Polder 17/2 but to improve upstream drainage. The road forms an effective limit to both the previous penetration of saline water from the Gangrail system in the polder and to any overflowing from the Bhadra. As discussed in Section 2.5.4 there is only one culvert in the relevant section of this road and on its own it did not have any effect on the Project area. Hence these areas north of the road, which

Section 2.5.4 there is only one culvert in the relevant section of this road and on its own it did not have any effect on the Project area. Hence these areas north of the road, which according to local people have been unaffected by the polder, should be omitted from the assessment of the Project.

1.5 AIMS OF THE PROJECT

The Coastal Embankment Project (CEP) was termed a land reclamation project designed at increasing agricultural production in the coastal regions by protecting against tidal and monsoon flooding. Hence the polders under this project aimed at direct environmental changes - reducing salinity levels inside polders was a primary aim, along with excluding flooding from outside, and improving internal drainage.

The polders were explicitly designed to prevent flooding from the highest normal tide levels (spring tides during the monsoon) with three feet of freeboard away from the open coast. "The embankments are not designed to prevent overtopping by cyclonic storm surges. Such high embankments are too expensive to be justified at this time. Raised community refuge centres and a good warning system are considered the best protection that can be paid for at the present state of land values." (Leedshill De Leuw, 1967; p 404.011). The blanket drainage standard adopted or claimed was that a 1-in-10 day storm of 10 days duration should not flood land to more than 12 inches for more than 3 days (except on "very low-lying" land), this was intended to protect young paddy plants (Leedshill De Leuw, 1967). The expected benefits were agricultural: increased areas under cultivation and higher effective yields. Provision of irrigation was not part of the Project except that structures could facilitate flushing of salts, which was already practised, and supplement low rainfall at the end of the Aman growing season.

The Early Implementation Project (EIP) started in the mid 1970's with the aim of implementing small-scale water management projects which could be constructed quickly and would provide employment in construction and higher agricultural production and incomes. The Project has a specific target group of benefiting small and marginal farmers. The Project aimed to complete the original plan of Polder 17/2 by closing the Gangrail. The ultimate aims of this were to eliminate saline water from the area and so end shrimp cultivation on 4000 acres. It was estimated that this would on average double Aman and Aus yields and that the area of Aus would be increased. No expansion of the area under Aman was predicted nor would shrimp cultivation be replaced by other crops.

The EIP Project was mainly taken up on distributional grounds on the assumption that without saline water in the Gangrail shrimp farmers would go out of business and so farmers would achieve higher Aman yields, the benefits of which would be distributed according to land holding. Profits from shrimp farming were reported to accrue to outsiders and large landowners and not to be distributed to small landowners whose land was taken into shrimp farming. However, no provision was made for any social or institutional support for small farmers to help achieve this objective, nor do any alternative more direct means appear to have been considered for attempting to correct the inequities of shrimp farming as practised.

1.6 ORGANISATION OF RRA

The RRA team comprised specialists in engineering, agriculture, fisheries, sociology and institutions, economics, and women's issues. Fieldwork took place between 1-7 June 1991 inclusive. The team was based in Khulna and travelled by road each day to the study

area. Access to most areas within the polder was by foot. Information is based on discussions with the BWDB Executive Engineer Khulna O&M Division 1, staff of the BWDB Dumuria Sub-division, the UNO and technical officers of Dumuria Upazila, the IDA Third Fisheries Project shrimp cultivation project, staff of NGOs operating in the polder, and on detailed discussions with many inhabitants of the Project area (particularly small and large farmers, landless people, and shrimp cultivators).

Figure : 1.1 Location of Selected PIE and RRA Projects

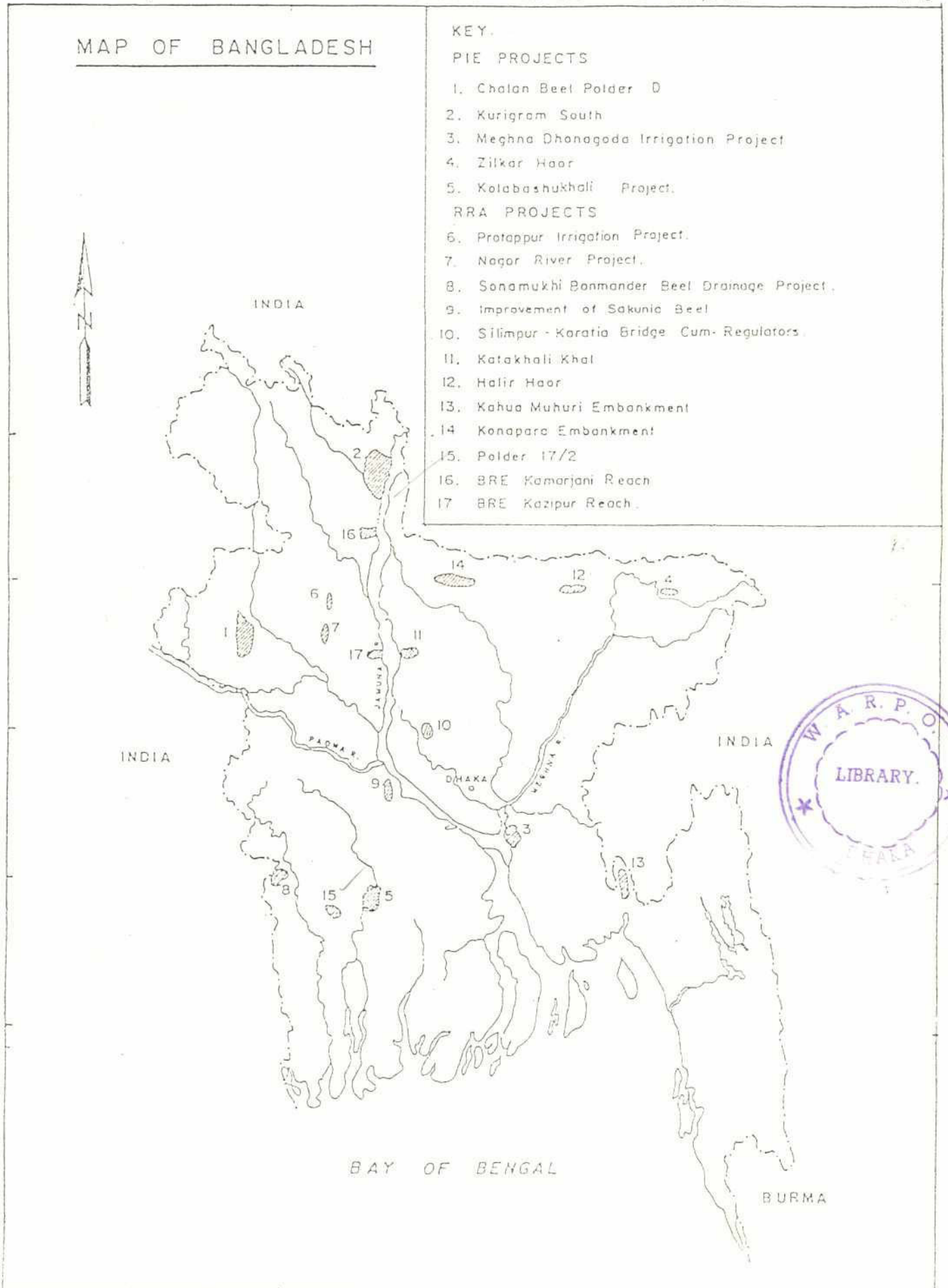
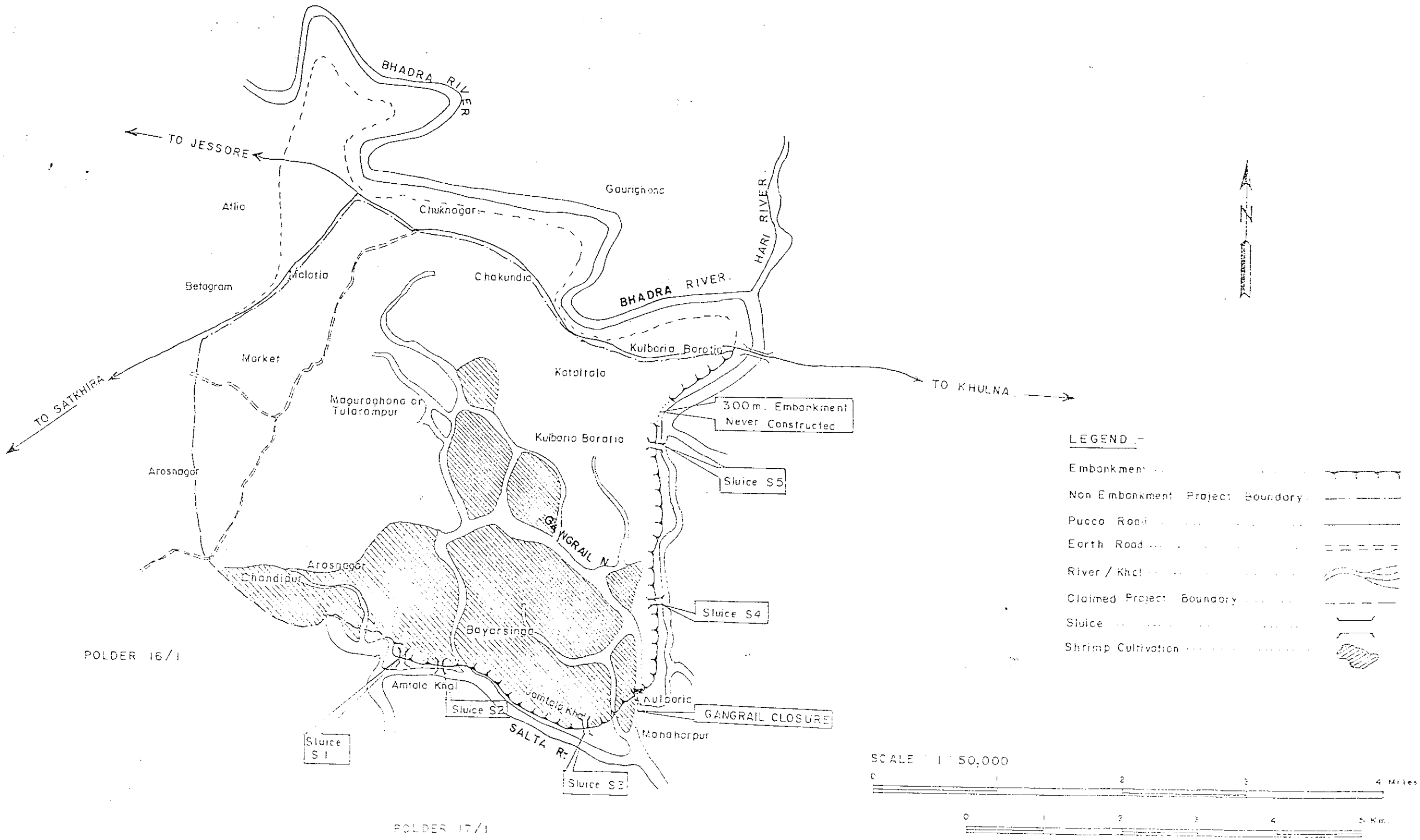


Figure: 1-2 Polder 17/2, Showing locations visited and key features



POLDER 17/2, KHULNA

2 ENGINEERING DESIGN, IMPLEMENTATION AND PERFORMANCE

2.1 PRE-PROJECT SITUATION

Most of the areas in the southern part of greater Khulna were inundated by tidal water until the late 1960's. At that time the farmers constructed small dykes around their lands at the farmer's own cost, organised by the local landlords, but due to lack of adequate strength and stability these dykes were usually damaged by high tidal water, surges and other natural calamities. Consequently field crops were often destroyed (cultivation on low land only being possible in the monsoon when the salinity level in river water dropped).

The area forming Polder 17/2 (about 9200 acres) was affected by the above-mentioned difficulties until the late 1960's. Total area of the Polder consisted of about 12 per cent high land, 21 per cent medium land, 57 per cent low land and 10 per cent embankment, river and canals. The whole area of the Project, except some portion of high land, was frequently inundated by the natural high tide water.

2.2 PROJECT OBJECTIVES

In order to prevent saline water intrusion, and to exclude annual maximum high tides, in the coastal areas, the then East Pakistan Water And Power Development Board had undertaken the Coastal Embankment Project from 1961 onward. Thereafter, the Bangladesh Water Development Board, in order to fulfil the above objectives, completed implementation of a total of 39 Polders in the greater Khulna District up to 1973-4. Polder 17/2 is one of these Polders.

2.3 ACHIEVEMENT OF PROJECT OBJECTIVES

In order to fulfil these objectives in Polder 17/2 a total of 6.5 miles (10.5 km) of embankment was constructed by BWDB on the south and south-eastern sides of the Project area. The other sides are bounded by paved roads which are under the jurisdiction of the Roads and Highways Department of Bangladesh.

In order to fulfil the drainage requirement of the Polder area, 5 sluices were constructed. Among these, one 1-vent sluice (S-5) and another 2-vent sluice (S-4), of vent size 5'x6' each, have been constructed along the Bhadra river side, and two 1-vent sluices (S-3 and S-2), and another 2-vent sluice (S-1) of the same vent size have been constructed along the Salta river side.

The BWDB documents and maps include a northern part of the Project, a relatively small area, which was considered as a Project benefited area. However, this area has no embankment along the Bhadra river beside it and consequently should not be considered part of the Project from a planning or benefit view point as it was unaffected by the Project. However, this portion of the Bhadra river was carrying a limited tidal flow as the river bed in this portion and its upper reaches had been silted up since the early 1970's. Areas north of the road are sometimes affected by very high tides. A small embankment supplemented by dredging spoil has recently been placed along the river bank, but most of the land in this area is relatively high.

The embankment and sluices appear to have been well constructed at the time, and since implementation they appear not to have been badly damaged, although maintenance

has been periodic rather than regular. However, the Gangrail closure (see Figure 1.2) was the key component of the Project: most saline water entered the polder area through the Gangrail river, so without a closure there was a very limited potential benefit from the other components of the Project.

The closure attempt in 1970 failed, perhaps partly because of the political situation in the country at the time. However, the two later attempts in 1975 and 1977 also failed for technical reasons: commencement of work too late in the construction season (almost during the rainy season), selection of inefficient contractors, and lack of proper organization of works. In both cases major slips occurred leading to the work being abandoned, the problem being unsuitable subsoil conditions (EIP, 1980).

The successful Gangrail Closure was designed to have a crest level of 16 feet PWD (compared with 13.5 feet PWD for the embankment), 14 feet crest width and stepped slopes with 30 ft wide berms at 9 ft PWD and slopes of 1:3 above and 1:5 below (river side) and 1:2 above and 1:4 below (country side). It would appear that in this last case proper site investigations and quality control over the material used were achieved.

2.4 POSITIVE ASPECTS

The Polder 17/2 Project did little to eliminate natural intrusion of saline water after implementation of the embankment and sluices and until closure of the Gangrail river, since this river carried tidal water inside much of the Project area through its branches. Therefore, most positive impacts and engineering successes only date to the period after 1983.

a) Completion of the Gangrail closure after more than a decade has been successful in preventing natural tidal water intrusion into the Project's channel network. As a result, salinity has been reduced significantly in the high land and some medium land areas (far from the shrimp culture areas).

b) The embankment, together with the Gangrail closure has been successful in preventing tidal inundation of the village areas which were vulnerable to unusually high tidal flow. As such, land owners in the low lying areas are in a better position to construct their houses in those lands.

c) The embankment has been constructed with sufficient set back distance from both the Bhadra and Salta rivers. The borrow pits made during construction and subsequent re-sectioning within the set back distance are now being used for shrimp culture. While this would most likely have happened anyway, the Project's construction helped the process.

d) The embankment generally had a good section which compares well with the design standard, and the crest is also higher than the sluice tops. Thus the last resectioning in 1988/89 appears to have been well done, and to have a useful life of at least 3 years.

e) Both construction and subsequent re-sectioning of the embankment have created some short term employment for the people of the Polder area.

f) Construction of the Gangrail closure has increased efficient use of agricultural land, and internal dykes around the agricultural lands are less necessary. It has also reduced the flood risk to shrimp farm dykes so that smaller size (cross-sectional area) dykes serve the intended purpose, resulting in a corresponding increase in farming areas. The portion of the

Gangrail river outside the Polder area, which has been silted up due to the closure, is now being used for shrimp and other fish culture.

g) Ignoring shrimp farming, the sluices have been quite efficient at reducing saline intrusion, and in draining out rain water. In the case of sluice 4 the gate design has been modified (to include vertical lift gates in addition to flap gates), as part of IDA funded repairs, to improve its efficiency in water retention.

2.5 NEGATIVE ASPECTS

2.5.1 Overall Project Planning/Implementation

a) The objectives set forth in favour of the Coastal Embankment Project, and hence the objectives of this polder, have not been fully realized. The embankment constructed between the late 1960s and early 1970s could not effectively prevent saline water intrusion inside the Project area, since the Gangrail river and its branches were active for more than a decade thereafter. The first three attempts to close the Gangrail river, the main source of saline water intrusion inside the Project area, failed as noted in Section 2.3. Hence the potential benefits from the initial works were not realised until more than ten years later than intended.

b) The intended operation of the polder rapidly became obsolete to a considerable extent with the growth during the 1970s of shrimp cultivation. However, no attempt to modify the Project design or to alter the operating and management procedures, such as they are, has been made. Since the polder is a BWDB polder, and hence BWDB might be presumed to have overall responsibility for water management in the polder, the striking of some compromise between the interests of paddy farmers and shrimps farmers, or at least some clear policy in managing the polder, should have been decided and acted upon.

2.5.2 Embankment

a) About 1000 ft length of the embankment was never constructed along the distributary of the Bhadra River on the north-eastern side of the Project area (see Figure 1.2). This area was under homesteads and the residents argued that the land was high enough to be above flood risks, and that they did not wish to lose their homesteads. The land dispute raised by the households there appeared to have been overcome by a compromise between them and the then BWDB officials for the Project. Water level at high tide remains 1-2 ft lower than the river bank at that site, but the natural levee might be overcome by an unusually high tide during monsoon.

b) Although the embankment of Polder 17/2 seems to be in a good condition after reconstruction (some three years ago), it still needs some periodic maintenance work due to inadequate earthfilling done by the shrimp farmers during placement or removal of their tidal flow inlet and outlet structures, and due to rat holes which are damaging the embankment and hampering its stability and serviceability as a continuous road. No regular embankment maintenance works are being done by the BWDB or local people, especially the shrimp farmers, on their own initiative.

