South East Region
Water Resources Development Programme
BGD/86/037

FAP-5

Noakhali North Drainage and Irrigation Project
Feasibility Study
Volume 5 - Annex F
Fisheries

October, 1993

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NOAKHALI NORTH DRAINAGE AND IRRIGATION PROJECT
FEASIBILITY STUDY

ANNEX F - FISHERIES

CONTENTS

FISHERIES

CHAPTER F.1

INTRODUCTION AND ENVIRONMENTAL CONTEXT

F.1.1   General

The importance of freshwater fish as a source of income and cheap protein for a large proportion of the human population in Bangladesh has been widely recognized. However, ecological and biological data regarding fish, especially for the smaller species, and their utilization appear to be lacking.

In the Noakhali North study area, there are a number of rivers, Khals and ponds, although Beels appear to have disappeared to give way to various agricultural activities. A considerable portion of the area is however subject to flooding -which enhances fisheries by carrying migrating species from the rivers and Khals onto the floodplain for breeding, feeding and dispersal purposes. Thus, capture fisheries occur to a large extent and it plays an important role in subsistence fisheries.

Man-made Khals and other types of depression such as road-side borrow pits and canals act as fisheries production sites and are good settings for the cultivation of commercially important species. The Raipur Hatchery and Training Centre is located near the study area and supplies some of the privately owned ponds with fish fry or fingerlings.

Part of the study area has already been embanked and it is easy to appreciate that habitat alterations have taken place. Nonetheless, it is not easy to assess the extent of these alterations and their effect on the general ecology, fish diversity and fisheries of the area. However, there is a need to evaluate the existing fish diversity and fisheries in the area and the potential ecological impacts that any further control projects might have on their life cycles and on the natural environment.

To carry out such an evaluation properly, detailed fisheries and ecological assessments and their interaction with the local human population are necessary. Given the short period of time available for this study, it is beyond the scope of this project to attempt to assess the existing environmental situation in detail.

F.1.2   Scope of the Fisheries Study

The main objective of the fisheries component of the Noakhali North Feasibility Study was to carry out an evaluation of the existing fisheries resources of the area and make an assessment of the impact of proposed interventions on capture and culture fisheries. An assessment has been made on the likely effects of the intervention on the fisheries resources.

Given the importance of open water floodplain fisheries in the region, the focus was placed on these activities and it is hoped that information gathered in this study will form a much needed baseline for the further analyses necessary to fully evaluate the fish systems of the area.

F.1.3   The Noakhali North Project Area

The Noakhali North Drainage and Irrigation Project, referred in this Annex as the Noakhali North study or project area, lies to the south of the South East Region (SER) of Bangladesh (Figure F.1.1). Within the region the project area is located in the south-central part (Figure F.1.2). It is bounded to the north by the Dakatia River; to the east by the divide between the Little Feni and the Noakhali Khal basins; to the south by the old coastal embankment which it follows. The western boundary comprises the left embankment of the Meghna River in the southern parts and the eastern embankments of the Chandpur Irrigation Project up to the Dakatia River.

The Noakhali North project area is 160.814 ha in size with approximately 46% of it covered by water bodies. The dominant feature of the area is the Begumganj Depression, centred on Begumganj, with a land elevation of approximately 3m PWD and almost completely encircled by higher ground. Figure F.1.3 shows details of the project area and its main features.

F.1.4   Social and Economic Context of the Capture Fisheries in the Area

Substantial numbers of people in Bangladesh engage in subsistence fishing in contrast to full time and part time fishing, where all or part of the catch is sold for cash. It is therefore important to define subsistence fishing as the utilization of a **free common good resource** by family members in order to supply them with the majority of their animal protein. Subsistence fishing mainly applies to people who are too poor to buy fish at markets and who therefore enter a wageless labour system producing food for their families by catching fish. It is these people, unlike the full and part time fishermen, who are likely to suffer most due to the destruction of capture fisheries by FCD and FCDI schemes. Such poor and marginalised families will find it much more difficult to obtain the necessary levels of nutrients with their low and intermittent wages.

Much of the fish consumed in Bangladesh requires no intermediate market mechanisms, being outside the cash economy, costing families nothing but their labour. The presence of free or low cost fish has important implications for population stability in the rural society. The loss of subsistence fisheries could force many landless families, and small farmers who rely on these fisheries, to move to the city. The importance of the species which make up the bulk of the subsistence catches, usually the ones with lower economic value but high in nutritional merit, lies in their being less regulated by leasing systems, easier to catch with cheap gear and independent of culture fisheries markets and government stocking programmes.

The 1980-81 Nutritional Survey of Bangladesh found that of 28 g of animal protein consumed per capita, 22 g (nearly 80%) came from fish. This shows the extent to which people, especially the landless, rely on a wide variety of species to meet their protein needs. Species diversity is thus also essential to subsistence fishermen and it is a vital component of the nutritional profile of the Bangladeshi people.

F.1.5   Physiography

Figure F.1.4 shows the mapped classification of the Agro-Ecological Regions in the study area based upon the 1988 FAO Land Resources Appraisal of Bangladesh. This information, together with information on topography (Figure F.1.5) have been used to link the hydrology of the area. A description of the agro-ecological regions in the project area is given in the Environmental Annex H.

Figure F.1.1
Project Location Map

N

U.S.S.R.
N
AFGHANISTAN
CHINA
NEPAL
BHUTAN
PAKISTAN
INDIA
BURMA
Bangladesh
THAI-
LAND
SRI
LANKA

Rangpur
Dinajpur

Jamuna

FAP 2
(NW)

Jamalpur

Sunamganj

FAP 6
(NE)

Sylhet

Bogra

Mymensingh

Old
Brahmaputra

Rajshahi

Tangail

FAP 3
(NC)

Meghna

Pabna

Kushtia

DHAKA

FAP 5
(SE)

Faridpur

Mawa

Comilla

Padma
(Ganges)

Chandpur

FAP 4
(SW)

Jessore

Noakhali

**Noakhali North
Study Area**

Khulna

Barisal

Chittagong

Pathargate

Cox's Bazar

Bay
of
Bengal

0   30   60   90   120   150 km

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Figure F 1.2 — Project Regional Location Map

LEGEND

—··—··—	Project Boundary
————	Existing Flood/ Coast Embankments
▨	Project Area
●	Principal Towns
······	Drainage Channels

North East Region

INDIA

Meghna River

Comilla

Chandpur

Laksham

Chatkill

Feni

Laksmipur

Begumganj

Noakhali

Bay of Bengal

0 5 10 15 20 Km

N

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Figure F.1.3

Project Area Base Map

Legend:

■ Thana H.Q.	⌇ River
■ District H.Q.	⌇ Khal
● Other Important Places	
	Railway
	Road
	Project Boundary
	International Boundary
	Embankment

Scale:

0 — 5 — 10 km

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RAHMATKHALI REGULATOR

CROSS-DAM Nr 1

CROSS-DAM Nr 2

KAZIRHAT REGULATOR

OLD COASTAL EMBANKMENT

CHANDPUR IRRIGATION PROJECT

MEGHNA RIVER

CHANDPUR

HAIMCHAR

FARIDGANJ

RAIPUR

RAMGANJ

HAJIGANJ

SHAHRASTI

CHITOSHI

KACHUA

CHATKHIL

LAKSHAM

NANGALKOT

CHAUDDAGRAM

SONAIMURI

SENBAG

UTTAR SAHAPUR

DAGAN BHUIYAN

FENI

SONAGAZI

COMPANIGANJ

KABIR HAT

KALAMUNSHIR HAT

UTTAR NAMCHI

NOAKHALI

CHAUMUHANI

BEGUMGANJ

CHANDRAGANJ

BATTALI

DASHER HAT

MANDARI

LAKSHMIPUR

Figure : F 1.4

Agroecological Zones

Figure F. 1.5

Topography

Legend:
- Thana H.Q. ■
- District H.Q. (■)
- Other Important Places ●
- Railway
- Road
- Project Boundary
- International Boundary
- Embankment
- River ■
- Khal

Elevation above PWD	
5.0 - 5.5	
4.5 - 5.0	
4.0 - 4.5	
3.5 - 4.0	
< 3.5 m	

Scale: 0 5 10 km

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F.1.6   Climate

The project area is influenced by a typical monsoon climate, with hot summers from May to October and cooler dry winters. The mean annual rainfall at Noakhali is in the order of 3,200 mm and decreases northwards to about 2,000 mm at Comilla. Evapotranspiration exceeds rainfall between October and March throughout the region. Rainfall in the early and late monsoon periods is highly variable. The climatic norms at Noakhali are shown in Figure F.1.6.