2.5.3 Sluices

a) All the sluices are not functioning well, because there remains in most cases a gap between the upper end of the flap gate and sluice opening. Most of the flap gate rubber seals have been damaged, and consequently tidal water has been intruding into the Polder area at a considerable flow rate. Some sluices were repaired, and flap gates were replaced, under the IDA flood rehabilitation programme about 2-3 years ago (the structures had not been damaged during the severe flood years of 1987 and 1988 but had suffered from a lack of routine maintenance). All of the sluices have slots for a fall board system (as per the CEP sluice design), but in sluice 4 this system has been replaced by vertical lift gates. Still it was observed that the flap gate, together with the vertical gate, in sluice 4, is unable to prevent leakage causing saline water intrusion.

b) The sluices which were constructed more than two decades ago need some maintenance work in addition to the repair work done through the IDA programme. Siltation of drainage channels connecting to the sluices 1, 2 and 3 and siltation of that part of the Salta River itself which drains the area is causing severe drainage problems in the polder during the monsoon period. A local NGO has re-excavated the outlet channels of sluices 1 and 2, but those channels have again silted up.

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

2.5.4 Water management consequences of Shrimp Farming

a) Unplanned (Shrimp farm) box inlets

A total of 14 temporary structures of different kinds have been installed by the local people. Eleven are long small size wooden boxes with small gates on both sides. These are being used by the shrimp farmers for introducing saline water, draining it out, and for flushing fresh water into the ghers.

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

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

b) Status of shrimp culture

There exists one GOB notification in favour of shrimp culture, which is to be enforced through the Divisional and Upazila Shrimp Culture Regulation Committees. These have an outline procedure for giving approval for shrimp culture, but no strict legislative or enforceable procedure has been mentioned for preventing unauthorised embankment cuts being made by the shrimp farmers. Whether or not the shrimp culture has been disfavouring the Polder objectives and overall welfare of the polder inhabitants, it has been hampering an important facility of continuous road communication around that area by damaging the embankment sections. According to BWDB officials no such embankment cuts for shrimp culture have ever been approved from their side.

2.5.5 Siltation

In the pre-Project situation the portion of the Salta River along the southern boundary of this Polder had a few live branch channels Projecting inside the Polder area which, together with other branch channels of the Gangrail River, had almost formed a regime channel network that kept the Salta River in an equilibrium position with the tidal flow. Closure of the Salta River branch channels during embankment construction, and the closure of the Gangrail River, have ended the ebb-tide pressure on the Salta River.

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

2.6 CONCLUSION

Polder 17/2, one of the many Polders constructed under the Coastal Embankment Project, had been completed by the early 1970's, except for the closure of the Gangrail River which was completed more than a decade later. Most of the structural components of the Polder were completed, despite the hiatus during the achievement of Independence by Bangladesh, within a very reasonable time, and significantly realized some of the Polder's physical objectives. However, prevention of saline water intrusion, the major objective, was not effectively realized because of the live Gangrail River and its branches inside the Project area, following repeated failures to close this river.

The Gangrail closure, however, was successfully completed, after failure of three attempts made in 1971, 1975 and 1977 respectively, under EIP in 1982-3 and was expected to realize all the objectives of the Polder.

Prevention of saline water intrusion inside the Polder area was a major objective, but this aim has been contradicted through intrusion of saline water inside the Polder area for shrimp culture. Although this shrimp culture has been legalized through a GOB notification which also enables regulation, there is still no provision for taking any strict legislative and enforceable action against unauthorised shrimp farming. There also exist both Divisional and Upazila Shrimp Culture Regulation Committees, and a procedure for issuing licenses for shrimp culture and placement of BWDB approved sluices in such practices. But due to improper or nonexistent implementation of this system, the shrimp farmers have been using

temporary, inadequate and low strength wooden boxes, together with insufficient earth filling during their installation or removal. This uncontrolled activity not only hampers stability of those embankment sections, but also hampers the serviceability of the embankment as a continuous road.

It should be noted, however, that the BWDB approved control structure was reported to cost Tk. 1.5 lakh to build, whereas wooden boxes have material costs of perhaps Tk. 5000. There appears to have been no attempt to find or invent a compromise low cost but adequate design which would be financially acceptable to shrimp farmers and would not risk the embankment structure.

Closure of different rivers and their branches within such polders, implemented under the CEP, has seriously affected some tidal rivers, especially the reach of the Salta River on the south side of Polder 17/2. The siltation of the Salta River in this reach has been creating serious drainage problems from stagnant monsoon water inside the polder. No effective measures have yet been undertaken by BWDB to ameliorate this situation, but the problem is one of revised integrated water management of the polder system rather than piecemeal dredging around existing polders.

Overall, implementation of Polder 17/2 has contributed towards alleviating poverty and distress levels of the Polder inhabitants. However, about 30 per cent of the Polder area is under shrimp culture which has been subjected to some hidden, complicated, nitty-gritty, shrimp politics, and this situation has prevailed and will continue to prevail in and outside the Polder areas. This reality should be accepted and polder management and planning should aim to achieve a technical (and economic and social) balance between land users by requiring and regulating shrimp farmers to be effective at excluding saline shrimp water from designated fresh water areas.

2.7 RECOMMENDATIONS

- Rigorous study of tidal rivers is necessary before implementation of such polders in the coastal areas, especially to prevent or to minimize siltation of such rivers.

- Possibilities of future usage of the embankment and its appurtenant structures, such as regulators/sluices, as a road should be explored properly.

- Provision and implementation of proper monitoring and regular or periodic maintenance, whichever is more economic, of all structural components of such Polders should be taken up.

- Whenever socially and economically feasible alternative options of production, such as shrimp culture, arise which were not originally planned for, a clear decision after consultation on the priorities for separate or combined land uses should be taken. In this connection, relevant changes in Project operation (and possibly facilities) should be made, with a clear outline of proper authorization and strict means of controlling these practices.

3 INSTITUTIONAL DESIGN AND PERFORMANCE

3.1 INTRODUCTION

This section is concerned only with institutional issues directly linked with water management in the polder. General details of other social institutions in pre- and post-Project conditions can be found in the social impact assessment (Chapter 10). Information was collected from: Coastal Embankment Project Operation and Maintenance Manual (Leedshill de Leuw, 1967), from BWDB officers (from Executive Engineer down to sluice khalashis), and from farmers in the Project area.

3.2 PRE-PROJECT CONDITION

3.2.1 Pre-CEP

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

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

3.2.2 Pre-closure

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

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

3.3 POST-PROJECT CONDITIONS

3.3.1 Water management

So far as water management in much of the polder is concerned, the ghers are little changed. Inflows and flushing of saline water are under the effective control of the shrimp farms. It is rare, although not unknown (See Chapter 2.4.5 for a case of farmers abandoning shrimp cultivation in favour of Boro), for farming interests to overcome the investment and powerful position of the shrimp farms. Moreover water management in non-gher areas is affected since they make it difficult to drain out water, while seepage of saline water affects cultivation outside the ghers.

However, the BWDB embankment and sluices have altered the institutional setting. Now there is a public embankment, and public sluices. The polder means that BWDB could, if it were interested and had enforceable means, regulate the management of the polder and arbitrate between private land uses where they have adverse impacts on others.

3.3.2 Maintenance of the embankment

Maintenance of the embankment is the responsibility of BWDB. This means that no regular maintenance is done, but periodically when external funds become available the embankment is resectioned. This has apparently happened twice since the embankment was built. There is no local involvement in maintenance, and while gher operators do rebuild the embankment after cutting to place boxes, the local people did not appear interested in repairing one hole which developed in the embankment during the RRA fieldwork, although it had been repaired during the following two months.

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

3.3.3 CEP institutional framework

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

The CEP sluices were each to have a kalashi and were to have sluice committees comprising the SO, UP chairman, and Union agricultural assistant (Block Supervisor). Hence the committee was one of local technical functionaries who were supposed to listen to farmers' demands and make decisions and judgements accordingly. This was to extend to mobilising local works to overcome problems, such as local drainage channels, and not just opening and closing gates, as it was recognised that the basic project planning and design would not cope with all problems. Moreover unspecified contacts with local farmers, joint

inspections of water levels and problems, and operating criteria based on experience were all to be part of operation of sluices (Leedshill de Leuw, 1967, p404.02).

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

Moreover, there was apparently no provision for funding and supporting the proposed operation system, for training or encouraging farmer participation in management of parts of the polder area. There was also no provision for local involvement in coordination at the polder level, which was presumably intended to be done by the SDE and Executive Engineer. Without a continuing commitment to supporting local involvement in polder management, at least during the early years of the polder, it is not surprising that the concepts in the O&M manual have largely not been put into practice.

3.3.4 Project monitoring

The same problems are seen in project monitoring - Leedshill de Leuw (1967) detailed an elaborate procedure for monitoring embankments and structures so that they would be properly maintained (on the assumption that there would be resources for this). However, minor maintenance work would not appear to have entered the job descriptions of those BWDB employees available on the ground, while the monitoring system reported by the Executive Engineer to be followed by BWDB differed from the CEP system, and in any case could not be followed for lack of resources and time. Such systems seem doomed to become at best administrative procedures with little practical meaning when they are divorced from accountability to the polder manager's clients (the farmers) and have no means of finding resources to make repairs speedily when a problem is identified.

3.4 LESSONS FOR FUTURE PROJECTS

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

- Extensive O&M manuals prepared by external consultants are of little use (however appropriate the procedures and institutions they recommend, and many of the details in the CEP O&M manual seem still to be valid and

appropriate) if there is no interest in or funding to set up and run the management systems they entail.

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

- To achieve effective management technical expertise is required along with resources. While some external funding (funding external to the polder) may be necessary, if the polder is bringing substantial financial benefits (and the profitability of shrimps seems clear) there is no reason why direct funding of O&M from the beneficiaries could not be realised, if the polder authority were given such powers.

4 IMPACT ON AGRICULTURE

4.1 PRE-PROJECT SITUATION

4.1.1 Agricultural Conditions

The Project area of Polder 17/2 (Figure 1-2) is bounded by the Bhadra River to the north and east, Salta and Taltala Rivers to the south, and Polder 16/1 on the west side. The Gangrail River flowed into the area for 7.5 kms. At the junction of the Bhadra and Gangrail Rivers the tide rises up to 14 feet (4.25m) during the rainy season and 7 feet (2.1m) during the dry season. The water became saline from November until June. During the rainy season the river water became sweet. At each high tide (twice in a day) water entered into the Project area inundating the low land. During unusual high tides low lands were inundated under 7-8 feet (2.1-2.4m) and high land up to 1.5 feet (0.45m). Farmers constructed private bunds to prevent intrusion of saline water in to their agricultural plots, but these bunds risked being overtopped or breached by the tidal floods. According to the local farmers, only once in every five years could they harvest their Aman crop on low land. Moreover, the yield was low due to salinity.

According to the EIP evaluation (Nabiul Islam, 1988) the total land area inside the Project was 9200 acres (3723 ha) where 8400 acres (3399 ha) were the benefitted area. Measurements by planimeter confirmed the total area of the Project as defined by BWDB as about 9200 acres. While checking the 4" to 1 mile maps (Survey of Pakistan, 1960-64) categories of low, medium and high land were used based on the contours, plus separate categories for embankments and channels (percentages in Section 2.1). However, during fieldwork local farmers classified the cultivated land as high and low. Based on the locations visited, the breakdown of the Project area becomes:

- high land was either above normal flood height or affected by 0-1.5 feet of inundation and mainly used for winter vegetables, Broadcast Aus (B. Aus) and Jute cultivation, homesteads, roads and embankments. About 33 per cent of the claimed Project area falls into this category, of which perhaps 2036 acres (824 ha., 22 per cent of the total area) was estimated to be cultivated. However, 377 acres (153 ha.) of this high land is in fact outside the road which defines the genuine Project area (4 per cent reduction in project area);

- low land was defined by about 5 to 7 feet (1.5-2.1m) of tidal water occurring during high tide. In these low lying areas (estimated at 5236 acres or 2119 ha., 57 per cent of the area) only transplanted Aman (T. Aman) was extensively grown in the Kharif season.

The remaining areas were bunds and rivers/channels (about 10 per cent of the area). Hence by implication about 6900 acres (2792 ha.) were cultivable at that time (excluding the area not benefited by the Project) which is in good agreement with the estimate of the UAO Dumuria who reported that on an average, in 1980-81, about 6842 acres (2769 ha) of the Project were cultivable land. There were no shallow tubewells before the closure. Farmers used to irrigate their farmland by indigenous methods from nearby sweet water sources. T.Aman was grown in some high lands too.

The soil is classified as Saline Ganges Tidal Floodplain. The soil contains a buried dark coloured top soil or organic layer (UNDP/FAO, 1988).

The main crops cultivated were winter vegetables, B. Aus, Jute and T. Aman (Tables 4.1 and 4.2 report the cropping patterns found in the field surveys in high and low land respectively). The vegetables grown were mainly cabbage and chillies, but brinjal, cauliflower, tomato and potato were grown to a lesser extent. The varieties grown were all local.

Before 1970 use of high land was quite intensive (Table 4.1) where salinity was relatively low (approximately 2 mmhos/cm), but in several villages higher lands were affected by salinity (cropping intensity about 50 per cent , Table 4.1). An early monsoon crop was grown on most of the land, preceded by vegetables or other rabi crops. Even at this time there was clearly a demand for vegetables in the nearby towns. The simple average cropping intensity for this land was 145 per cent .

Low land was less intensively cultivated (Table 4.2). All cultivable low land was under one crop a year (T. Aman) when salinity levels fell during the monsoon, but even then there were uncultivated wetlands.

The alternative cropping patterns or sequences for high and low land areas are given in Table 4.3. The yields of different crops in the pre-Project situation, based on group interviews, are reported in Table 4.4 (input levels were probably similar to present levels for those crops which were grown at that time). Yields of some crops were low due to high salinity in the soil, which was the main environmental constraint. Table 4.5 gives the general impact of soil salinity on crop (possibly Aman) yields for Khulna District. Specific soil surveys for Polder 17/2 appear not to have been carried out.

The percentages of households comprising agricultural labour and landless labourers were high in the Project area. The land price was very low. The farmers even reported that nobody wanted to buy land at that time.

4.1.2 Problems in the Pre-Project Situation

Intrusion of saline water in the Project area resulted in heavy damage to crops. The low lying areas of some mouzas could not be cultivated (Table 4.2). There was reportedly a good harvest of T. Aman in low lying areas only once in five years.

4.2 PROJECT OBJECTIVES

The two stages of the Project (CEP and EIP closure) had a main objective of preventing saline water intrusion into the area. The Project was thereby expected to bring about more intensive cultivation, provide better drainage and thereby increase crop production, mainly through protection from flooding. Specifically CEP Polder 17/2 aimed to virtually double T. Aman yields (BWDB, 1978). The EIP Gangrail closure again aimed to double T. Aman yields (these not having doubled earlier).

4.3 EXPECTED BENEFITS

The CEP documents for Polder 17/2 give little information, but base their calculation on a 15 mds/acre (1.38 mt./ha.) increase in paddy yields (BWDB, 1978) - implying that cropped areas were not expected to increase. However, the implication of the EIP feasibility study (EIP, 1980) is that this had not taken place by 1980, since the closure was aimed at

raising T. Aman yields (on the same area - 3035 ha.) by 13 mds/acre (1.2 mt./ha.). EIP's closure was also intended to increase the area and yields of Aus from 100 to 500 acres (40 to 200 ha) and from 9 to 15 mds/acre (0.8 to 1.38 mt/ha), and to increase the area under rabi crops from a claimed 150 acres (60 ha.) to 2500 acres (1010 ha.). Rabi yields were also expected to rise substantially. There would, of course, also be the loss of 1620 ha. of seasonal shrimp farming. The data presented in Tables 4.1, 4.2 and 4.4 suggest that the pre-Project appraisals (from both 1970 and 1980) underestimated the existing productivity of the area both in yields and cropping patterns, and similar conclusions regarding yields were reached by Nabiul Islam (1988).

4.4 PROJECT IMPACTS

The agricultural impact of the Project has differed considerably between high and low land, and has also depended on the compensating actions of shrimp farmers.

4.4.1 High land

A few marginal areas of "high" land have been converted to ghers (Table 4.1), but for the most part Aus crops have benefited, not so much from increased areas but from increased yields - which according to the farmers match those of T Aman (Table 4.4), having doubled from a higher pre-Project level than EIP reported. Rabi crop area has indeed expanded substantially, reflecting reduced salinity in higher lands, but yields may not be higher than before. Annual flood levels have been reduced from about 0.3m to zero, but more important is the associated decline in salinity.

4.4.2 Low land

A substantial area which was reported to have remained fallow in the monsoon season is now reported to be under T. Aman; however, this impact is unclear since farmers' recall is at variance with the areas of Aman reported in earlier project documents. T.L. Aman yields are reported to be slightly higher in non-gher areas than they were before, with a mean yield of 36 md/acre rather than 30 md/acre (in a good year), and a small area had converted to T HYV Aman where saline water intrusion is prevented.

However, a large part of the T. Aman still follows shrimp farming, the area of which is only partly reduced, and yields in these areas are effectively unchanged. The salinity level of the gher areas (shrimp culture enclosures) is still higher than in the pre-polder period, and the farmers are cultivating shrimp from January to July and Transplanted Aman from August to December. The farmers of this area have to prepare seedbeds outside the project. During the shrimp harvest the cultivators drain out the water from the gher and in that soft soil they transplant Aman paddy without any tillage. In this area farmers do not use any fertilizer, and therefore the production cost is low.

Hence, the Aman impact is reduced to a small reduction in the area of shrimp ghers, where a doubling of yields has consequently occurred, and small increases in yields in non-gher areas.

There has been some growth in HYV Boro cultivation in recent years on low land where shrimps are not farmed. According to farmers, a reduction in salinity of 25-50 per cent in parts of the Project increased the profitability of HYV Boro cultivation (Table 4.5). This has

encouraged a number of large farmers to install shallow tubewells. Water is sold to other farmers for a 25 per cent share of the Boro crop. There are now 90 shallow tubewells and four LLPs in polder 17/2. According to the tubewell owners, if they bore a 100 ft well the water flow is less but the water is sweet, but at 200 ft. depth the flow is better although the water is slightly saline. HYV Boro yields currently average about 45 md./acre (4.15 mt./ha.) and the farmers are hoping to have increased yields in the future as the soil salinity decreases. This change would not have been possible without the embankment and closure, as these have enabled salinity levels to be reduced in some areas. However, it is impossible to say how much of the gher area might be under Boro without shrimp cultivation.

4.4.3 Summary of positive impacts

a) Crop Areas, Yields and Output

Overall the primary objective of the Project has been fulfilled (to the extent possible given the growth in shrimp farming) through:

- increased crop production;
- increased cultivable land in low-lying areas;
- increased cropping intensity due to reduction of salinity; and
- increased crop security against water level fluctuation.

After the Project saline water intrusion in the northern area has been totally prevented which allows the top soil to be saline free. Salinity of the soil of Khulna district and percent area under each salinity level is given in Table 4.5, yield reduction of transplanted aman rice is also shown in the table.

A comparison of yields of major crops in the pre-Project and post-Project periods according to EIP sources and the RRA is given in Table 4.7, it seems clear that there has been an increase in yields of paddy crops, even though the feasibility study for Gangrail closure (EIP, 1980) appears to have underestimated yields at that time. The overall cropping pattern has also changed considerably.