The region is affected by severe tropical cyclones which develop in the Bay of Bengal. Cyclones most commonly occur in the periods before and after the main monsoon season from May to October. Recently, cyclones have affected the region in 1970, 1985 and 1991. Cyclones are generally accompanied by very strong winds, high rainfall and storm surges, which together with high tides can have disastrous consequences in coastal regions.

F.1.7   Fisheries Environments

The Noakhali North project area is a significant and productive wetland which harbours a large number of organisms, important both in economic as well as ecological terms. This importance becomes obvious when fish and fisheries in the area are considered, although fish are just one of the many links in its complex ecological web.

The biodiversity of a place such as the Noakhali North basin is due to its proximity to both the Meghna, one of the major rivers in the country, and the old coast which interact in a complex manner. In addition, a series of internal rivers, Khals and other aquatic environments make it a good feeding, nursery and growing area for a myriad of aquatic animals and plants, of which fish and crustaceans are major components.

A summary of the main aquatic habitats that are important for fish and crustaceans is given in Table F.1.1 below:

F.1.7.1   Major River Systems

The main rivers influencing the study area are the Lower Meghna River, which is referred to as the Meghna River in this report, and by the Dakatia River to the north. During the monsoon, they contribute substantially to the floodplain fisheries in the study area.

It is beyond the scope of this study to attempt to quantify the contribution that the Meghna River makes to the fish production and to the ecological processes of the study area. However, results from the hydraulic model show that the flooding from the Dakatia comes into the basin from the northern part, west of Hajiganj, and in the area of the Laksham depression and spreads southwards but in a relatively confined manner. The southern part of the study area is flooded by stored local rainfall which gradually spreads over the area. In consequence, it is believed that fish, spawn, fry and breeding adults, are carried into the ecosystem at this time. The contribution of the rivers to the fish production in the Noakhali North study area is thus believed to be important.

Figure F.1.6
Climatic Norms at Noakhali

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TABLE F.1.1

Area per Fishery System per Zone in the Noakhali North Study Area

	Zones (ha)				
	A	B	C	D	Total
Gross Area	29 332	35 553	32 769	63 160	160 814
Meghna River$	5 937	0	0	6 031	11 968
Dakatia River	0	0	0	594	594
Int River & Khals+	242	264	226	484	1 216
Floodplains*		16 737	13 098	42 933	72 768
Sub-Total	6 179	17 001	13 324	50 042	86 546
Ponds#	692	2 292	2 323	2 707	8 014
Total	6 971	19 293	15 647	52 749	94 560

\# Source : Thana Fisheries Office Survey carried out during this study

   Refers to "Cultured" ponds only.

$ Area immediately outside project area

+ Minor Khals not included

* Area calculated from the MIKE 11 hydraulic model

For the analysis of the fisheries estimates, the area of the Meghna immediately adjacent to both Zones A and D (please refer to Figure F.2.3) has been measured and a productivity assigned to it on a per unit area (Table F.2.3.). However, it is likely that this procedure may underestimate the actual contribution of this great river. It is possible that the Meghna's contribution to the fish production in the Noakhali North area may be higher. For the purpose of the analyses carried out in this study about 2,106 MT (11,968 ha) have been considered.

The proposed interventions will not affect these catches and therefore, their accurate measurement is not required for the purposes of this study.

F.1.7.2   Minor Rivers and Khals

The project area is cris-crossed by a network of internal rivers and Khals which range from permanent to seasonal waterbodies with a total area of approximately 1,216 ha. Table F.1.2 shows the surface areas for some of the more important internal rivers and Khals in the region. The area to the south of the Daudkandi to Comilla road has three main drainage features: the Dakatia River, already discussed in the previous section, the Rahmatkhali Khal and the Little Feni River.