Table 4.8 summarises the pre- and post-Project cropping patterns found in the RRA, based on the data in Tables 4.1 and 4.2, weighted by the estimated proportion of the villages within the project, and the total area represented by these survey locations (which is the majority of the project). The post-Project estimates represent 1990-91, some of the changes have been relatively recent as the salinity levels decline and area under HYV Boro for example expands - this is shown in the records from the "blocks" which include parts of the Project (Table 4.9).

b) Crop Diversification

Some crop diversification (Country bean, sugarcane and wheat) has occurred on higher land free of salinity.

c) Induced Economic Growth

Due to higher production in the Project area, and improved communications there has been some consequent economic growth in the area, including rice mills, trade, and a shrimp processing plant. The percentage of landless farmers and agricultural labourers in 1980 was

reportedly 19 per cent (EIP, 1980), this does not appear to have grown subsequently (compare with Table 4.10), which may be a benefit of the Project. Table 4.10 also reports the wage rate for agricultural labour in 1991.

d) Land Prices

Changes in land prices are a reflection of the changes in agricultural possibilities, but also are affected by the ghers. Table 4.11 shows a mixed impact, recall of pre-Project prices is probably not very reliable, but the relative changes indicate that low land has rarely become relatively less valuable, and in six out of 11 locations has increased in relative price by a large amount.

e) Trees

A wider variety of fruit trees are now grown in the Project area, since they are not saline tolerant.

4.4.4 Negative agricultural aspects

a) Reduction of Aman Yields

There has been a decline in Aman yields in the gher areas, compared to that possible with the project, due to water management in favour of shrimp farming.

b) Agricultural Pests and Weed Growth

With reduced salinity and a safe embankment the rat and the insect populations have increased creating agricultural problems, and in the former case damaging the embankment.

Weed growth has increased in upland crops.

4.5 RECOMMENDATIONS

i. Adaptive research to find suitable crop varieties which can further increase production is needed.

ii. Agricultural extension services should be strengthened in the Project area to help farmers in adapting new varieties and to improve use of inputs.

iii. The problems of waterlogging and salinity intrusion from gher areas into adjacent farmland during the dry season need to be addressed by compensation or better water management (conflicts within the gher areas between shrimp and agricultural interests are discussed in other chapters).

4.6 SOURCES OF INFORMATION

EIP Project evaluation report for Gangrail Project- Polder 17/2
SE, BWDB, Khulna
SDE, BWDB, Dumuria
XEN, O&M Division 1, BWDB, Khulna
SO, BWDB, Dumuria, Khulna
UNO, Dumuria
Additional Agriculture Officer, Dumuria, Khulna
URDO, BRDB, Khulna
Farmers Group interview
MPO technical report no. 1.

Table 4.1 Cropped Area by Crop Season in High Land, Polder 17/2.

Place Village/ Mouza	Land Level & % Area	Pre-Project						Post-Project					
		Rabi		Kharif I		Kharif II		Rabi		Kharif I		Kharif II	
		Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area	Crop	% Area
Chakundia	37.5	Winter Veg.	60.00	B. Aus	50.00	-	-	Winter Veg.	75.00	B. Aus	37.50	-	-
		Mustard	30.00	Jute	50.00	-	-	Mustard	15.00	T. Aus	12.50	-	-
		Pulse	10.00			-	-	Pulse	10.00	Jute	50.00	-	-
Mathbaria	25.0	Mustard/Lentil	50.00	B. Aus	50.00	-	-	Cauliflower	75.00	B. Aus	12.50	-	-
		Cauliflower	40.00	Jute	50.00	-	-	Chili	20.00	T. Aus	37.50	-	-
		Spinach	10.00			-	-	Wheat	2.00	B. Ground	25.00	-	-
						-	-	Potato	3.00	Jute	25.00	-	-
Baratia	50.0	Winter Veg.	6.25	B. Aus	6.25	-	-	Cauliflower	18.75	B. Aus	6.25	-	-
		Fallow	93.75	Jute	43.75	-	-	Cabbage/Rad.	6.25	T. Aus	18.75	-	-
								Mustard	25.00	Jute	75.00	-	-
								Pulse	25.00				
								Bean	25.00				
Aroshnagar I	50.0	Winter Veg.	10.00	B. Aus	50.00	-	-	Winter Veg.	12.50	T. Aus	25.00	-	-
		Banana	12.50	Jute	50.00	-	-	Mustard	12.50	Jute	75.00	-	-
		Fallow	77.50					Pulse	50.00				
								Banana	25.00				
Aroshnagar II	37.0							Cabbage	80.00	T. Aus	33.00		
								Mustard	10.00	Jute	33.00		
								Pulse	10.00	Chilli	16.00		
										Brinjal	16.00		
Maltia	25.0	Winter Veg.	25.00	B. Aus	12.50	-	-	Winter Veg.	75.00	T. Aus	12.50	-	-
		Fallow	75.00	Jute	12.50	-	-	Mustard/Pulse	25.00	Jute	12.50	-	-
				Fallow	25.00	-	-						
Kulbaria	25.0	Winter Veg.	25.00	B. Aus	50.00	-	-	Land taken under 'gher' for shrimp culture					
		Mustard/Pulse	75.00	Jute	50.00	-	-						
Kulbaria Baratia	25.0	Very saline soil unproductive						Winter Veg.	25.00	B. Aus	12.50	-	-
								Mustard	25.00	T. Aus	6.25	-	-
								Pulse	12.50	Jute	81.25	-	-
								Sugarcane	12.50				
								Wheat	25.00				
Magura Ghona I	12.5			B. Aus	50.00	-	-	Winter Veg.	100.00	B. Aus	37.25	-	-
				Jute	50.00	-	-			T. Aus	12.75	-	-
										Jute	50.00	-	-
Magura Ghona II	25.0			T. Aus	62.50			Boro HYV	25.00	Jute	62.50		
				Jute	37.50	T. Aman	100	Winter Veg.	25.00	T. Aus	25.00		
								Fallow	50.00	Fallow	12.50	T. Aman	100
Chucknagar	25.0	Winter Veg.	50.00	B. Aus	50.00			Winter Veg.	75.00	B. Aus	37.50		-
		Mustard	50.00	Jute	50.00			Mustard	25.00	T. Aus	12.50		-
										Jute	50.00		-
Boyersinga Ghona I	25.0	-	-	B. Aus	12.50			Shrimp culture					
				Jute	12.50	T. Aman	100					T. Aman	100

Source: Farmers' group interview.

Table 4.2 Cropped Area by Crop Season in Low Land in Polder 17/2

Place (Village Mauza)	% Land of this level	Pre Project (about 1970)						Post Project (about 1990-91)					
		Rabi		Kharif I		Kharif II		Rabi		Kharif I		Kharif II	
		Crop	% area	Crop	% area	Crop	% area	Crop	% area	Crop	% area	Crop	% area
Chakundia	62.5	--	--	--	--	T. Aman Wetland	87.5 12.5	Boro HYV	25			T. Aman LIV	100
Mathbaria	75.0	--	--	--	--	T. Aman LV	100	Boro HYV	10			T. Aman HYV T. Aman LV	50 50
Baratia	50.0	--	--	--	--	Fallow	100	Boro HYV Fallow	75 25			T. Aman HYV	100
Aroshnagar I	50.0	--	--	--	--	T. Aman LV	100	Boro HYV	100			T. Aman LIV	100
Aroshnagar II	62.5	--	--	--	--	T. Aman LV Khals/ Fallow	80 20	Shrimp Boro HYV Fallow	20 20 60			T. Aman LV Khals	80 20
Maltia	75.0	--	--	--	--	fallow	100	Boro HYV	100			T. Aman LV	100
Kulbaria	75.0	--	--	--	--	T. Aman	100	--	--	--	--	T. Aman LV	100
Kulbaria baratia	75.0	--	--	--	--	Fallow	100	Boro HYV Fallow	25 75	T. Aus Fallow	25 75	T. Aman LV	100
Maguraghone I	87.0	--	--	--	--	Fallow	100	Boro HYV Fallow	50.0 50.0	--	--	T. Aman LIV	100
Maguraghone II	75.0	--	--	--	--	Fallow	100	--	--	--	--	T. Aman HYV Fallow wet	50 50
Chucknagar	75.0	--	--	--	--	T. Aman LV Wet Fallow	75 25	Boro HYV Fallow	25 75	--	--	T. Aman LV	100
Boyersinga	75.0	--	--	--	--	T. Aman LV	100	--	--	--	--	T. Aman LV	100

Source : Farmers' group interview.

Table 4.3 Cropping Pattern for High and Low Land levels.

High land		Low land	
Pre Project	Post Project	Pre Project	Post Project
a) Winter vegetables - B. Aus b) Winter vegetables - Jute c) Mustard/Pulses - B. Aus d) Winter vegetables - Jute e) T. Aman	a) Winter vegetables -B or T Aus b) Winter vegetables - Jute c) Mustard/Pulses - Jute d) Mustard/Pulses -B or T Aus e) Sugarcane f) Wheat -Jute g) Boro HYV-T.Aus h) Boro HYV-T.Aman	a) T. Aman - Fallow	a) Boro HYV -T. Aman b) Shrimp -T. Aman c) Fallow -T. Aman d) Boro HYV -T. Aus e) T. Aus -T. Aman

Source : Farmers' interview

Table 4.4 Inputs and Outputs for Main Crops in 1990-91 in Polder 17/2.

Crop	Input Cost (Tk.)										Yield (md/ac)	
	Tillage		Fertilizer		Seed		Irrigation		Labour		Pre Project	Post Project
	No	Rate Tk./ till	kg./ ac.	Rate Tk./ kg.	kg./ ac.	Rate Tk./ kg.	% of total Yield	Tk./md of rice	No./ ac.	Tk./ Labour		
Boro HYV	6	50	240	5.5	30	10	25	200	60	35	--	45
Mustard/Pulse	6	50	60	5.5	3	20	-	-	45	35	9	9
B. Aus	5	50	60	5.5	20	10	-	-	45	35	18	40
T. Aus	5	50	90	5.5	30	10	-	-	60	35	--	36 (LV)
Jute	5	50	30	5.5	30	10	-	-	60	35	24	30 (HYV)
T. Aman LV *	4	-	-	-	20	10	-	-	45	35	30[1]	36
T. Aman LV **	-	-	-	-	20	10	-	-	30	35	--	18
T. Aman HYV	5	50	180	5.5	20	10	-	-	60	-	--	60
Winter Vegetable	6	50	240	5.5	3	30	-	-	90	-	84	135

* Non-gher area
** Gher area
1 Yield in a good year

Source: Averages from group interviews with farmers

Table 4.5 Area with Salinity Problems and Yield Reduction due to Soil Salinity in Khulna District.

Total area of Khulna District (ha.)	Yield of T. Aman (tons/ha.) S_0 (0-2 mmhos/cm)	Salinity level	% area	% Yield reduction
549600	2.5	S_1(2-4 mmhos/cm)	9.6	0
		S_2(4-8 mmhos/cm)	47.2	17
		S_3(8-12 mmhos/cm)	9.9	50
		S_4(>12 mmhos/cm)	3.8	58

Source : MPO Technical Report No. 1

Table 4.6 Input Costs of Main Crops in 1990-91, Polder 17/2. (Tk./acre)

Crop	Input Cost (Tk.)					
	Tillage	Fertilizer	Seed	Irrigation	Labour	Total
Boro HYV	300	1320	300	2250	2100	6270
Mustard/Pulse	300	330	60	--	1575	2265
B.Aus	250	330	200	--	1575	2355
T. Aus	250	495	300	--	2100	3145
Jute	250	165	300	--	2100	2815
T. Aman LV *	200	--	200	--	1575	1975
T. Aman LV **	--	--	200	--	1050	1250
T. Aman HYV	250	990	200	--	2100	3540
Winter Vegetables	300	1320	90	300	3150	5160

* Non-gher area
** Gher area

Source: Averages from group interviews with farmers

Table 4.7 Comparison of Yield Estimates for Main Crops in Pre- and Post-Project Periods, Polder 17/2

Crop type	Yield in tonnes/ha.					
	Pre-project			Post-project		
	EIP (1980)	N.Islam (1988)	RRA	EIP (1980)[1] forecast	N. Islam (1988)	RRA
HYV Boro		1.97	NG		2.16	4.43
Mustard/Pulses	0.39		0.89	0.69		0.89
Winter Veg[2]		2.95	8.26		4.92	13.28
B. Aus	0.89	1.97	1.77	1.48	1.97	3.93
T. Aus			NG		5.90	3.54
Jute	0.69	[3]	2.36		1.48	2.95
T. L. Aman	1.18	3.15	2.95[4]	2.46	3.44	3.54
T. L. Aman[5]						1.77
HYV Aman			NG			5.90

1 Forecast of conditions with Gangrail Closure.
2 Yields are only indicative as they vary greatly by type of vegetable, cabbages are one of the main crops involved.
3 Typing mistake in report (90 md/acre).
4 RRA information appears to be an overestimate for this crop, typical yields in MPO (1987) in this region are 1.35 tonnes/ha.
5 Yield in ghers

Sources: see column headings

Table 4.8 Cropping Patterns in Polder 17/2 based on RRA Survey

Crop	Pre-project (c1970)	Post-project (c1990-91)
Low land (2120 ha cultivable)		
HYV Boro	0%	33%
B. Aus	0%	3%
TL. Aman	44%	80%
HYV Aman	0%	16%
Total cropping intensity	44%	132%
High land (672 ha cultivable)		
HYV Boro	0%	2%
Mustard & pulses	7%	26%
Winter vegetables	15%	39%
Other rabi crops	0%	9%
B. Aus	22%	10%
T. Aus	5%	14%
Jute	34%	48%
Other summer crops	0%	2%
TL. Aman	30%	30%
Total cropping intensity	113%	180%

Source: Tables 4.1 and 4.2, see text for explanation of estimates

Table 4.9 Crop Areas for Extension Blocks Covering Polder 17/2

Total area (ac.)	Crops	Area (ac.)			
		1988-89	1989-90	1990-91	Status
10300	Boro HYV	774	935	1462	I
	Wheat	539	406	101	D
	Winter vegetable	1213	2122	2575	I
	Pulses	112	0	0	D
	Mustard	254	135	112	D
	B.Aus HYV	925	775	635	D
	B.Aus LV	235	200	182	D
	T.Aus HYV	50	195	313	I
	T.Aus LV	15	30	62	I
	Jute LV	25	22	15	D
	HYV	295	475	625	I
	T.Aman HYV	985	1190	1275	I
	LIV	80	85	83	S
	LV	8150	8225	8350	S
	Sugarcane	13	15	20	I

Notes: I = Increased
D = Decreased
S = Same

These data are for the Chucknagar, Atlia, Maguraghona and Boyersinga blocks which include most of Polder 17/2.

Source : Upazila Krishi Office, Dumuria

Table 4.10 Percent Landless Households in different areas, and labour wage for peak and off season in 1990-91, Polder 17/2

Places	% Landless	Wage rate Tk/day	
		On season April-July	Off season May-June
Chakuria	30	40	20
Mathbaria	20	30	25
Baratia	25	40	25
Aroshnagar	5	30	20
Maltia	10	35	30
Kulbaria	25	40	25
Kulbaria Baratia	5	40	20
Maguraghona I	10	40	30
Maguraghona II	2	40	30
Chucknagar	5	35	30
Boyersinga	5	40	20

Source: Farmers' interview.

Table 4.11 Land Prices during Pre- and Post-Project Periods, Polder 17/2

Place	Land Price Tk./ac.						
	Pre Project		Post Project				Relative increase Low/High %
	Tk.	Tk.	Tk.	Tk.	% of Pre Proj. price		
	High land	Low land	High land	Low land	High land	Low land	
Chakundia	750	300	75,000	48,000	10,000	16,000	160
Mathbaria	15,000	12,000	75,000	60,000	500	500	0
Baratia	30,000	18,000	90,000	60,000	300	333	11
Aroshnagar	7,500	6,000	120,000	90,000	1,600	1,500	-7
Maltia	90	30	75,000	60,000	83,333	200,000	240
Kulbaria	3,000	1,500	24,000	36,000	800	2,400	300
Kulbaria baratia	1,500	1,000	75,000	36,000	5,000	3,600	-28
Maguraghona I	6,000	2,500	60,000	40,000	1,000	1,600	160
Maguraghona II	45	30	75,000	30,000	166,666	100,000	-40
Chucknagar	150	100	75,000	60,000	50,000	60,000	120
Boyersinga	3,000	1,500	24,000	36,000	800	2,400	300

Source: Farmers' interviews

Notes: Pre-Project data refer to 1970
Post-Project data refer to 1991

5 IMPACT ON LIVESTOCK

5.1 PRE-PROJECT CONDITIONS

Data on livestock populations during pre-Independence times for Polder 17/2 were not available. However, according to local people most farm households maintained bullocks and cows, and good numbers of poultry. The main feedstuffs for cattle were paddy straw and coarse grasses (such as Pati and Bholos). Saline flooding at unusual high tides meant that all low land was fallow for about 7-8 months of the year, and some land was always fallow, hence the availability of green fodder was greater in terms of area and time, although the quality of grazing was not so good as salt tolerant plants grew there. At the same time demand for draught power was relatively low since there was only one crop a year on low land.

5.2 LIVESTOCK OBJECTIVES OF PROJECT

Neither CEP nor the EIP Gangrail closure stated any direct objectives concerning livestock. Since livestock play a key role in crop production and farming systems, discussion of livestock implications and proposed actions would have been appropriate in the Project planning. Examples of supplementary objectives for livestock programmes would be assessment of forage availability and of means of providing conserved feed for the monsoon such as silage.

5.3 DATA SOURCES

Information on livestock populations was obtained from the Upazila Livestock Officer, while discussions with local leaders, and both groups of farmers and individual farmers revealed the trends affecting livestock in the area. There is a lack of information on livestock in the Project documents. It was found that the main domestic animals are cattle, goats, and poultry; very few buffalos and sheep were observed during the field visit.

5.4 PRESENT LIVESTOCK SITUATION

A decline in the population of all livestock types was reported, particularly of cattle and goats in the areas surrounded by shrimp ghers. Consequently poorer farmers who possess only cows now use these occasionally for draught power.

Pasture availability has declined markedly. Khas land within the Project has been allotted, so there is no longer any permanent grazing land. In the non-gher areas the area of fallow land during the post-T Aman harvest period is gradually falling as farmers increasingly cultivate dry season crops (Boro, rabi, or Aus crops). The situation is much worse in the areas covered with shrimp ghers, where there is no land at any time available for grazing. Cattle are sent to nearby polder areas without ghers to graze. The journey takes 2-3 hours in each direction including a river crossing. In some cases, to avoid this journey, cattle are sent for 6-7 months to gher free areas in the care of friends, relatives, or cattle keepers. This is against a monthly per head payment, allowing milking of cows and draught use of bullocks, and use of dung by the herdsmen.

5.5 POSITIVE CHANGES RELATED TO LIVESTOCK

a) Grazing Quality and Crop By-Product

In non-gher areas as a result of the Project the availability of good quality grass has increased compared with the poorer salt tolerant species found before. Additionally the availability of crop by-products for fodder has increased, reportedly by 30-40 per cent.

b) Draft Power Requirements

There has been an increase in draft power requirements in the non-gher areas of 25-30 per cent. However, this is partly being met through the introduction of power tillers.

c) Livestock Health

A reduction in cattle mortality was reported. This may be due to lower salinity in some areas since this affects cattle health, but may also reflect improved veterinary services.

d) Hand Composition Changes

With the increase in grazing quality there appears to have been a decline in the buffalo population, since buffalos are better able to cope with saline conditions and poor fodder, but eat more.

5.6 NEGATIVE CHANGES RELATED TO LIVESTOCK

All of the negative changes identified for livestock populations are direct results of shrimp cultivation and not of the Project itself - the closure may thus have been helpful in reducing these negative impacts. While economically these impacts may be unavoidable, there are distributional implications.

a) Decline in Livestock Populations

In the gher areas a decline in the numbers of all livestock types was reported, but particularly cattle and goats (down 50 per cent in numbers). The gher operators have banned the movement of ducks in the gher water,and hence the duck population is also declining.

b) Grazing and Fodder Shortage in Gher Area

There is a complete lack of grass and reduction in crop byproducts in the gher areas. Aman straw quality is apparently directly affected by stagnant water in the ghers. Alternative sources of fodder such as khas land are not available, since khas land has been distributed for cultivation, and fodder crops are not grown given the lack of land for much of the year. Farmers in the gher areas are therefore forced to send their cattle to other areas outside the Project where grazing is available. This entails transport and supervision costs.

c) Animal Health in Gher Areas

Cattle disease and ill health is on the increase in the gher areas, where the salinity of the water causes diarrhoea.

5.7 RECOMMENDATIONS

The following would improve the livestock situation in the polder:

i. to meet requirements for cattle feed, planned production and storage of fodder could be undertaken. However, this could take land out of more productive uses in the Project. If there is sufficient forage outside the Project for at least part of the year attempts to conserve this, for example as silage, might relieve the fodder constraint. However, there would be a problem of continuing to move the cattle to the fodder, or of buying and then transporting fodder to the animals in the polder;

ii. improved and strengthened preventative veterinary measures could be taken in anticipation of increased disease problems (from salinity and restricted areas for housing livestock);

iii. extension services should try to find ways of improving husbandry of livestock within the constraints imposed by the shrimp ghers; and

iv. in general the experience of Polder 17/2 points to the need for integrated planning for polders - considering both the original intended impacts of the polder and subsequent changes in management (shrimp farming) on other aspects of the local farming system such as livestock. In this Project only water management and agriculture were directly considered in Project planning.

6 FISHERIES

6.1 PRE-PROJECT SITUATION

Prior to final closure of the Gangrail River in 1983, there was little change to the fisheries situation in the area, which had prevailed for a number of years. This centred on the daily inflow and ebb of tidal water throughout the Gangrail river system, which was strongly saline during the dry season but fresh during the monsoon period. In addition to capture fisheries, it was possible to convert low lying inter-tidal land, after harvesting the T. Aman crop in December, into larger bunded ghers which could be flooded with saline water and stocked to produce a crop of shrimp. After harvesting the shrimp, usually in July, the area was flushed out with fresh monsoon water to remove the salt and the paddy fields restored for the next T. Aman crop. The record is not clear as to whether this situation obtained before the embankment was built in 1970/71, but it had certainly developed several years prior to the Gangrail closure thirteen years later.

According to the ex-post evaluation report (Nabiul Islam, 1988) more than 40 per cent of the total area within the polder, i.e. about 3600 acres, was used for seasonal shrimp culture in this fashion before the Project (4000 acres according to EIP (1980)). Much of the land involved was leased by shrimp cultivators from neighbouring small farmers, for relatively small rental amounts. However, the opportunity for some cash income from land during the time of year when it was otherwise subject to daily saline tides and therefore virtually unusable until the next monsoon, made the system generally acceptable to the farming community at that time.

In addition to the shrimp gher areas, there were a number of small beels/depressions to the west and north-west of the Project area in otherwise higher ground. These reconnected with the external rivers only during the annual monsoon flood and were thereby naturally restocked with major carp varieties from the common stock which migrates to and from the rivers. The rivers which nearly surround the Project area, namely the Bhadra, Gangrail and Salta Rivers, also supported important stocks of riverine and migratory species.

The beel and riverine fisheries sustained a community of full time fishermen numbering 200 families and about 1800 people in total (Nabiul Islam, 1988). Because of the prolific nature of the pre-Project capture fisheries, these fishermen were reported to have earned about Tk.6000 each per month over the whole year. At a then average price for fish of Tk.15 per kg. (DOF Annual Report 1982/83), this corresponds to an annual catch of 4800 kg. per year per fisherman, or 960 mt per year from the capture fisheries in the Project area.

There was very little background documentation available specifically relating to Polder 17/2 except for the ex-post evaluation report already referred to above, a BWDB Project Proforma and a rather brief appraisal report dated June 1980, prepared for the Netherlands Technical Assistance Programme. The appraisal report included some details and analysis of shrimp farming in the Project area but gave little or no consideration to the capture fisheries.

6.2 PROJECT OBJECTIVES

There was no reference to fisheries in the PP nor did it detail any objectives other than to complete the construction of embankment, sluices and river closure, with schedules of costings. The only reference to objectives for the fisheries sector is in section 6 of the

appraisal study (EIP, 1980) which welcomes the prospect that the exclusion of saline water would mean the end of shrimp farming and much of the capture fishing in the area, in the interests of expanded paddy and other agricultural production. There was no suggestion of any provision for compensation or assistance towards re-location for the people who would be affected by these changes.

None of the BWDB or Fisheries Department staff who were stationed in Khulna at the time of Project planning were still there. In consequence it was not possible to judge the correctness of assertions that there was no consultation between the two agencies, and that the interests of the fisheries sector were never given any consideration when the Project was being planned and implemented, but the lack of any provision for ordinary fishermen or fish farmers strongly suggests that this was the case.

It is clear that BWDB, and also the donor, fully intended that salt water shrimp farming should cease as a direct consequence of Project implementation. They accepted that this would also mean the demise of capture fishing in the tidal waters of the Gangrail and other Project area water bodies but neglected to consider the effects on the people concerned. In the event the Project succeeded in destroying the resource base on which 200 landless fishing families depended for their livelihood, but totally failed to stop shrimp farming. Gher managers proved more resilient than expected and simply arranged their own means of sea water supply when the river closure cut off their original source. BWDB seems to have been powerless to prevent these private sluices.

6.3 RRA DATA SOURCES

The main documentary sources consulted were an abbreviated form of PP prepared by the BWDB Executive Engineer, Khulna; the EIP appraisal report and EIP evaluation report (vol.4) compiled by Nabiul Islam, May 1988; DOF Annual Report for 1982/83 and DOF Annual Fish Catch Statistics Bulletins, from 1983/84 to 1987/88 inclusive. Interviews and less formal discussions were held with BWDB officials, Khulna Division, District and Dumuria Upazila Fisheries Department staff, IDA Shrimp Project staff, other Upazila officials, CARITAS staff and with farmers, fishermen, shrimp gher owners and managers and fish market traders.

A summary of fish production trends in Khulna District is provided in Table 6.1, and current (1990) data on fisheries in Dumuria Upazila and the Project area are shown in Table 6.2. Khulna fish market prices are detailed in Table 6.3.

6.4 POSITIVE IMPACTS ON FISHERIES

Completion of the Gangrail River Closure effectively prevented any further tidal rise and fall of water level within the polder as well as minimising saline water inflow. A number of ponds which existed in areas previously subject to periodic tidal over-flooding were largely derelict until, following Project completion, their value was greatly enhanced as a consequence of the protection accorded against such flooding. Virtually all of the 200 fresh water ponds within the Project have now been restocked and many have also been re-excavated. Fish species said to have been stocked include Rui, Tilapia and Silver Carp and they are being grown partly for sale and partly for domestic consumption. Project area pond production is estimated at 36 mt/year (Table 6.2) equivalent to a yield of 1530 kg. per hectare.

Further expansion and intensification of fish farming, in partial mitigation of other adverse Project effects on fish production, is feasible but will depend on mobilisation of a more effective aquaculture extension service than is currently available.

Borrow pits believed to date from the time of embankments construction and dug in the "set back" zone between embankment and river bank have in many cases been converted into small shrimp ghers, as also has the area immediately downstream of the Gangrail closure. Such areas are vulnerable to over-flooding during an unusually high tidal surge but the risk appears small enough to warrant the substantial cash outlay involved in each case for leasing, bunding and stocking the ghers. A typical case is detailed inter alia in Table 6.4.

6.5 NEGATIVE IMPACTS ON FISHERIES

The possibility of shrimp farming continuing and expanding within the polder appears not to have been foreseen or was ignored when the CEP was planned. By the time the EIP closure was planned (1980) shrimp farming was a major land use, yet the Project completion was deliberately planned to eliminate shrimp farms. In either event the planners failed to make any provision for facilities to minimise any adverse effects of shrimp farming on other nearby land users. When faced by the embankment and river closure which blocked their access to saline water, the response of the gher owners, in self-defence, was to install their own through-bank supply systems without regard to possible embankment damage or to consequent drainage problems in the polder. Nevertheless, some gher owners furthest from the embankment had to give up because they no longer had access to reliable supplies of salt water. There has been a decline in the gher area since the closure, from 1447 ha. (3600 acres) to the 1991 estimate of 910 ha. (2300 acres), see Table 6.2.

Because of the protection which it affords against flooding, the embankment has encouraged the creation of large ghers in excess of 100 ha. (250 acres), in contrast to the much smaller units of pre-Project days. Such large enterprises require very large amounts of cash for investment and working capital and an associated separation of management from land ownership. In consequence the management of some of the ghers has become less sensitive to the needs of adjacent agriculture, or to the feelings of neighbouring farmers whose land may be affected by, or even be part of, the gher. This has led to many disputes and at times to arbitrary and unreasonable actions on the part of gher owners/managers.

Efforts to regulate shrimp farming by the creation of Upazila and Divisional regulatory committees, (vide Bangladesh Gazette Notification No. MF11(Misc.) 2/86/17, dated 6th March 1986) and thereby minimise the causes of such disputes, proved ineffectual because of Government's apparent inability to provide these authorities with legally enforceable means of regulation. In consequence, shrimp farm development has been uncontrolled and in conflict with other Project objectives. The shrimp farmers appear to be acting within their rights and are apparently not contravening any existing laws or legally enforceable regulations. The problems arise mainly because of the planners' failure to include provision for the safe operation of shrimp farming as one of the on-going in-polder activities.

The embankment and river closure now effectively prevent the annual migration of a range of fish species, including the major carps, from the beel areas to the rivers for spawning, and the return of juveniles to the former floodplain and beels in search of nursery and feeding grounds. In consequence there has been a loss, particularly of major carp, in the capture fishery inside the Project which is directly attributable to the Project. There has also been a similar reduction of fish stocks and catch rates in the external rivers adjacent to the

Project area, which is however due to the cumulative impact of this and the other polder developments along the river network.

Many of the former traditional and full time fishermen have been forced to move away from the Project area, or to seek other means of employment, and the remainder can now only fish for part of the year inside, or in the rivers outside the polder. Compared with the pre-Project total of 200 families, one respondent stated that there remained only about 70 fishermen and many of these could not operate on a full time basis.

There are no official estimates for present day capture fishery production in the Project area, but if the pre-Project estimate of 960 mt per year is correct and assuming that the remaining fishermen now average catches half as large as in the past (and they could well be much less than that) - then the current total catch figure cannot be more than about 170 mt. per year. It follows that there has been a loss on fish production of the order of 790 mt. per year, much of it comprising the most valuable major carp species and at present day average market prices, say Tk.40 per kg., this represents a **yearly financial loss of Tk.31,600,000**. Even using the 1982 average fish price of Tk.15 per kg, the financial loss would still be Tk.11.8 million.

6.6 LESSONS

a) Consultation in Project Planning

Although the behaviour of some of the shrimp gher owners towards neighbouring small farmers may be described as unreasonable, it is also quite unreasonable for a polder Project to be designed and implemented by BWDB in ways that are inimical to the interests of important sections of the population and economy of the polder, without any attempt at consultation or efforts to adjust the plans so as to accommodate the activities concerned. It is therefore recommended that BWDB should re-examine its planning and consultation procedures so as to ensure full participation by the various interested groups and the other technical agencies involved, such as the Fisheries Department.

b) Compensation for Disbenefited Groups

If it should prove to be the case that an activity such as shrimp farming or full time capture fishing cannot be accommodated within a polder without suffering loss, or because its continuation would cause unacceptable harm to other land uses and to the principal objectives of the Project, then such disadvantaged groups, particularly fishermen, should receive relocation assistance if appropriate and compensation for the predicted losses due to the FCD/I Project, in the same way that land acquisition is compensated for. Provision for such compensation must therefore be included in the Project budget, and taken into account in the cost/benefit analysis.

c) Unnecessary Entrenchment of Institutional Policies

BWDB and the EIP donors both appear to have taken dogmatic attitudes to the shrimp farming/rice cultivation issue; BWDB on the grounds seemingly that salt water cannot be permitted inside a polder without causing harm, and the donors (Netherlands & Sweden) on the grounds that most of the profit from shrimp farming accrues to the entrepreneur investors rather than to the small farmers/landowners whose lands are leased for a season each year.

The experience of the World Bank funded Polder 20 and 20/1 shrimp farming Project which is summarised in Annex 1, appears to contradict both attitudes in that it demonstrates the practicability of introducing sea water into a polder and subsequently removing it after harvesting the shrimp crop in time to convert the land for a paddy crop, without apparently having any adverse effect on paddy yields after more than four years. It also demonstrates that it is possible to organize groups of small farmers/landowners with NGO assistance, to directly undertake and thereby benefit from shrimp farming operations. BWDB is fully aware of this experience, having been responsible for the engineering work involved, and should therefore apply the results more widely, whenever any new coastal polders are being planned, or where major rehabilitation is proposed.

d) Strengthening of Regulatory Framework

In order to reduce the current conflicts between shrimp farmers and other land users in the polders, and permit the future development of shrimp farming to be implemented in an orderly and planned fashion, it is recommended that the Government of Bangladesh take early measures to activate the Shrimp Cultivation Regulatory Committees, by means of legally enforceable regulations corresponding to the Terms of Reference already given to the Committees and thereby enable their implementation and enforcement should this prove necessary.

e) Protection of Remaining Capture Fisheries

In view of the severe decline in open water capture fishery stocks and catches, which was noted in this area (as well as in other parts of the country), and of the open and apparently widespread and unchecked use of illegal nets, it is strongly recommended that the remaining open water inland and marine fish stocks must be protected against further damage from FCD/I projects, as well as from over exploitation in general. To this end the Fisheries Department should be given the resources and unequivocal instructions needed to enforce already existing fisheries management regulations. It should also be obligatory for BWDB to consult the Fisheries Department during the plan phase for any new or rehabilitated FCD/I projects to ensure that fisheries interests are properly considered. In view of the often long interval between planning and implementation, fisheries should also be represented on the Project management team to facilitate any adjustments to plans which may become necessary because of changed circumstances.

f) Culture Fishery Development

FCD/I polders create opportunities for enhanced culture fisheries, especially in ponds and other small water bodies. However the pace of such development will be slow unless the level of extension services and the supply of fingerlings for stocking purposes can be greatly improved. The provision of fisheries extension should therefore be as much a part of Project planning as other aspects in order that the necessary resources can be made available.

Table 6.1 Fish production trends - Khulna District (metric tonnes)

Fishery	1983/84	1984/85	1985/86	1986/87	1987/88
i. Riverine Catches					
Major Carps	282	479	8	35	3
Other Carps	-	-	1	4	-
Catfish	255	433	78	63	38
Hilsa	246	418	1619	335	484
Shrimp*	581	988	6583	2493	2260
Misc. spp	3108	5282	3783	2432	2103
Total	4472	7600	12074	5362	4808
ii. Beel Fisheries					
Mixed spp	164	78	80	89	125
iii. Flood Lands					
Mixed spp	9464	10002	6395	8981	8975
iv. Ponds					
Mainly carps	5144	5121	5418	4662	5696
v. Shrimp Farms (s/w)					
Area (ha.)	31817	39453	62120	62120	68363
Shrimp (mt.)	2514	4878	12016	11361	13493
Shrimp (kg./ha.)	79	124	193	183	197
Fish (mt.)	2354	1957	4432	5977	6064

Note: * Riverine shrimp catch comprises mainly *Macrobrachium* species of freshwater shrimp.

Source: Fisheries Dept., Annual Fish Catch Statistics of Bangladesh.

Table 6.2 Background Information on Fish Farming and Capture Fisheries in the General Area of Polder 17/2 (1990)

ITEM		DUMURIA UPAZILA		POLDER 17/2	
Fish Farming		**No**	**Area (acre)**	**No**	**Area (acre)**
Private ponds	cultivated	2523	732	200	58
	cultivable	1077	118	na	-
	derelict	469	98	na	-
Khas ponds		15	6	na	-
Shrimp Farms		150	8200	18	2300
Total		4234	9154	na	na
Perennial Water Bodies					
Jalmohals/beels - less than 20 acres		120	1000	13	na
Public beels - more than 20 acres		20	3000	na	na
Estimated Catches (metric tonnes per year)					
- ponds		450		36	
- beels		900		na	
- rivers		250		na	
- shrimp farms		300		84	
Fishing Effort (numbers)					
- fishing villages		22		2	
- fishing families		225		na	
- fishing cooperatives		22		na	
- cooperative members		2635		na	

Source : Dumuria Upazila Fisheries and Statistical Offices.