TABLE F.1.2

Major Khals in Noakhali North Area

Name of River	Length (Km)
Mohandra K.	28.20
Thanarhat Kachirhat K.	17.85
Barakanchi K.	18.00
Mellar K.	21.50
Sadar K - Noakhali K.	60.50
Naodona K.	4.40
Dhamra K.	17.65
Panchgur - Mohandra - Manik Chara K.	47.90
Gazaria - Sonaimuri K.	35.00
Shek Sufi K.	22.50
Chaumuhani K.	10.20
Atiabari K.	17.40
Dadna K.	8.50
Rahamatkhali-WAPDAK	46.50
WAPDAK.	21.20
Debipur K.	21.25
Hornakhali K	14.60
Musar K. - Oder K	27.00
Kata Khal	16.00
Kabir Khal	17.00
Atiabari K.	6.20
Kalamunshir K.	12.30
Karambox K.	13.10
Kamta Khal	50.00

These rivers are interconnected by a complex system of channels but they do provide primary fish access routes. The Dakatia River has its source with the Sonaichari and Pagli Rivers which drain small catchments in the Tripura Hills. The Little Feni collects drainage from the Kakri and a number of catchments in the Tripura Hills, although these are all significantly smaller than those north of the Gumti River.

Rahmatkhali Khal forms the main access route for fish in the south of the region. Before completion of the Meghna cross dams, the coastal embankments and polders, the Noakhali Khal was a more important drainage route. However, with land accretion in the south, the primary access routes from the South Noakhali area is through the Rahmatkhali regulator. The Little Feni which drains into the Bay of Bengal via the Kazirhat regulator suffers from siltation in the outfall channel (Figure F.1.3).

F.1.7.3   Floodplains

Floodplains are areas of relatively low lying land seasonally inundated by overspill from adjacent rivers and natural depressions. During the dry season, organic matter (animal excreta, rotting vegetation and other material) accumulates in this vast area. Nutrients rapidly become integrated in the system during the early stages of flooding and in combination with riverborne silts, minerals and nutrients support rapid growth of plants, insects and other aquatic life. This increase in productivity provides essential conditions for reproduction and growth of numerous species of fish and crustaceans which use the floodplain system as breeding, feeding and nursery areas. A schematic representation of the nutrient cycle in a floodplain is shown in Figure F.1.7. The seasonal cycles of events in the floodplain in the study area are shown in Figure F.1.8.

It should be noted however that the Noakhali North floodplain being largely stored rainfall receives no appreciable riverborne silts, minerals and nutrients which suggests that the floodplain in this area may be less productive for fish development than many other areas.

The floodplain is by far the most important aquatic ecosystem in the project area and during the peak flood it is substantial, covering approximately 73,984 ha or 46% of its total area of 161,423 ha. For this calculation, all the MPO flood phases greater than 30 cm (i.e. F1, F2, F3 and F4), given by the MIKE 11 hydraulic model have been included as they are considered potentially suitable for fish production. Table F.1.1 shows the area of floodplain (F1+F2+F3+F4) per zone within the project area.

F.1.7.4   Beels

Beels are natural depressions which hold water for long periods of time. According to the District Gazetteer, there are no Beels in the Noakhali North project area. However, reports from the Thana of Faridganj included some Beels but it was not possible to verify if these records refer to a situation prior to the construction of the Chandpur Irrigation Project or if these Beels were within the project area. The total area of Beels in Faridganj was reported to be approximately 222 ha with a fish production of 131 MT. These data were not included in the analysis because they could not be confirmed. In addition, it was not possible to obtain satellite imagery for the wet and dry seasons during this project to cross check and establish the location and area of permanent Beels, if any, in the project area. Future work should include this task.