Table 6.3 Khulna Market Fish Prices, 6th June 1991

SPECIES	REMARKS	PRICE (Tk. PER kg.)
Hilsa	Various sizes, ex-Barisal area	45-50
Katla Large	4 Kg. fish ex-Jessore	80
Katla Medium	about 1 kg. each	60
Katla Small	Less than ½kg. each	40
Mrigal		60
Boal		50
Rita	ex-coastal area	30-40
Tengra		30-40
Tilapia		24
Small fish	Various/mixed species	20
Small Prawns	Poor quality	32
	DHAKA MARKET, 8TH JUNE 1991	
Ruhi	Large	130-150
Katla	Large	70-80
Hilsa		55-60
Shrimp	Large	90-95
Singi		80-90
Koi		100-130

Table 6.4 Summary of Shrimp Farming Data

Item	Inside Embankment			Outside
Gher size (bighas)	300	600	800	60
Share owned %	28	58	100(?)	17
Leased in %	72	42	83	
P.monodon stocked (lakhs)	1.5	9.0	9.0	1.0
Stocking rate per bigha	500	1500	1125	1670
Cost per shrimp (Tk.)	0.87	0.89	0.85	0.85
Stocking time (month)	Early March	March	Early March	February
Harvest completion (month)	July	July	June	June/July
Expected crop (lakhs)	0.75	3.0	2.7	0.5
Survival rate (%)	50	33	30	50
Crop weight @ 25 per kg.(kg.)	3000	12,000	10,800	2000
Selling price @ 25 per kg. (Tk.)	200	250(est)	320	250(est)
Gross income from sales (Tk.)	**600,000**	**3,000,000**	**3,456,000**	**500,000**
Productivity - kg. per ha.	75	149	101	249
No. of Full time staff	15	na	37	5
Wage rates (Tk. per month)	1000	na	1100	1000
Area per man (bigha)	20	na	21.6	12
Temporary staff (harvesting)	20m/m	na	20m/m	-
Costs (Tk.)				
Stocking	130,000	800,000	765,000	85,000
Leasing -in	86,000	100,800(est)	nil(?	20,000
Wages	200,000	na	510,000	60,000
Feeding and Misc.costs	20,000(est)	na	181,000(?)	10,000
Cost of sales	436,000	1,456,000	175,000	
Net profit	**164,000**		**2,000,000**	**325,000**
Net profit per Bigha (Tk.)	547		2500	5417

Table 6.5 Khulna: Shrimp Processing Factory Buying-in Prices

Species/season	Grade	Price per kg. (Tk)
1. *P.monodon* (April to July/August)		
	Under 15 per lb	495
	16/20	410
	21/30	325
	31/50	205
	51/70	125
2. *Macrobrachium* (September to January)		
	Under 5 per lb	590
	6/8	490
	8/12	410
	12/20	370
	21/30	260
	31/50	190
	51/90	135

Notes: i. Khulna-Barisal contributes 70 per cent of shrimp farm production in Bangladesh.

ii. Main market is in Japan; but Bangladesh exports contribute about 1 per cent of Japanese market capacity.

Source : Bangladesh Sea Foods Industries Ltd. Khulna; 24/4/91.

7 OTHER ECONOMIC IMPACTS

7.1 SOURCES OF DATA

Data were obtained primarily from discussions with farmers and landless people spread throughout the Project area including the main markets on the Project periphery, and are compared with information in the previous evaluation of the Gangrail closure (Nabiul Islam, 1988).

7.2 PRE-PROJECT CONDITIONS

During pre-Independence times it was reported that few people left the area to find employment. Although much of the land was fallow for a large part of the year there were more livestock in those areas (see Chapter 5). More important as sources of work were the need to build and maintain the bunds used to keep saline and flood water off the land. It was reported in Aroshnagar that the areas enclosed by these bunds were on average 400-500 bighas (60 ha.), and that work on their maintenance was needed throughout the year except for Poush-Magh (January-February) - the labour contribution was one person per day for 10 bighas, and working on alternative days for 5 bighas. While the actual inputs may have been less than this (since the information is based on lengthy recall) it is clear that employment was available for labourers. Otherwise there was little paid non-agricultural work available, but part-time fishing in the channels and rivers of the Project area provided a livelihood for quite a sizeable fishing community - 200 households in 1980 according to Nabiul Islam (1988).

Transport in the lower parts of the Project area was mainly by boat using the natural network of channels, although the bunds provided access by foot, and local markets existed (as now) along the main roads bounding the Project area. Moreover there was a substantial risk from flooding - in a number of villages it was reported that housing had been flooded during exceptional high tides, as often as 1 in 2-3 years in some places. This clearly placed some limitations on the areas available for homesteads and on the investment in houses. Unfortunately such events were so far in the past that estimates of losses were not possible. However, in some villages people reported that during the pre-Project period economic stresses were greater and hence they had more often to borrow from moneylenders which had resulted in their losing land over time.

7.3 PROJECT OBJECTIVES

The CEP did not have explicit non-farm or distributional aims, but the aim of preventing floods from all but cyclones would offer greater security for people in the Project area. However, projects under the EIP are aimed both at providing employment in construction and at benefiting marginal farmers. To the extent that the Project aimed at flood protection and improved conditions for agriculture, it might be expected to have some subsequent consequences such as reducing flood losses and generating employment in agricultural processing.

7.4 DIRECT EMPLOYMENT IMPACTS

The with-Project employment pattern differs to some extent between parts of the Project area. In areas further from the ghers where HYV Boro cultivation has developed (Section 4.4.2) there is more local employment in cultivation in the winter. However, in the gher areas there are substantial slack periods for labourers - both during the shrimp period

particularly in Falgun-Chaitra (mid-February to mid-April)and Jaistha-Bhadra (mid-May to mid-September), and during the growing period for Aman (Ashin-Kartik)(mid-September to mid-November). Local people are not employed in the shrimp farms as a deliberate policy by the gher proprietors since they believe they would steal shrimps. Additionally, in the gher areas inputs have declined in Aman cultivation - there is less need for land preparation and with lower yields labour inputs have declined. Hence in the gher areas some people have moved in for permanent and temporary work in shrimp farming, but many of the people from villages in these areas now move out of the Project area to find work - either in agriculture or earth works.

Additionally, it was reported that in the gher areas landowners were less inclined to share-crop out land; this may be because Aman production is low and the larger landowners in any case are sharing in the profits from shrimp cultivation. A share rate of 6/16 to the tenant was reported. This may be part of the power struggle in which larger landowners and shrimp cultivators are gaining effective control over land in the ghers - renting out land to small farmers would run counter to this aim.

Since shrimp farming had developed without the Gangrail closure, and would have developed without the rest of the Project, much of the employment change would have occurred in any case and the impacts of the Project - in safeguarding higher land where vegetable production is higher, and in encouraging HYV Boro cultivation by reducing salinity levels - have been positive for agricultural employment. However, the reduction in local bund building, the lack of regular maintenance of the Project, and the decline in open water fisheries, have all adversely affected income earning for landless households.

7.5 TRADE AND TRANSPORT

The Project embankment acts as an earth road safe from even the highest tides and hence has improved communications around the southern and eastern edge of the Project. This is particularly important for the shrimp farms in that area as it is important to move the harvested shrimp out quickly to the processing plants. However, the numerous cuts for water control structures for shrimp farming weaken and disrupt this route. There has also been a development of earth roads (under WFP and CARE programmes) since the Project; however, this would most probably have happened in any case, particularly as most are on higher land. Even so, village road communication has been improved as earth roads are no longer submerged by unusual high tides. Boat communication, both from the Project to outside areas, and within the Project area, has declined, reflecting both improved roads, cutting off of channels within the Project, and silting of some of the channels outside. Meanwhile the number of vans and rickshaws has increased in the area, and are important for transporting local produce to market.

The local markets which border the Project, such as Chuknagar and Atlia, have experienced substantial growth since the Project but some of this would have happened anyway due to improved road communications with nearby towns and general population growth. However, increased numbers of small rice mills in the villages, and four larger electric powered mills in Chuknagar, also probably reflect increased paddy production. The numbers of traders in paddy/rice, jute and vegetables were all reported to have increased, and since they buy locally to sell to larger dealers this provides some extra employment due to the Project. Additionally, there are now reported to be 30-35 shrimp traders based in the Project area who act as middlemen between the ghers and shrimp processing plants. However, this

is not a direct consequence of the Project, nor is the shrimp processing plant in Chuknagar which is the one major industry to have set up in the Project area.

7.6 FLOOD PROTECTION IMPACTS

Throughout the Project area it was reported that high tide flooding had not occurred since the Project was completed. The only floods affecting property were from overtopping of parts of the embankment in the November 1988 cyclone, and from localised heavy rainfall causing drainage congestion in the eastern edge of the Project where there are some pockets of higher land which were affected. Hence, damage to buildings and roads and crops, and loss of shrimps, has been prevented. Associated with this, and with general increased prosperity at least for landowners, have been improvements in the housing stock - people reported that houses are larger now, and that more tiled roofs had been installed (and a number of new ones were seen during the RRA).

There have also been some impacts on tree cultivation which are covered in more detail as an environmental impact (Section 11). Briefly, there has been some replacement of more saline tolerant trees with types such as fruiting trees which were previously inhibited from growing there, but it was not clear if there had been any overall increase in tree crop production since there is continued salinity in the gher areas.

7.7 LESSONS

Overall, the Project has had some positive impacts on other economic activity. These are mostly indirect, due to better communications and increased production in the area. However, the growth in shrimp cultivation during the same period makes it difficult to separate Project from non-Project impacts. Benefits from reduced flood damage have occurred but could not be quantified in the RRA since past experience of damage was over 20 years earlier.

A few lessons for future projects can be drawn:

i. coordinated planning of embankment and road projects could result in savings if later upgrades in roads are required - by designing structures to cope with such loads;

ii. there has been a decline in earthwork employment in the Project area because of the Project. While this is not necessarily bad (the labour was voluntary), formal local participation in the Project might have resulted in some continued input to embankment maintenance and hence some additional regular employment for the landless; and

iii. the increased security from flooding is at best partial. The Project is not designed to provide protection in cyclones, yet there is no evidence of public investments in providing safe places during cyclones. Although this is a small polder with slightly higher land nearby and sheltered by the Sunderbans and more southerly polders, there is a danger in population pressure resulting in houses being built on lower land made available by the Project. Emergency planning for over-design events (particularly when they would take the form of cyclones) is needed.

8 NUTRITION AND HEALTH IMPACT

8.1 PRE-PROJECT SITUATION

The nutrition and health condition of the inhabitants inside the Project area was very bad. Due to intrusion of saline water on lower land only Aman paddy was grown and there was a good harvest only once in a five - year period. Water intrusion also was inundating houses. Cooking was very difficult in some parts of the area.

At that time the general pattern of food intake was different to that at present. Villagers were eating more home made wheat chappati than rice. In some villages people reported that fishing was one of the main sources of income. Seventy percent of the villagers reported more fish consumption during pre-Project conditions. However, about 50 per cent of the villages reported less milk production and consumption compared to with-Project conditions, due to low feed quality and less grazing land. Vegetable production was good in the Project area and villagers could eat vegetables in the winter season. Due to the limited number of trees that could tolerate salinity, the number of fruit trees was very low. Only those people who could afford to buy fruits could eat them.

The number of full-fed persons was very low. Some villagers reported they cooked once in a day and most of the time ate only chappati or a little rice once in a while. The general health condition was bad. People were suffering from malnutrition. Stomach diseases like diarrhoea and gastric ulceration were very common.

Drinking water supply was a big problem in the Project area. People used pond water for drinking, washing, cooking and other purposes. Villagers could only get sweet water during the monsoon.

8.2 PROJECT OBJECTIVES

There was no explicit nutritional objective for this Project. It might be assumed that with an assured crop harvest as a result of security against saline water intrusion, the farmers would harvest more paddy, closed water fish culture would increase, and more fodder would be available for livestock. This would provide more work for the poor, increasing their purchasing capacity, so increasing food availability and the access of the poor to that food.

8.3 SOURCES OF DATA

Personal interviews with villagers and family planning workers are the major sources of information.

8.4 PRESENT NUTRITIONAL STATUS

8.4.1 Food Consumption

Food security in the Project area has not been achieved, but the nutritional status of the poor has improved. About 30 per cent of the households can eat three good meals a day throughout the year. Food deficit is obvious in other households during Chaitra, Baishak and Jaistha (mid-March to mid-June). In those months jobs for the labourers are fewer, and even if they get work they get a very low wage with which they cannot buy food for the entire family for sufficient meals. However, they have reported that they are eating more rice than before.

Fish consumption has decreased, however, as all the open water fishing lands are now leased out and the general population cannot fish freely in those areas. Fodder availability and quality have increased in some areas which has increased the cow population and milk availability. The polder produces vegetables for outside markets and so plenty of vegetables are available and at low cost. Even the poor and landless people can purchase vegetables. Fruit availability is somewhat higher now with reduced salinity levels.

Overall the Project impact on nutrition has been positive; food availability and consumption have increased. About 80 per cent of the inhabitants expressed their deep satisfaction over the improved living status.

However, the loss of capture fisheries for both casual fishermen and professionals is an adverse impact. For the few villagers in the gher areas conditions are not so good, food output is not increased and grazing and capture fisheries are less, so food supply is poorer while local employment is reduced.

8.4.2 Drinking Water Supply and Health

The Project inhabitants are now drinking tubewell water. Some NGOs and Government organisations have installed tubewells for drinking water. There is no scarcity of drinking water. Villagers use pond water for other purposes. Pond water becomes dirty (algae develop in it) and smells bad during Falgun and Chaitra (mid-February to mid-April). The stagnant fresh water in the ponds provides better breeding grounds for mosquitoes (see Section 11.4). Although the frog population has also increased, pressure from collecting frogs for frog leg processing may limit their role as a natural control on mosquitoes.

The overall health condition of the inhabitants has improved. In the Project area there is one health centre and a family planning clinic. About 12 family planning workers work in the Project area, but the number of children per family is still often from 7 to 10. Infectious diseases were reported to have increased in the Project area, specially gangrene, skin diseases, and dysentery are common. Overall these impacts are largely unrelated to the Project.

8.5 SUMMARY

Nutritional impacts are difficult to assess over a long period, but there appeared to be a consensus among most people in the Project area that they were able to eat more now than in the pre-Project period. Availability of vegetables has increased but fewer fish are available.

However, in the villages surrounded by shrimp ghers there has been little such gain.

9 IMPACT ON WOMEN

9.1 PRE-PROJECT SITUATION

The Project area was severely disturbed by the intrusion of saline water which was damaging crops as well as homestead areas. The low-lying areas were flooded twice daily during high tide. As agricultural production was low and there were no rural industries, agricultural and non-agricultural labour requirement in the Project area was low. Labourers were migrating to other parts of the District for work. Women, as in other areas of Bangladesh, were not engaged in any work outside the house; they were only active in household work. Homestead gardening was practised but not extensively.

9.2 PROJECT OBJECTIVES

There was no stated objective in reference to the improvement of status of women in the Project planning. As women in those days were more secluded there was no opportunity for the women to work outside. However, it could be inferred that if the Project objectives of reducing saline water intrusion and increasing agricultural production were achieved then the post-harvest activities of women would increase. Development of agro-based industries would provide more jobs for the women in the Project area, and better communication would create scope for work outside the Project area.

9.3 POST-PROJECT SITUATION

9.3.1 Road Maintenance Work

As the tidal water intrusion risk has been reduced more roads are now constructed under CARE and FFW programmes. About 25 per cent of the total labour force for the road construction work are women. They are low paid labourers, but the extra income still helps the poor households. This is an indirect benefit and impact on the status of women.

9.3.2 On Farm Activities

A small portion of the agricultural labourers (5 per cent) are women. They sow seed, transplant seedlings, and mostly do weeding. Some women labourers pluck chili as this is a major chili producing area. They also harvest vegetables. They earn Tk. 15-20 per day.

9.3.3 Post Harvest Activities

Agricultural production and crop diversity have increased with the Project. The range and volume of post-harvest activities has also increased in the area. Women are boiling, drying and milling paddy in the rice mills. They are earning Tk. 20 per day during the peak period and Tk. 10 per day during the lean period. About 30 per cent of the mill workers are women.

9.3.4 Handicraft

Mat preparation is a very common activity of the women in the Project area. In the saline water "Pati" grass grows well. With this pati grass women prepare mats and sell each mat for Tk. 15-20. Pati grass is also a good fodder for the livestock. Now some cultivators in the adjacent area grow pati grass on a commercial basis and sell the grass from one acre

for Tk. 1200. The area of natural (free access) pati grass declined with the Project (Section 11.1) disbenefiting these women.

9.3.5 Shrimp Processing

Shrimp production has increased in the area. A new shrimp processing firm, Satkhira Food Ltd, was established in 1989 in the Project area. About 200 women are working in the plant, the capacity of the plant is about 50 md/day. The number of permanent women workers is 12. They are earning Tk. 1000/month, but the temporary or casual labourers were reported to be earning Tk 60/day in the peak season. As shrimp cultivation developed before the closure this change is not related to the Project.

9.4 OVERALL IMPACT ON WOMEN

The overall impact on women is positive. Women workers are mostly poor and destitute, and get more work to service their needs from their own earnings after the Project. Although the wage rate is low for the women labourers, still the chance of finding paid work is increasing. However, this growth in employment for women has been at best indirectly linked with the Project, and there is no direct employment for women created by the Project itself. Provision should be made in the planning stage for jobs for women in maintaining polders.

10 SOCIAL IMPACT

10.1 PRE-PROJECT SITUATION

The pre-Project situation can either be taken as the late 1960s, or about 1980-81 just prior to the completion of the closure of the Gangrail River under the Early Implementation Project (EIP) in 1982-83. General impressions are given for the earlier period, while some data from 1981 are presented.

Agriculture was the main occupation of the villagers; but agricultural crops were damaged by tidal saline water and annual floods. The land ownership pattern for the whole of Dumuria Upazila based on the 1981 population census is given in Table 10.1. It shows 7 per cent of households had no land, 41 per cent of households had less than one acre of land, 40 per cent of households had between 1 and 4.99 acres, 11 per cent of households had between 5 and 14.99 acres and 1 per cent of households had landholdings of 15 acres or more. By comparison the socio-economic survey for EIP (EIP, 1980) found that in two Project villages 19 per cent of households had no cultivable land, 13 per cent owned up to 1 acre, 53 per cent owned 1-7.5 acres, and 15 per cent of household owned 7.5 acres or more (41 per cent of land).

Other occupations included a substantial number of fishermen. There were many paras (sub-villages) exclusively of fishermen. Nabiul Islam (1988) noted that there were, before the closure, 200 fishing households in the Project. Even now 70 fishermen families live in the main para of Mathbaria village.

The population density was 493 per km^2 in the Upazila in 1981. The density for Khulna District was 365, and it was 605 per km^2 for Bangladesh. The area was a labour surplus region. Labour would out-migrate to neighbouring Districts and Upazilas. But in-migration of labour from Bhanga (Faridpur) and Satkhira occurred, particularly for earth work. A limited amount of female wage labour was also found. Besides agriculture and fishing other professions were mat-making with malee leaves, jute trading, making huts, carpentry, and pottery making.

Although the Khulna-Satkhira highway ran along the north of the polder via Kathaltala and Chuknagar there were no good link roads in and through the area. It was very difficult to walk through the muddy clay roads in the monsoon and boats were the main means of transport in that season.

As might be expected from the land ownership patterns (Table 10.1), traditional village panchayats consisted of a landed elite group who controlled local affairs. The Union Parishad leaders belonged to this class of people. Even now both the Chairmen of Atlia and Maguraghona Union Parishads are big land holders and local "aristocrats".

There were no other kinds of rural institution such as co-operatives, banks or non-governmental organizations in the region. There were a few formal and informal religious and educational institutions such as mosques, maktabs, madrashah, and tols (as a large part of the population are Hindu) schools, but their number could not be ascertained. The number of educational institutions for the whole of Dumuria Upazila is shown in Table 10.2 based on the 1981 population census report.

Table 10.1 Land ownership by size of owned land in Dumuria Upazila

Types of ownership	All House-holds	House-holds Owning No Land	Number of households owning land						
			0.01-0.49 Acre	0.50-.99 Acre	1.00-2.49 Acre	2.50-4.99 Acre	5.00-7.49 Acre	7.50-14.99 Acre	15.00 and above
Total holdings	37345	2560	10712	4610	9173	5862	2391	1655	382
Holdings with no Homestead area	862	445	182	51	96	43	24	17	04
Holdings with Homestead but no cultivated area	5472	1586	3456	150	164	71	24	11	10
Holdings with homestead and cult (optd) area upto .50 acre	8502	268	5646	1584	602	265	83	42	12
Holdings with homestead and cult (optd) area .51 to 1.00 acre	3899	83	408	1772	1453	114	36	25	8
Holdings with homestead and cult (optd) area >1.00acre	18610	178	1020	1053	6858	5369	2224	1560	348

Source : District Census, Khulna 1981.

Table 10.2 Number of educational institutions in Dumuria Upazila in 1981.

Institutions	Number
Primary schools	136
Madrasha	27
High/Junior High Schools	32
Colleges	02

Note: There was a private school upto class VI in Kulbaria Mouza.
Source: 1981 Census, Khulna Division.

The general health and hygiene condition was poor and people suffered from water borne diseases. Drinking water was a minor problem, as use of tubewells was scarce (see Section 8.1).

However, before the closure of the polder an important change in the local economy took place - cultivation of shrimps became widespread in up to 4000 acres of the Project (EIP, 1980). While this brought an economic pre-monsoon land use in place of fallow land, it was reported that Aman yields were reduced because of extended saline inundation[1]. However, yields were already affected by tidal flood losses.

More importantly it was reported (with some discrepancies) that the distribution of returns from shrimp cultivation was not fair among land owners within a shrimp gher. Social conflicts resulted: while a shrimp entrepreneur had to make a deal to pay fairly the larger landowners, the rural power structure meant that small farmers had little say in the use of their land in the gher. The shrimp cultivators may or may not pay an agreed rent depending on the profit from shrimp and the power of the land owner concerned. This problem is exacerbated by the lack of enforceable regulations for shrimp farming.

10.2 OBJECTIVES OF THE PROJECT

There was no explicit objective for improving social and rural institutions or services in the coastal embankment Project. Nevertheless there may have been an expectation that with the construction of the embankment rural services like communication infrastructure, educational institutions, farmers' organizations and community services would emerge, creating a social impact in the Project area.

The Gangrail closure had very definite social aims, although technical feasibility depended on improved site investigation and closure technique, and economically it was "just feasible". It was regarded as "socially very feasible" since it would mean a large financial loss to a group of entrepreneurs (shrimp farmers) but no loss to the economy as a whole, and would "make small and middle peasants in the polder more independent from money lenders and large peasants. The aim of this Project entirely agrees with the target group policy of the Netherlands Technical Assistance Programme" (EIP, 1980; p8-10).

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1 Experience in Polder 20 (IDA project) suggests this need not be the case and that yields can be maintained.

Hence, the aim was to use water resource engineering to achieve social engineering. The shrimp farms were defined as socially undesirable per se, rather than considering wider policy options to regulate the anti-social aspects of their management which were reported. It appeared to be assumed that without natural flows of saline water in the Gangrail, shrimp farmers would abandon their investments and be instantly defeated, ignoring the adaptability and resistance which might be expected from these businessmen. Hence there are strong grounds for regarding the objectives of the closure as:

- just as unfair as the actions of the shrimp farmers; and
- unlikely to be achieved by the means adopted.

10.3 SOURCES OF DATA

Data were collected from both primary and secondary sources. Primary sources include interviews and discussions with the officials of BWDB, District and Upazila; community leaders, local elites, public representatives, and villagers in the Project and nearby areas; and by participant and non-participant observations. Secondary sources include Project documents, Project Proforma, maps, Government statistical publications and NGO documents and records.

The team divided into small groups and visited the following mouzas and sites: Kathalbata Bazar; Baratia; Narkerl (Gher); Sharabpur; Kharnia; Chuknagar; Arashnagar; Kulbaria; Nichukali; Matbaria; Suripukur Gher Bayarshing; Maguraghona; Maltia; Narnia; sluice gates 1 to 5; and Gangrail closure.

10.4 IMPACTS OF THE PROJECT

Since the final completion of the polder and Gangrail closure in 1983 both positive and negative impacts can be found in the area. It is not possible to identify the explicit part played by the Project activities as other variables could not be controlled. However the impacts can be highlighted as described below.

10.4.1 Positive Impacts

a) Improved Land Communications

The embankment provides improved road communication particularly in the south-east corner of the area. There was subsequent construction of a road from Kathaltala bazaar to Kulbaria (Panchumari Gher) connecting the Khulna-Satkhira highway to the embankment. Another road was developed from Chuknagar to sluice no 1 via Maltia and Maguraghona. Both the roads were constructed with the help of CARE. Road communication transformed the modes of transport. Rickshaws and vans are plying on the roads, shortening journey times and facilitating rural services.

Roads have facilitated a common change in living conditions, access to resources, marketing and distribution system and developmental activities by the government departments and Non-Government Organizations like CARITAS. There are six family planning workers in Atlia Union. EPI immunizing service is also extended there.

b) New Settlement in Low Areas

New human settlements developed in the Kulbaria and Nichukhali mouzas as the tidal intrusion of water stopped. A private primary school up to class three has been established in the Nichukhali village. There are 24 students in the school - class I-08, class II-11 and class III-09 students.

c) Increased Employment

There is an increase in employment opportunities partly due to the introduction of HYV Boro and installation of shallow tube wells for irrigation. A shrimp processing factory also provides employment for many women.

d) Psychological Benefits

The psychological impact of the Project deserves to be highlighted. The stress levels faced by the villagers seem to have been reduced as the losses from flooding and salinity are largely eliminated. Consequently, housing conditions have improved and people are enthusiastic and confident. Though many people are not reaping the full benefits of the Project due to human barriers, they are optimistic regarding the Project impact, or its potential compared with pre-Project conditions.

10.4.2 Negative Impact

a) Defects in the Project Concept

There is a contradiction in the objectives of the Project. It was meant to improve agricultural production by stopping intrusion of saline water. In practice the gher owners continue shrimp cultivation with the intrusion of saline water which cannot be stopped by the BWDB authority.

The area of shrimp farming did decline, but the closure may have strengthened the negative impact of shrimp farm management, since it was an attempt to put people out of business with no consultation or attempt to find an alternative solution. It failed to eliminate conflicts over shrimp farming.

The approach adopted by BWDB implies a gulf in its thinking: the realistic social implications of its intentions were not assessed; and, given the identification of a social problem, the options of liaison with other Departments, lobbying for legislative changes, and working with NGO's appear not to have been explored.

b) Social and Legal Conflicts

There prevails a grave conflict between the gher owners and farmers with small landholdings. The gher owners do not always abide by the lease contract in terms of payment and other conditions. Resentment of the ghers located closer to high land and homesteads is very common. This is because the slightly higher land here is less saline and so more suited to HYV Boro cultivation, and because being more distant from saline water sources less land is under shrimp, but the drainage of these areas which cannot go under shrimp is obstructed by "downstream" shrimp farms. Rights against neighbours for directly negative external impacts appear to be lacking or unenforceable.

The litigation now running over the Narkul gher in Kulbaria-Baralia mouza of Atlia Union can be cited as an example. A total of 74 land owners filed an application with the Upazila Fishery Officer to cancel the lease agreement of the gher but he was powerless to do much about it. On inquiry the Upazila Fishery Officer acknowledged the complaint. The consultants met some of the complainants, who argued the following advantages in favour of paddy cultivation over shrimp cultivation:

i. Introduction of HYV Boro plus salt free Transplanted Aman would yield at least 70 maunds of paddy per acre per year;

ii. The fields could be used as grazing land in between crops for a large number of cattle;

iii. There would be fishing of sweet water species in the khals in the monsoon; and

iv. Reduced salinity would improve conditions for trees.

The consultants met one of the owners of the gher and he acknowledged that there were complaints and agreed to abandon the gher in the future if all the land owners demanded it.

c) Disbenefits to Traditional Fshing Communities

The disbenefits of the Project for fishermen were not foreseen. The conditions of the traditional fishermen continue to deteriorate as there has been a loss of the natural fishery in the rivers inside the Project (Section 6.5). The case of the fishermen's community of 70 members in Male Para of Mathbaria mouza can be cited as an example. They are on the verge of extinction. They have to go to far off places outside the Project for fishing with uncertain catches, resulting in food shortages for family members.

d) Water Transport Disbenefits

Boats were the main and a cheap means of transport in the monsoon. But now due to the Project no boat can ply inside the polder, yet most of the muddy clay roads go out of use for vans with the monsoon rainfall, making life difficult for the population of the interior.

10.5 SUGGESTIONS AND RECOMMENDATIONS

a) Development of Rural Institution

There is no provision for the development of social infrastructure and rural institutions. Parallel provisions should be made to develop institutions like co-operatives, credit institutions, markets, schools and facilities for income generation activities for inhabitants of Projects.

b) Restoration of Equity

Benefits from the Project cannot be shared fairly due to some contradictions in the polder "management" and the power of the rich and large landowners. There should be a clear cut agreement between the shrimp cultivators and agriculturalists. If both interests are to have enforceable rights, and terms and conditions for an amicable settlement, government intervention is clearly necessary.

Provisions should be made to rehabilitate disadvantaged groups such as the fishermen's community.

10.6 LESSONS LEARNED

- The social objectives and impacts of the Project were not well planned or conceived.

- The social cost of the Project was not kept in mind at the time of planning. There is conflict between "beneficiaries".

- In any future such Project social conditions and implications of alternative policies and Projects should be taken into consideration before implementation.

11. ENVIRONMENTAL EVALUATION

11.1 ENVIRONMENTAL BACKGROUND

The Project area is within Agro-ecological subregion 13e, the Ganges Tidal Floodplain Agro-ecological Region (FAO, 1988). Polder 17/2 is in the semi-saline zone of Bangladesh. To the south is Polder 17/1, and Polder 16/1 is to the west.

Polder 17/2 forms one of 39 polders constructed under the Coastal Embankment Project (CEP) in greater Khulna. The Project area is occupied by a single soil association - Gh 813 - this comprises highland and medium highland (33 per cent) and medium lowland (57 per cent) (FAO, 1988, Report 5). The area is crossed by numerous tidal creeks. The soils are mainly saline in the dry season. Calcareous silt loams to silty clays occupy river banks and basin margins, and are grey to dark grey in colour. Tidal flooding was mainly shallow but some basin centres were more deeply flooded and stayed wet for most or all of the dry season. The tidal water is brackish or saline.

During a substantial part of the year the rivers and khals in the area held saline water: according to records in Leedshill De Leuw (1967) for Dumuria in 1966 and 1967 the conductivity of river water only dropped below 3000 (EC x 10^6) in October to January (water with conductivities of more than 3000 (EC x 10^6) is considered unsuitable for paddy cultivation). Moreover the land is mostly low and was frequently flooded by saline water at high tides. Only during the monsoon and post-monsoon period with high rainfall and fresh water runoff from the north did salinity levels drop in the rivers and on the land.

In the pre-Project period (pre-1971) T.L. Aman was dominant, with smaller areas of B. Aus, Jute and vegetables. It was reported by local people that intrusion of saline water in the Project area severely restricted agriculture. Low lying areas of some mouzas were uncultivated, and cultivation of T. Aman depended on the construction of local bunds.

During the period from the building of the original embankment (1971) to the successful Gangrail closure (1983) the practice of shrimp cultivation in ghers became widespread. After harvesting the T. Aman crop in December, low lying inter-tidal lands were converted into ghers and flooded through inlets with saline water for shrimp cultivation. After harvesting the shrimp, usually in July, the area was flushed out with fresh monsoon water to remove the salt, and the paddy fields restored for the next T. Aman crop. Approximately 1457 ha (3600 acres) were used for seasonal shrimp culture (Nabiul Islam, 1988). Natural wetlands comprised a number of beels and depressions to the west and north-west of the Project area.

Many years ago, the area may have been dominated by mangroves. However, the rapid growth of population had eliminated this in favour of cultivation long before the Project was implemented, leaving natural vegetation only in the residual wetlands and a limited diversity of macro-fauna, with the exception of fish.

11.2 PROJECT OBJECTIVES

The Coastal Embankment Project (CEP) was designed to increase agricultural production in the coastal areas by protecting them from tidal and monsoon flooding. There was a single environmental aim of preventing the intrusion of saline water. No attempt was made at pre-Project environmental assessment. The narrow view based on financial analysis completely ignored a number of key issues that economic evaluation and the holistic

perspective of environmental evaluation would have addressed. Such issues include: external areas affected by the Project, both adjacent and downstream; fisheries; livestock; and wetland ecology. The Gangrail closure was little better; it was designed to end shrimp cultivation in favour of small scale agriculture, and although it recognised that capture fisheries would be lost, the evaluation of this was inadequate and wider environmental impacts were ignored.

11.3 APPROACH AND SOURCES OF INFORMATION

The approach to the environmental component of rapid rural appraisal (RRA) is based on simple scaling checklists for each for the three main categories of environmental issues: physical, biological and human (Tables 11.1-11.3). This has been discussed in detail in the Methodology Report.

Rapid scoping of the full range of potential FCD/I environmental issues allowed the selection of those issues relevant to Polder 17/2. Impacts relating to these are summarised in Tables 11.1-11.3. The main emphasis here in the discussion of environmental impact concerns those affecting ecological (physical and biological) issues. The human issues are mostly discussed in more depth in other Chapters of this report, but are summarised here in Table 11.3.

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 case of Polder 17/2, because there are a number of adjacent polders and so it is not possible to evaluate its environmental impacts in isolation. External impacts are evaluated in both immediately adjacent and downstream areas.

The EIP reports (EIP, 1980; Nabiul Islam, 1988) include some data of relevance to physical and human aspects of the environment but no biological data. Information on agro-ecological zonation and characteristics are available in the comprehensive FAO (1988) work which covers all of Bangladesh.

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.

It is important to note that while there have been major environmental changes in Polder 17/2 these are not all due to the embankment and closure. In particular shrimp cultivation developed before the closure, and would almost certainly have developed without the embankment, although the embankment made gher construction slightly easier.

11.4 PHYSICAL ENVIRONMENTAL IMPACTS

Physical impacts have been subdivided into water related and land related (Table 11.1); other physical issues such as climate and atmosphere have not been affected by the project.

11.4.1 Physical Impacts (Water)

a) River flow

River flow parameters include the discharge, velocity, timing and duration of the flows. To provide for the drainage requirement of the polder area, five sluices were constructed along the Bhadra and Salta Rivers (Section 2.3). These sluices are likely to have had little overall effect on flow parameters. However, they prevent tidal inflows and outflows to and from the Project, and since the closure there is no natural tidal cycle in the Project (other than through leaking sluice gates). Consequently the branch of the Salta River along the south side of the polder has much less flow during the tides (as there are no channels leading off it to be filled and drained). The timing and duration of water flows and levels is, however, unlikely to have been affected by the Project either adjacent to it or in downstream areas.

The network of channels of the river within the area is now controlled by sluice gates or blocked by closures, and hence these channels are now inactive.

b) River Quality

Potential key quality factors are sewage, agrochemicals, sediment load and turbidity. The chief quality concern in this Project is salinity. The changes are complex: the Gangrail closure prevents natural saline water intrusion, so water in the low flow period is less saline, but this Project impact has been negated in the gher areas where water quality is managed so that the brackish saline conditions needed for shrimps are achieved.

Pollution of the rivers by agrochemicals or sewage is adequately diluted by the high monsoon flow, although it should be monitored in the dry season in rivers in the Project if HYV Boro cultivation expands further, since fertiliser application is increasing. The amount of sediment is also perhaps no higher than pre-Project, so that turbidity may be much the same.

c) River Morphology

River morphology changes mainly as a result of bank erosion, bed scour and siltation. Closure of the Salta River branch channels during embankment construction, and the closure of Gangrail River, have ended the ebb-tide pressure on the Salta River. The portion of Salta River flowing through Bhangaria and Gangrail Rivers on the both sides of Polder 17/1, has a common source of tidal water on the southern side of Polder 17/1. Consequently, with no additional flows into and out of the branch channels in Polder 17/2, there is stagnation of tidal water in the reach of the Salta River from sluices 1 to 3, which has resulted in high siltation of the Salta River particularly between sluices 1 and 2 (where the channel is reduced to about one third of its pre-Project width, see Chapter 2).

d) Flooding

The Project was mainly designed to prevent saline water intrusion, but also to exclude annual maximum high tides (but not cyclonic surges). Since the Gangrail closure the flood protection objective appears to have been successfully achieved, and the embankment is in good shape (Section 2.4), hence security from flooding has improved (Section 7.6), and the area under T. Aman cultivation has increased with the embankment and improved gher bunds.

e) Groundwater levels

This is potentially an important issue which deserves monitoring because of the recent and continuing spread of shallow tubewell irrigation in the Project area (currently 90 STWs, Section 4.4.2). There is less monsoon season flooding than in the past, so it is possible that there is a minor negative impact on groundwater levels inside the Project area because of the polder.

f) Groundwater quality

The lack of scientific data does not allow any impact to be properly evaluated. Chapter 4 has shown the low overall use of agrochemicals, especially fertilisers and pesticides, hence the possibility of groundwater contamination is low. However, farmers reported that deeper groundwater is slightly saline in the area (Section 4.4.2) which suggests that continued extraction of fresh groundwater may have an adverse impact over time.

Monitoring is needed, here as elsewhere, to clarify such trends.

g) Wetland and Waterbodies: Extent and Recharge

All cultivable low land was under one crop per year. From December up to July ghers are flooded with saline water for shrimp cultivation and form a temporary wetland. On the western side of the Project approximately 30 ha of land is permanently waterlogged and forms small beels.

In addition, the creeks present in the Project are considered wetland bodies. These creeks were regularly flooded by high tides before the Project. Despite the sluice gates these channels are still usually full of water because of the ghers. Therefore, there has been a negligible impact. Downstream of the polder no impact is noted.

h) Wetlands and Waterbodies: Quality

The same remarks apply as in (g). The **Project** impact is unclear; the gher water quality is artificially maintained, some of the channels now are less saline, even fresh, away from the ghers, however there is some seepage of saline water from the ghers into adjacent areas of drainage congestion. Sewage levels could not be assessed; to the extent that there is no daily flushing of water with the tides the Project may have on adverse impact on this aspect of water quality. However, accurate data are required, as throughout most of Bangladesh, to evaluate any trends with accuracy. Similarly, the levels of nitrate, phosphate, BOD, salinity and other key indicators need to be known.

11.4.2 Physical Impacts (Land)

a) Soil Fertility

Both the Project and shrimp cultivation have brought important changes to soil conditions by affecting salinity levels, although soil fertility in itself has been little changed. By excluding saline tides, the soil salinity in non-gher areas has been much reduced resulting in increased cropping intensity on higher land, and making HYV Boro cultivation possible on lower land (Chapter 4); however there are no reliable data on the changed salinity level.