Figure F. 1.7
Nutrient Cycle

BEEL

FISH FRY
FEEDING+GROWING

KHAL

FLOODPLAIN

DISPERSAL OF FISH
INTO MAIN RIVER

ZOOPLANKTON

NUTRIENTS → PHYTOPLANKTON

NUTRIENT RICH FLOOD WATER WITH
PLANKTON, FISH LARVAE AND SPAWN

BENTHOS

PREDATORY
FISH

FISH FRY
FEEDING+GROWING

MAIN RIVER

FISH HARVESTED

DISPERSAL OF FISH INTO KHALS AND
BEELS FOR REFUGE IN DRY SEASON

KHAL

BEEL

A. PEAK FLOOD

Floodplain

SPAWN + FRY DISPERSE + GROWTH

KHAL

BEEL

B. DRY SEASON

DROP IN WATER LEVEL

POSSIBLE ROUTE FOR
DISPERSAL INTO MAIN RIVER

REFUGES FOR FISH IN DRY SEASON

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Figure F. 1.8
The Seasonal Cycle of Events in the Floodplain

| A | M | J | J | A | S | O | N | D | J | F | M |

WATER LEVEL

Level of floodplain

FLOW CONDITIONS

| SLOW | INCREASING | HIGH | THROUGH FLOW | HIGH | SLOWING | SLOW | VERY SLOW |

CONDITIONS OF PLAIN

Flooded Phase

| Dry | Inflow to Khais | Flooding increasing area | Peak flood | Drying | Water in Khais | Dry |

FISH BEHAVIOUR

Feeding and Growth of young   Dispersal

Breeding

Major species

Smaller species

Longitudinal migration   Return to river

Dispersed in permanent waters   Lateral migration   Dispersed in permanent waters

FISHING ACTIVITY

Fishing for migrants in floodplain   Fishing on floodplain

Fishing in permanent waters of floodplain and river   Fishing for migrants in river channels   Intensive fishing for juveniles fish   Fishing in river channels

VEGETATION WILD CONDITION

Terrestrial plants   Submergence of terrestrial plants   Growth of terrestrial plants

Rapid growth of floating and rooted aquatic plants   Progressive die back of aquatics as increasing areas of floodplain are exposed

CROPPING CALENDAR

T. Aman (L/LIV)

B. Aman (L)

Boro (HYV)

Mustard/Pulses

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F.1.7.5   Ponds and Borrow Pits

According to the TFOs, there are approximately 8,014 ha of cultured ponds in the Noakhali North project area as shown in Table F.1.1, and the area of culturable and derelict ponds may be in the region of 15% to 35% of that of the cultured ponds. In addition, there are numerous borrow pits which have resulted from home and road construction site excavation.

Borrow pits along road embankments may become important micro fishery environments when managed. They are owned by the Department of Roads and Highways (DRH) and are leased out for fishery purposes. Borrow pits created during the course of FCDI construction works are owned by the BWDB and are leased out for fish production by auction. Water supply to these is dependent on river overflow and rainfall, and in general, their fish resource is reliant on movements of fish on to the floodplain during the monsoon.

Fish stocks in borrow pits mostly comprise miscellaneous species which are exploited for subsistence and minor commercial sale. Katta fisheries are commonly used during the early dry season to harvest the larger species. Fish fences with basket traps or bunds often subdivide these pits which may be drained later in the season to harvest all fish. Borrow pits are affected by changes in the water supply. As they are usually only about 60 cm to 90 cm deep, those pits which are not drained intentionally will often dry out naturally by the end of the dry season.

F.1.7.6   Katta Fishery

Katta fishery can be best described as a 'fish attracting device'. It consists of a frame made out of bamboo poles with brushwood in the middle that is placed at strategic sites within a Beel or along the course of rivers and Khals (see Plate F.1.). They are usually about 0.5 to 1 ha in size and serve as valuable feeding, nursery and refuge areas for a wide variety of fish and other aquatic life such as birds, insects, molluscs, crustaceans, etc.