The situation in the ghers is unclear, but is not due to the Project. Continual flooding with saline water for shrimp cultivation for six months may have harmful impacts in the long term for soil fertility and structure ((b) below), but the experience of the IDA Shrimp Culture Project (Annex 1) suggests this is not likely to be the case. In addition, high applications of lime are made in the ghers to promote blue-green algae growth, assisting the low input cultivation of T. Aman after shrimps.

b) Soil - Physical Characteristics

Parts of the area dry out seasonally now where they were previously flooded by tidal water twice a day. During the tidal regime there was deposition of clay particles, but this no longer occurs. However, it is thought that no real change in soil physical characteristics, (such as texture, structure, and moisture holding capacity) has occurred.

c) Soil Moisture Status

Exclusion of saline tidal water has improved soil moisture status, but the ghers restrict drainage in some areas causing drainage congestion. Outside the Project there is little reason to believe that waterlogging has been affected since these areas are either ghers or in separate polders.

d) Soil Erosion

Soil erosion is a negligible issue inside Polder 17/2. No Project induced soil erosion occurs in the external area.

e) Land Capability

Land capability has increased significantly, since cultivation of HYV Boro and vegetables is now successful and T Aman is more widespread (Chapter 4). In pre-Project conditions, due to high salinity, only a portion of lowland was cultivated with T. Aman and the yields were low (Section 4.1.1).

f) Land Availability

Land availability has similarly shown a positive impact. Both the gross cropped area and the cultivable area have increased, particularly low lands which were fallow in the monsoon season in the pre-Project period. At present the available lands are intensively cultivated with very little land left under permanent inundation (approximately 30 ha. on the western side of the Project, Section 11.4.1.g, and a few other channels).

11.5 BIOLOGICAL ENVIRONMENTAL IMPACTS

Biological environmental issues affected by Polder 17/2 can be subdivided into fauna and flora issues. Most biological issues in Polder 17/2 have suffered no significant impacts but they are briefly examined here because of the popular awareness of them as issues.

11.5.1 Biological Impacts (Fauna)

a) Bird Communities/Habitats

The area was probably of limited interest immediately before the Project since the area was quite densely populated with few areas of natural vegetation. Impacts of the Project on bird populations are not clear. It is reported locally that numbers have declined. The decreased area of perennial water and beels may have adversely affected some species, but the ghers may provide an additional habitat, particularly when they are being drained and flooded, for waders (Charadridae). Fieldwork during the migration and winter periods would be needed to confirm the current status of the area.

b) Fish Communities/Habitats

The impact on fish is complex (see Chapter 6):

- capture fisheries have declined rapidly both in quality and diversity. The embankment and river closure effectively now prevent the annual migration of a range of fish species, including the major carps, from the beel areas to the rivers for spawning;

- the Project has increased confidence in fish cultivation in ponds because the embankment has effectively prevented any floods from overtopping ponds within the polder and has minimised saline water inflow, improving water quality for fresh water fish cultivation;

- borrow pits have been converted into ghers for shrimp culture. In addition, because of the protection which it affords against flooding, the embankment has encouraged the creation of large ghers; and

- however, shrimp cultivation had developed in the polder before the closure; the embankment may have encouraged this, but probably had little effect since inside and outside areas are under ghers. The borrowpits formed ready made shrimp culture ponds, while the embankment and closure have made large ghers possible and necessary (since they need direct access to saline water and the closure limited this to the periphery of the polder). The area of shrimp cultivation declined by 36 per cent with the closure.

On balance there is a moderate to major negative impact on fisheries inside the Project area.

c) Other Micro-fauna Communities/Habitats

The same comments apply as for (a) above: already by 1971, the intensive occupation and utilisation of land had severely reduced the diversity of mammals, reptiles and amphibious almost to the very low populations of 1991. At present the frog population is reported to have shown an increasing tendency, possibly due to lower salinity levels in water in parts of the Project.

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 11.4.2 (a) where it was noted that the amount of blue-green algae, one of the major micro-biota elements in Bangladesh had increased in the gher areas, but not due to the Project. In the total absence of data it is assumed that other micro-biota are not significantly affected by the Project. Although the ghers are likely to have different fauna from non-gher areas, the species involved may not be different from pre-Project conditions.

11.5.2 Biological Impacts (Flora)

a) Trees

The trees grown by people have changed to some extent - more saline tolerant ones being cut down, and in non-gher areas more fruit trees being planted - as many as 20 per cent more according to local people. There appeared to be no natural woodland even before the Project.

There is no evidence of coconut plantations along the embankment (although they were planned according to the Project proforma). It is unclear whether this was discouraged by the BWDB, since they should still be able to grow, even with shrimp cultivation. The chance to afforest the embankment has not been taken up, even though Acacias have been planted along the earth roads on higher land in the area.

b) Other Terrestrial Vegetation

In areas with reduced salinity the vegetation has changed both through replacement of semi-natural vegetation with crops and by changes in the plant community due to changed salinity levels. Fresh water marsh vegetation such as Banju, Shishu, Sheola, and Churi Sheola have been favoured, to the detriment of salt tolerant species such as Patia (important for mat making). In addition, agricultural weeds were reported to have increased in four out of six villages. This may reflect reduced salinity levels and increased cultivation. Grazing quality has improved in non-gher areas, but grazing land has disappeared in the gher areas.

c) Aquatic Vegetation

Plant species diversity is reportedly higher, which is consistent with a mixture of fresh water and saline habitats rather than a more uniform seasonally saline and fresh water environment. This is not a significant change.

11.6 HUMAN ENVIRONMENTAL ISSUES

Some of the most important environmental impacts of Polder 17/2 are those affecting the human environment. However, many of those are covered in other Chapters of this report. Here they are presented in Table 11.3 and are briefly summarised below.

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

11.6.1 Human use impacts

a) Crop cultivation

Chapter 4 shows that on the high land around the margins of the Project rabi vegetable, aus and jute crops have benefited from prevention of saline flooding. On lower land where saline water intrusion is prevented HYV Aman is cultivated now. A reduction in salinity of 25-50 per cent in parts of the Project made HYV Boro cultivation (using STWs) possible; the average yield is 4.4 mt./ha. This change would not have been possible without the embankment. The increased agricultural output must be regarded as a positive impact.

b) Livestock

Some decrease in livestock population was noted (Chapter 5), but is not due to the Project itself.

c) Fisheries

The polder, and closure in particular, have adversely affected fisheries: the capture fishery has declined severely, while shrimp cultivation has been reduced.

d) Afforestation

No impact, but an opportunity to plant the embankments is being missed. According to the PP coconut plantations along the embankment were planned; these have never been implemented.

e) Agro-industrial activities

No significant impact of the Project, but a shrimp processing near the Project provides employment for many women.

f) Transport and Communications

Earth roads have developed in the polder but probably would have done so even without the Project; however, the embankment acts as a village road and a road from Kathaltala Bazar to Kulbaria connecting the Khulna-Satkhira highway to the embankment has been constructed. Meanwhile boat communication has declined in importance.

g) Domestic Water Supply

If ground water levels and quality are reduced by irrigation within the polder (11.4.1), this may have had a minor negative impact on domestic water supplies from hand tubewells which have increased in the area (see Chapter 8).

h) Sanitation

The embankments prevent any effective flushing of surface water in which indiscriminate sewage has accumulated, creating at least a minor negative effect.

i) Recreation

Not affected.

j) Energy

A slight negative impact results from the increased absorption of energy by STWs and via the increased number of rice mills and electric powered mills in Chuknagar (Chapter 7).

11.6.2 Social Impacts

a) Human Carrying Capacity

The increased land capability and consequent crop production (and financial return from shrimp culture in ghers) have caused a slight rise in human carrying capacity, although population growth has at least matched this.

b) Demography

The Project itself has probably not significantly influenced demographic structure and trends, except as in (a) above. Even then population growth and demographic structural changes have not been significantly directly influenced by the polder and are influenced more by better roads.

c) Gender

A minor positive impact of the Project on the role of women, by creating greater employment opportunities, was noted (Chapters 9 and 10).

d) Age

No real impact.

e) Health and Nutrition

A minor positive impact due to Project related increases in crop production and to the maintenance of a clean drinking water supply from shallow tubewells (Chapter 8).

f) Disruption, safety and survival

Extreme floods causing damage to property did occur, but were not common, before the Project. The polder prevents any typical flooding, and this has increased security for buildings and property. However, there is little improved safety in the event of a major cyclone in the area (although the Khulna area has relatively low cyclone risk). The embankment has not failed during its life so far (1971-1991).

g) Land Ownership

Apparently not affected by the Project, but the management of some ghers seems aimed at intimidating small farmers and may ultimately press them into giving up control of their land or selling out.

h) Equity

While the shrimp ghers have had a negative impact by favouring larger land owners and businessmen at the expense of small farmers, the polder has had little affect on this. The closure has resulted in some decline in shrimp farming and has facilitated expansion of HYV Boro cultivation which is less inequitable. Losses to traditional fishermen because of the closure affect a particularly vulnerable group.

i) Social Cohesion

Social cohesion has suffered from the negative impacts on equity noted in (h) above. There is much resentment amongst the losers, especially the traditional fishermen. Moreover in pre-Project times (Section 3.2.1) there was a common interest in maintaining bunds against tidal intrusion and hence greater social cohesion.

j) Social Attitudes

There prevails a grave conflict between the gher owners and farmers with small land holdings. Resentment against the ghers is greatest in areas adjacent to them. This is because the slightly higher land here is less saline and so more suited to HYV Boro cultivation, and because being more distant from saline water sources, less land is under shrimp, but the drainage of these areas is obstructed by "downstream" shrimp farms, which may also leak saline water into non-gher areas. Concerning the ghers there were reports of legal cases, intimidation and violence; the closure has probably heightened conflicts of interest by encouraging Boro cultivation and deliberately attempting to undermine shrimp farming. Since there has been a loss of the natural fishery in the rivers inside the Project (Chapter 6) the condition of the traditional fishermen is deteriorating.

11.6.3 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 minor positive impacts (Chapter 7). In all three cases, the impacts arise primarily from the increased cultivation, and from shrimp culture in ghers; a full analysis of the data available is presented in Chapter 12.

11.6.4 Institutional Impacts

It is apparent throughout this report that neither of the two main institutions in the area, BWDB and Dumuria Upazila, have proved capable so far of managing, coordinating or defining and policing water use rights within Polder 17/2. To be fair, both have tried, but with a lack of commitment and powers. There is no water management plan for the polder. Therefore, conflicts over water management in the Project have caused substantial public resentment of the government institutions concerned. The main aim of the Project was to improve agricultural production by preventing saline water intrusion. However, shrimp cultivation with the intrusion of saline water is unplanned and unregulated by BWDB. Although

shrimp farming is economically and financially remunerative, it causes social conflicts, gives less equitable returns than cultivation, and adversely by affects drainage outside the ghers. Both issues (institutional roles and public participation), therefore have suffered negative impacts.

11.6.5 Cultural Impacts

The Project has probably not significantly influenced cultural heritage or scenic qualities in the Project area. There are no particular historical, archaeological or more recent cultural sites within the area.

The landscape has changed with flooding of a large part of the polder for shrimp cultivation during a large part of the year. Cultural continuity is threatened, particularly for the traditional fishermen. The traditional fishermen's community in the polder is on the verge of extinction because there has been a loss of the natural fishery in the rivers inside the Project (Chapter 6). However, overall the Project can reasonably claim to have improved the quality of life to some extent in the Project area through the increased health, crop production, and general well being of the people.

11.7 ENVIRONMENTAL SCREENING

The primary Project aims were the prevention of natural saline intrusion and increasing agricultural production. The scoping exercise in Sections 11.4 - 11.6 shows that these have been achieved but that in the meantime shrimp cultivation has developed.

11.8 CONCLUSIONS AND RECOMMENDATIONS

11.8.1 Conclusions

The CEP polders in Khulna area, including Polder 17/2, are in need of detailed and above all integrated review. The dangers of Project planning in isolation in Bangladesh are quite common and should be avoided in the future. The impacts on the wider environmental system were not considered in evaluating this polder, but collectively the CEP Polders in this region could have serious impacts, for example:

i. the Sundarbans, one of the single largest mangrove forests of the world, are downstream of these polders and are the most important natural environment in Bangladesh - upstream Projects may be adversely affecting their long term survival; and

ii. drainage in upstream areas may be affected by long term morphological changes.

The environmental impacts of the Project which have been assessed have been mixed. The major positive impacts seem to have been:

- improved soil conditions by preventing saline water intrusion;

- improved land capability and availability;

- increased crop production; and
- increased human carrying capacity.

The main negative impacts have been:

- loss of capture fishery and decline in shrimp cultivation;
- the secondary impact on ground water levels; and
- the failure of institutions to provide effective polder management.

11.8.2 Recommendations

i. establishment of monitoring programmes now for certain critical environmental parameters, particularly groundwater levels, and water and land salinity levels;

ii. there is a need to reassess the environmental impacts and aims of Projects, not only when major works are considered (for example the Gangrail closure), but also when new land uses (such as shrimp farming) arise, or when new data becomes available. This may indicate modification of the original Project plan or its management; and

iii. siltation outside the Project may bring benefits and disbenefits. In the short term new area for ghers may arise, in the longer term access to saline water may fall reducing the gher area. Eventually fresh water drainage congestion may occur, unless there is a planned network of long term drainage channels and integrated operation to keep these open in the polder network.

Table 11.1 Physical Environmental Impacts.

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

Table 11.2 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	-2	0
c. Other Macro-Fauna Communities/Habitats	0	0
d. Micro-Fauna Communities/Habitats	0	0
FLORA		
a. Trees	+1	0
b. Other Terrestrial Vegetation	0	0
c. Aquatic Vegetation	0	0

Table 11.3 Human Environmental Impacts

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

12 OVERALL ECONOMIC ASSESSMENT

12.1 PRE-PROJECT ECONOMIC APPRAISALS

An economic appraisal for the original investment in Polder 17/2 under the Coastal Embankment Project is available (BWDB, 1978); in fact this is based on the actual reported costs and on the earlier estimates of 1967/68, but does not amount to a post-evaluation. This assessment gives a benefit-cost ratio of 8.99:1 based on total costs (presumably in 1971 prices) of Tk 11.837 million, a 20 year life and a 5 per cent discount rate. The appraisal appears to have been a financial one - there is no mention of shadow prices. The benefit estimate is based on an incremental yield of paddy of 15 maunds/acre on 8000 acres with a value of Tk 80 per maund (it is not clear if this is a market price, economic price or gross margin). Additionally a small benefit was included for production of coconuts on the embankment, although no costs for planting coconuts were included and none have been planted on the embankment. Operation and maintenance costs were assumed to be 2 per cent of earthwork construction costs plus 1 per cent of structure construction costs per annum.

The Gangrail closure was also subject to a brief economic appraisal (EIP, 1980). This was based on estimates of changes in area and yields of the main crops in the Project area, and of the impacts on shrimp farming and open water fisheries. A benefit-cost ratio of 1.2:1 was derived but the parameters used in calculating this are unclear. Values appear to have been taken from a BWDB report and may well be financial rather than economic. The Project was justified on the basis of annual benefits of +Tk 82.6 lakh from agriculture, -Tk 64 lakh from shrimps, and -Tk 3 lakh from capture fisheries. Additionally it was reported that there was a much greater net benefit to marginal, small and medium farmers. The agricultural justification for the Project was based on an increase from 12 to 25 maunds/acre in T Aman yields on 7,500 acres, an increase in Aus yields from 9 to 15 maunds/acre and an increase in area from 100 to 500 acres, and a major increase in rabi crop area from 150 to 2,500 acres with an associated increase in yields from 4 to 7 maunds/acre. Shrimp cultivation would be wiped out in the process.

However, the same report noted that there was uncertainty over the returns from shrimp farming upon which the assessment was critically dependent. The assessment used a BWDB estimate of profits (financial?) to shrimp farming of Tk 1500 per acre despite noting that local people reported profits of Tk 8-10,000 per acre. Likewise it was noted that the estimate of open water fisheries losses was almost certainly too low. Obviously the Project would not have been justified, other things being equal, using the higher estimate of shrimp profits. However no sensitivity analysis was carried out as part of the Project appraisal and the general principle of using the most plausible or conservative assumptions was not followed in the assessment.

12.2 PROJECT COSTS

12.2.1 Construction costs

The recast PP (BWDB, 1978) gives a detailed breakdown of the original construction costs during the period 1967-1971. Unfortunately this is not broken down by year, but it is known that the sluices were completed in 1970 (dates inscribed on them) and that the

Gangrail closure was attempted on 23 March 1971 (EIP, 1980), since the latter contributed 79 per cent of earthwork costs and 49 per cent of total costs the simplest assumption is that all the costs were incurred at the start of 1971. The total (presumably financial) cost recorded was Tk. 8.583 million excluding interest charges. However, there is no note of the base date which renders the information virtually useless; the prices might be current costs (as incurred), or in 1971 Taka, or in 1978 Taka.

In 1980 the successful closure was expected to cost Tk. 9 million (EIP, 1980), but the actual costs were Tk. 10.644 million in 1983 (Nabiul Islam, 1988). Since there was approximately 700 per cent inflation between 1970 and 1980 in construction costs in Bangladesh (BBS, 1990) and the successful closure was more expensive because detailed site investigations were carried out, it is more plausible to assume that the original cost data are in 1978 prices. This gives a much more conservative inflation factor for updating costs to 1991 prices of 2.93. However, it should be noted that there is a chance that the original costs should have been updated by a factor of 14.22; this would obviously have a considerable impact on Project viability. There were also unsuccessful closure attempts in 1975 and 1977; it is assumed here that these cost the same as the 1971 attempt (in 1978 prices). However, an alternative interpretation would be that the three attempts were included in the recast PP; unfortunately no further details are given in BWDB (1978) for this major cost. If this alternative were the case then it would follow that the prices used were not 1978 prices since the differential in closure costs would be much higher.

Table 12.1 summarises Project costs and their updating into economic costs. Land acquisition has been excluded from the costs; instead the opportunity cost of land taken out of potential production is incorporated in the benefit estimates by reducing the with Project area relative to the without Project area by the 84 ha. taken.

12.2.2 Recurrent costs

Operation and maintenance costs were estimated at Tk 0.231 million (Nabiul Islam, 1988), but it is unclear if this was based on actual cost data or is an estimate at completion. BWDB Khulna provided details of the current (1991) establishment costs associated with Polder 17/2. These comprise the costs of 15.5 field staff directly related to the Project at Tk. 40,000 per month, but none of these staff are physically engaged in routine maintenance. Of these staff the embankment khalashis were not encountered during the survey, nor the drivers (there being nothing to drive) while one sluice khalashi post was unfilled. If the operation of sluices is handed over to user groups this staff level could be reduced to about two people. The establishment of the SDE Dumuria's office has been allocated as one third employed on Polder 17/2 which appears reasonable, although the monthly cost of Tk. 25,000 reflects overstaffing. However, 25 per cent of the Khulna O&M Division I establishment costs (Khulna office staff) were apportioned to the Project. This is clearly excessive since this Division is responsible for a number of projects and Polder 17/2 can make up no more than 10 per cent of their workload and probably rather less. On this basis the central establishment cost (including overstaffing) amounts to Tk 24,000 a month. In total the annual establishment cost is thus Tk 1.068 million a year or Tk 287 per ha (total area) and Tk 382 per ha of cultivated land.

In addition to normal staff there were repairs to the Project in 1988/89 under the "Flood Damage Repair" programme; in fact this was mainly repairs of general deterioration in sluices and protection from erosion. These costs amounted to Tk 1.868 million. The embankment has also been resectioned at least twice since it was originally built but no record of the costs

or exact years has been traced. Those costs for which details are available are summarised in Table 12.1. Based on other projects studied by FAP 12/13, embankment re-sectioning typically requires 18.8 metric tonnes of wheat per km, in 1991 prices this has an economic value of Tk 122,200 per km.; Polder 17/2 has 10.5 km of embankment so this is a cost of Tk 1.283 million per resectioning. It is assumed that the embankment is resectioned every eight years; the channels within the polder appear not to have been resectioned.

12.2.3 Cost records

The cost data reveal the importance of keeping proper records. Prices and costs without details of their base date, and what they are the cost of, are virtually useless in re-appraising a Project and mean that the time spent by officials in recording and compiling data has been wasted.

12.3 PROJECT IMPACTS

12.3.1 Introduction

Chapters 4 to 11 have discussed the impacts of Polder 17/2 (both the initial investment and Gangrail closure) and the other changes which have taken place within the polder over its 20 year existence. This section is concerned with aggregate economic impacts, upon which an economic re-assessment of the Project is made.

12.3.2 Agricultural Impact

Based on the input levels reported in Chapter 4 and those in MPO (1987) and updated costs from FPCO (1991) a comparison of input costs was made (Table 12.2). This indicated that survey based costs were comparable to those estimated by MPO and since they reflect local recent experience the survey based costs have been preferred for the analysis. Greater problems are raised by the survey based yield data (Table 12.3). While the estimates from group interviews for the pre-Project period appear reasonable, some of those for the present time are very much higher than the MPO estimates - notably reported B Aus, jute, TL Aman and HYV Aman yields were reported to be over twice those given by MPO and appear unreasonable (the yield for vegetables is plausible since high volume crops such as cabbages are most widely grown). Gross margins (financial and economic) are very sensitive to such large differences in yield estimates, so as a compromise (since the MPO estimates appear to be too low for these four crops) the mid points of the survey and MPO yield estimates have been used for the analysis.

The financial gross margins (Table 12.4) reveal the high relative profitability of shrimp cultivation before the closure. However, after the closure shrimps and HYV Boro have almost identical financial returns (and labour requirements); the difference is in the higher economic return to shrimps (which have relatively lower economic costs). However, other crops, particularly vegetables and T. Aus, appear to be even more profitable, and in the case of the former crops the area has increased considerably on the limited area of suitable land.

The assumptions used to model changes in cropped area between 1971 and 1991 are that before the closure winter and Aus season crops were unchanged, but associated with the growth in shrimp cultivation there was some increase in TL Aman cultivation since the embankment plus gher bunds provided more protection from flooding in the monsoon season

- this cropping pattern (1981 in Table 12.5) is taken to be the without Project pattern and it is assumed that no 'benefit' during the period up to 1983 can be attributed to the Project. However, during the period between the embankment construction and closure there was a leap in economic gross margins of Tk. 45.70 million per annum (in 1991 economic prices) which was largely attributable to the growth in shrimp cultivation. However, the maximum annual economic gain between the closure and 1991 is only Tk. 17.39 million per annum (1991 economic prices based on compromise yields for some crops) - gains from Boro, vegetables and Aus being partly offset by losses to shrimps (Table 12.6).

12.3.3 Identifying Project Impacts and Phasing Benefits

A major issue in making a realistic post-evaluation is the twin problems of deciding what would have happened without the Project, and determining whether there was any benefit during the period before the Gangrail was closed. The sequence of events is that the embankment and sluices were completed by 1971, but the polder remained open to tides until 1983 when the Gangrail was closed. During this period, however, major changes took place in the polder farming system and economy; by 1981 shrimp farming had reached its maximum extent - undoubtedly this would have happened without the embankment but there may have been some benefit in terms of reduced costs and greater security of building ghers adjoining a well built embankment. It is assumed that since tidal flooding remained there was no agricultural change apart from in the ghers. Since the closure there have been a number of agricultural changes because natural saline water intrusion has been excluded; the simplest assumption is that the 1981 conditions would have persisted without the Project.

Hence the situation observed during the RRA reflects with Project conditions, but the transition period following the closure is unobserved. From the RRA it is known that HYV Boro has only been grown for a relatively short time and that the area under shrimp cultivation has declined over the same period - in particular HYV Boro has expanded since the previous post-evaluation (Nabiul Islam, 1988) in 1988 and this reflects the slow take up of potential benefits when they are dependent on salinity levels falling. The benefits to agriculture on higher land started earlier, probably soon after 1983, since salinity levels may have already been falling on this land before the closure. The timing of the decline in shrimp cultivation is uncertain but earlier than the growth in Boro cultivation, since Nabiul Islam (1988) also reported a decline in shrimp cultivation but equally this decline did not happen immediately and the shrimp farmers adjusted to the changed access to salt water.

The simplest solution to phasing impacts has been to treat Boro, rabi and Aus, and Aman and shrimp cultivation as three separate sectors. It is assumed that changes took place linearly over the period 1983-87 for rabi/Aus, 1985-88 for Aman and shrimp, and 1988-91 for Boro.

12.3.4 Fisheries impacts

It is clear from Chapter 6 that Polder 17/2 has had serious impacts on fisheries. This section is concerned with fin-fish, since shrimps have already been treated as a crop in Section 12.3.2. Estimates of fin-fish output and returns are based on limited data and are less reliable than the agricultural assessment.

In pre-Project conditions (1971) it has been estimated that 960 metric tonnes of fish were caught a year (Chapter 6). Catches were apparently very high at 13 kg per fisherman per day due to the prolific nature of the fishery. In 1991 financial prices the value of output

would thus be about Tk 40/kg less Tk. 10/kg. production costs less Tk. 35/day labour (opportunity cost in agricultural labour), giving Tk. 27.3/kg. net profit. Assuming that the market price for fish reflects their economic value and that all costs are for unskilled labour, then the net economic return was Tk. 30.99/kg., giving an annual economic return of **Tk. 29.75 million** (in 1991 prices).

By the time of the closure there was still a major capture fishery. The trend between 1971 and 1983 is unrecorded but it seems plausible to assume some decline since the shrimp ghers helped to enclose part of the floodplain. It is assumed here that there was a 25 per cent decline in capture fisheries during the period between the embankment and closure, resulting in an open water catch of 720 metric tonnes a year with a net economic value of Tk 21.53 million per year. In addition there is a residual fish catch in the shrimp ghers; on average in Khulna District some 80 kg. of fin fish per ha of shrimp gher are caught a year (Table 6.1). However, since in Polder 17/2 the shrimp catch is less than the average (140 kg./ha. instead of 180 kg./ha.) it is assumed that the fish catch is similarly lower at 62 kg/ha. The offsetting fish catch in the ghers was therefore about 9 metric tonnes a year; there are no additional production costs since the catch costs are already included in the shrimp farming calculations, so this would have had an economic value of Tk. 0.36 million a year, giving a total fisheries return of **Tk. 21.89 million** a year (in 1991 prices).

By 1991 the capture fishery had been decimated and it was estimated that only 170 metric tonnes were landed by fishermen from Polder 17/2 (although this may be an overestimate, Section 6.5). Moreover, there is now a greater effort per kg landed (estimated to be 6.7 kg per fisherman day in Section 6.5) and hence the imputed labour cost of production is higher per kg at Tk. 3.7/kg. in 1991 economic prices. Hence the economic value of capture fish production is now Tk. 4.47 million a year. Likewise there has been a small loss of production from the ghers associated with the reduced area - 5.8 metric tonnes a year with a value of Tk 0.23 million a year. There has been a small compensating growth in fish cultivation since the closure with an estimated production of 36 metric tonnes a year. This has a somewhat higher economic value since more valuable major carp are cultivated, and it is assumed that production costs are no higher per kg than for capture fish at present, giving an economic value of Tk 1.49 million a year. Hence the total net economic value of fin fish production in Polder 17/2 is in 1991 in the order of **Tk. 6.19 million** a year in 1991 prices which represents only 28 per cent of the economic value before the closure, with an eventual annual loss to fin fisheries of Tk 15.7 million a year.

So far as phasing of fisheries impacts is concerned the impact on capture fisheries would have occurred almost immediately after the closure, whereas the growth in fish cultivation has been more recent and gradual.

12.3.5 Other Impacts

It has not been possible to assess economic values for other impacts of this Project, although it has undoubtedly had some impact on transport. It is unclear whether there has been any induced economic growth due to the Project compared with trends which would have taken place in any case. It is unlikely that the Project has provided any major additional non-agricultural flood damage reduction since the area was not at risk of major damaging floods before the Project, but a small benefit has probably been ignored by assuming this.

In aggregate there has been an increase in employment opportunities. It is not known how much employment was generated during the construction phase, but because of the four

attempts at the closure there would have been more employment and over a longer period than in a more successful project. It is estimated (Table 12.7) that the changes between 1971 and 1983 (principally shrimp farming) generated an additional 259,000 person days of farm employment a year, but this was not due to the Project - without it the shrimp ghers would have been smaller and would probably have needed more people to maintain their bunds. However, as a direct consequence of the closure some 144,000 person days of work were generated in agriculture, against which must be offset a loss of some 47,000 person days in fishing giving a net increase of only 97,000 person days.

12.4 ECONOMIC REASSESSMENT

Given the initial 13 years of Project life with no benefits, followed by a slow take up of agricultural benefits and a rapid loss to fisheries, the flow of net benefits, as discussed in Sections 12.3.2 to 12.3.4, (ignoring Project costs) does not become positive until 1991. Thereafter the annual net benefit is only Tk 1.69 million a year against annual O&M costs of Tk. 0.817 million until the assumed end of Project life in the year 2000 (30 years after the embankment and structures were completed). Hence for the combined investment pattern there are virtually no benefits in the cash flow and an internal rate of return cannot be computed - the Project as a whole was certainly not worthwhile economically.

However, it is also important to evaluate the Gangrail closure separately treating the previous costs as sunk. For this the closure is assumed to have a 30 year life from 1983 and only the final closure costs are included as a capital costs; periodic resectioning and establishment cost must, however, also be included in the cash flow. Again the early years, both because of the closure cost and negative fisheries impact, have negative cash flows and the last 21 years have very small positive cash flows. As a consequence the Net Present Value in 1991 economic prices is Tk. -62.79 million and an internal rate of return cannot be calculated. Hence, it is clear that even the decision to finish the polder, given that much of it had already been constructed, was not justified.

12.5 CONCLUSION

The very poor economic performance of the Project is largely dependent on the large adverse fisheries impact, but even if this were only half as bad as has been estimated the economic performance would still be very poor (IRR of 1 per cent for the combined investment flow from 1971, and at a 12 per cent discount rate a net present value of Tk -34.31 million). The Project performance is further adversely affected by the slow take up of agricultural benefits which is inevitable since farmers have had to wait for soil salinity levels to fall and the potential for ground water irrigation in the Project area was not appreciated until recent years. If the Project is taken as a whole, including the initial CEP investment, then it could never be viable since there was a 12 year delay before any tangible impact occurred. Moreover in the meantime the agenda had changed with the growth of shrimp farming. Not only was the attempt to end shrimp farming for social reasons only partly successful, but it brought economic disbenefits to both the rich shrimp farmers and the poor open water fishermen, and only modest agricultural gains to farmers.

Table 12.1 Polder 17/2 Costs

Year	Category	Current financial	SCF/ inflator	Economic 1991 prices
Capital costs:				
1971 (but in 1978 prices)			2.938	
	Earthwork (unskilled lab)	5.294	.71	11.043
	Sluices	0.628	.75	1.384
	Establishment & HQ	1.09	.82	2.626
	Engineering investigation	0.385	.82	0.928
	Equipment	0.143	.68	0.286
	Buildings	0.144	.75	0.317
	Operation and repairs	0.291	.71	0.607
	Contingencies	0.214	.82	0.516
Total		**8.189**		**17.707**
1975 (but in 1978 prices)				
	Closure attempt	4.2	.71	8.761
1977 (but in 1978 prices)				
	Closure attempt	4.2	.71	8.761
1983			1.71	
	Gangrail closure	10.644	.71	12.932
1989 "Flood damage repairs"			1.129	
	Sluices	0.761	.68[a]	0.584
	Earthwork and bank protection	1.107	.71	0.888
Total		**1.867**		**1.372**
Recurrent costs:				
1991 prices				
	Establishment	1.068	.765*	0.817

Note:

a average of concrete and steel conversion factors (concrete repaired and new gates fixed)

* average of skilled and unskilled labour conversion factors since the breakdown of staff costs is unknown.

Sources:
Costs: BWDB (1978), Nabiul Islam (1988), BWDB unpublished data
Factors: BBS (1991), FPCO (1991)

Table 12.2 Polder 17/2 crop production costs

Crop	survey financial	survey economic	MPO financial	MPO economic
HYV Boro	14249	14078.2	10050	7447.2
Oilseed/pulse	5409.2	4516.4	3682	2836.85
veg	11620	10699.8	11605	8523.1
B Aus	5606	4731.9	7920	6064.8
T Aus	7459	6385	7942.5	5907.9
Jute	8310	6488.6	9675	7126.2
TL Aman	4776	3548.1	6745	5059.6
gher Aman	3031	2261.5	4855	3509.8
HYV Aman	8356.5	7845	8055	5998.5
Shrimp	12749	11892.4	0	0

Source: Consultant's estimates, MPO (1987)

Table 12.3 Polder 17/2 crop input-output per ha.

Crop	Yield mt./ha.			by product (MPO)
	pre	post	MPO	
HYV Boro	N/A	4.43	4.04	4.04
Oilseed/pulse	.89	.89	.6	1
veg	8.26	13.28	6.24	0
B Aus	1.77	3.93	1.14	2
T Aus	N/A	3.54	3.67	2
Jute	2.36	4.92	1.35	2.5
TL Aman	2.95	3.54	1.66	3.3
gher Aman	1.77	1.77	1.66	3.3
HYV Aman	N/A	5.9	2.65	2.65
Shrimp	.14	.14	N/A	0

Source: Consultant's estimates, MPO (1987)

Table 12.4 Polder 17/2 Cropping Pattern (ha.)

crop	1971	1981	1991
HYV Boro	0	0	713
Oilseed/pulse	47	47	235
veg	101	101	262
B Aus	148	148	131
T Aus	34	34	94
Jute	228	228	323
TL Aman	1171	790	967
gher Aman	0	1457	931
HYV Aman	0	0	339
Shrimp	0	1457	931
Total	1729	4262	4926
Cropping Intensity	60.	152.	176.

Source: Consultant's estimates

Table 12.5 Polder 17/2 crop gross margins (Tk./ha. in 1991 prices)

crop	financial pre[1]	survey post[1]	financial MPO[2]	economic pre[1]	survey post[1]	economic MPO[2]
HYV Boro	0	22793	18830	0	15798	19993
Oilseed/pulse	7758	7758	5195	7598	7598	5330
veg	20486	39998	12649	18833	36782	13787
B Aus	7600	12492	1258	7794	12539	2554
T Aus	0	28959	29743	0	17119	18402
Jute	14568	20003	6119	12271	16728	5824
TL Aman	17342	17342	8503	17381	17381	9226
gher Aman	13021	13021	10393	12802	12802	10776
HYV Aman	0	24765	13190	0	23811	14174
Shrimp	22251	22251	N/A	23108	23108	23108

Note: First three columns in financial prices, last three columns in economic prices

Source: [1] Consultant's estimates, [2] MPO (1987)

Table 12.6 Polder 17/2 crop economic returns

crop	gross margin in Tk pa 1971	1981	1991
HYV Boro	0	0	11264047
Oilseed/pulse	357090	357090	1785449
veg	1902133	1902133	9636756
B Aus	1153503	1153503	1642548
T Aus	0	0	1609141
Jute	2797700	2797700	5403108
TL Aman	20352701	13730687	16807056
gher Aman	0	18651916	11918280
HYV Aman	0	0	8071992
Shrimp	0	33667773	21513176
Total	26563128	72260803	89651552
Increment		45697674	17390749

Source: Consultant's estimates

Table 12.7 Polder 17/2 Crop Labour Requirements

crop	1971	1981	1991
HYV Boro	0	0	105524
Oilseed/pulse	5217	5217	26085
veg	22422	22422	58164
B Aus	16428	16428	14541
T Aus	5032	5032	13912
Jute	33744	33744	47804
TL Aman	129981	87690	107337
gher Aman	0	107818	68894
HYV Aman	0	0	50172
Shrimp	0	193781	123823
Total	212824	472132	616256
Increment		259308	144124

Note: Total person days per year

Source: Consultant's estimates

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ANNEX 1

IDA SHRIMP CULTURE PROJECT (POLDER 20, 20/1)

1. General Description

Internal layout of the polder is arranged in blocks, of varying sizes and numbers but each provided with a flushing (inlet) channel and a separate drainage (outlet) channel - see Figure A1. The system operates on the following basis:

January - preparation of ground for shrimp culture;

February to July incl.- flooding with saline water, stocking with juvenile shrimp, ongrowing and feeding and harvesting to be completed by late July;

August to December - flushing with freshwater, transplanting paddy for harvesting in December.

2. Area

At project start in 1986/87, Polder 20, 20/1 comprised 1430 ha under paddy, of which about 750 ha were also used seasonally for shrimp farming. Redevelopment has resulted in a net 1176 ha of productive land designed to produce consecutive crops of shrimp and paddy. The balance of 254 ha was taken up by embankments and the network of flushing and drainage channels.

3. Production

i. 1986/87 :	Shrimp -	52 mt. (750 ha. x 68 kg./ha.)
	Paddy -	2373 mt. from 1430 ha.
ii. 1990:	Shrimp -	205.8 mt. (1176 ha. x 175 kg./ha.)
	Paddy -	2329 mt. from 1176 ha.

4. Revenue

Revenue from sales of rice and shrimp were stated by the Project Director as follows:

1986-87	...	Tk.140 lakhs
1988	...	171
1989	...	241
1990	...	411

5. Participation

With NGO assistance (notably CARITAS) the project commenced with 20 groups having a total membership of 273 people. By 1990 this has grown to 32 groups and 490 members.

Figure: A-I Polders 20 and 20/1 showing compartmentalisation for sequential shrimp-Paddy cultivation.