Katta are harvested approximately every 6 to 8 weeks by enclosing them with seine nets mainly and/or with other traditional netting, such as bag, cast, lift nets and traps (Plate F.2). The harvest period is usually from October to June in the main rivers, but the Beel season is shorter, from December to February

Plate F.1   Typical Katta Fishery - October 1992

Plate F.2   Harvest of Katta Fishery

CHAPTER F.2

BASELINE ASSESSMENT METHODOLOGY

F.2.1 Secondary Data Collection

Data collected from secondary sources have been used to evaluate the status of the existing fisheries in the area. The majority of the statistics have been obtained from the Fisheries Resources Survey System (FRSS) of the Directorate of Fisheries (DOF) sources in Dhaka. However, it is recognized that the used of these data is of limited value due to the unavailability of up to date information. The latest complete set of available figures for this study correspond to 1988-89, as riverine data for 1989-90 is missing. Furthermore, the present system has many weaknesses such as small sample sizes, very few sampling villages and a backlog of data due to insufficient processing capacity.

The FRSS was initiated in 1983-1984 to provide a more systematic approach to the collection of fisheries statistics. Prior to that, fish production estimates were based primarily on fish consumption data generated by the Nutrition Surveys of Rural Bangladesh, for the years 1962-1964, 1975-1976 and 1981-1982. This information was complemented with the results of the Household Expenditure Surveys and DOF surveys.

The floodplain fisheries of Bangladesh are extremely complex and thus, the collection of catch statistics is understandably a major task even with adequate resources. Unfortunately, in Bangladesh comprehensive fisheries surveys for project studies are not possible with the present allocated resources and therefore, the accuracy of FRSS data cannot be adequately checked. In addition, the last river fishery frame survey was carried out in 1981-82 with FAO support and the data on number of canoes gathered from this survey is still being used today, although the situation is unlikely to have remained unchanged.

A similar situation was found regarding ponds, as the pond production estimates are based on sample data of 40 sample Thanas measured by SPARRSO with infra-red aerial photography taken in February 1983 (DOF, 1983-84). Since no indication is given in the latest available Fish Catch Statistics (DOF, 1989-90) regarding pond areas, it is assumed that the same areas used in 1983-84 are still used for recent estimates without consideration to the actual state of ponds.

Trends in fish production for six years have been calculated from available FRSS catch statistics. However, their validity is questionable for the reasons mentioned above.

At present, raw data is collected by DOF personnel from sampling stations and sent to Dhaka for processing. In an attempt to obtain more up to date data, information at the Thana level was gathered directly from each Thana Fisheries Office. However, the level of detail provided by the various offices varied considerably.

F.2.2 Primary Data Collection

A short fishery survey of eight weeks duration was undertaken in an attempt to gather useful information regarding the project area in particular.

Although great care was taken at all stages of this study, it should be reiterated that this type of survey is inadequate both in terms of time and funding, to adequately describe the fisheries and to predict future changes in a complex system such as that which exists in the Noakhali North project area.

This study was carried out during the period from September 1992 to February 1993, and field data were collected during mid-October to early December 1992. Fishing patterns, gears used and operators were addressed for each type of capture fishery system. Unpublished data from the TFOs were used for estimations of pond fish production.

Unfortunately, the results from this short field study cannot be crossed checked with existing data from the DOF (1983-84 to 1989-90) as their data for the last 3 years is not yet available. Furthermore, given that this catch assessment survey was carried out in collaboration with the local fishermen, most likely to be full time and part time fishermen, the recorded catches are assumed to be commercial catches, whereas those reported by DOF are for subsistence household fisheries. Subsistence fishing is defined in this report as being carried out by people who directly catch and consume "common good" fish resources for a large proportion of the animal protein in their diet and who are mostly landless and poor.

However, a benchmark has been set for the assessment of the impacts and subsequent monitoring of the fisheries resources of the Noakhali North project area.

F.2.3   Fisheries Impact Assessment Methodology

The FPCO Guidelines for Environmental Impact Assessment recommend that for Feasibility Studies 'detailed investigations entailing data collection and consideration of seasonal cycles should be undertaken.' However, as stated earlier, timing and funding of the present study were grossly under resourced to comply with the basic requirements for ecological and/or biological cycles to be taken into account. Nevertheless, these guidelines were used in the present study where possible and were organized as follows:

F.2.3.1   Catch Assessment Survey

The emphasis of the catch assessment survey was placed on the capture floodplain fisheries and thus data were collected for some Khals and sections of rivers within the project area. The FRSS catch assessment forms were used to record leasing arrangements and fish catches in the area.

F.2.3.2   Thana Fisheries Survey

All Thanas Fisheries Offices in the project area were requested to provide information on the number of fishermen and categories of operation, i.e. full-time, part-time, occasional (FAO/UN, 1962). Additional information resulting from this survey includes fish production estimates, dominant species caught per Thana, fish species occurring in the area, fisheries developments and main problems related to fisheries in each Thana. Figure F.2.1 shows the Administrative boundaries at the District, Thana and Union level.

Legend :

■	Thana H.Q.
■	District H.Q.
•	Other Important Places

River
Khal

Railway
Road
Project Boundary
International Boundary
Embankment
District Boundary
Thana Boundary
Union Boundary

Scale: 0   5   10 km

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CHANDPUR
IRRIGATION
PROJECT

MECHNA RIVER

CHANDPUR
HAIMCHAR
FARIDGANJ
RAIPUR
RAMGANJ
HAJIGANJ
SHAHRASTI
CHITOSHI
GHATCHIL
KACHUA
LAKSHAM
NANGALKOT
CHAUDDAGRAM
FENI
SONAGAZI
DAGAN BHUIYAN
COMPANIGANJ
UTTAR SAHAPUR
ENBAG
KABIRHAT
KALAMUNSHI HAT
UTTAR NAMCHI
NOAKHALI
CHAUMUHANI
BEGUMGANJ
CHAN RAGANJ
BATTALI
DASUR HAK
MANDARI
LAKSHMIPUR

RAHMATKHALI
REGULATOR

KAZIRHAT
REGULATOR

OLD COASTAL
EMBANKMENT

CROSS DAM Nr 2

CROSS DAM Nr 1

F.2.3.3 Fish Market Survey

Twelve fish markets in Planning Zones A, B, C and D were surveyed during the same field visit as for the catch assessment (see Figure F.2.2). This has allowed for some fish price analyses and fish availability levels to be detected as well as the type of operators.

F.2.3.4 Agro-Socio-Economic Survey

This survey was carried out by the agro-socio-economic team, to establish the typology of fishing operators. Three surveys relevant to fisheries included a) fish pond, b) fishermen and c) farmers questionnaires. Details of the surveys are presented in Annex J.

F.2.3.5 Fish Pond Production

Data on pond production was also collected through the agro-socio-economic survey, along with published statistics from FRSS and unpublished data from the TFO.

F.2.3.6 Hatcheries and Nurseries

Information on hatcheries and nurseries in the area was gathered from secondary sources, mainly FRSS, and Thana Fisheries Offices.

F.2.3.7 Public Participation Meetings

Public participation meetings were also held at the village level. Proposed project development strategies and options were discussed with fishermen and local people in relevant areas. Details of these meetings can be found in Annex G.

F.2.4 Sampling Programme

Four sampling sites (N1 to N4) were selected in the main floodplain area (Figure F.2.3) of the Noakhali North project area, which includes Zones A, B, C and D. Field visits had a duration of 4 days during which information on fish catch was collected.

F.2.5 The Use of the MIKE 11 Hydraulic Model for Estimating Impacts on Fish Production

The analysis of the potential impacts on the fisheries of the Noakhali North project area relied heavily on the results provided by the MIKE 11 hydraulic model, which provides a simulation of water levels and discharges at particular nodes in the schematisation of the river system in response to a set of boundary conditions which effectively comprise upstream flows and downstream water level controls.

Fish Systems and Sampling Sites

Figure F.2.3
Sampling Sites and Planning Zones

For the analyses of fisheries impacts, the minimum water level in three values per decad (10 day period) were used. As the focus of the fisheries component was placed strongly on open water capture fisheries, i.e. the floodplain, it was decided to aggregate all water levels greater that the MPO Flood Phase F0 (30cm). The hydraulic model results were mapped to provide a spatial distribution to changes in the extent and duration of the floods in the Noakhali North study area. Model runs were carried out for a 1 in 2 year flood (a mean or 'normal' year) from a 25 year period of record. Results of the rising and falling 1 in 2 year flood patterns are shown in Figures F.2.4 and F.2.5.

Model results clearly indicate that approximately 45 % of the project area is under water during the wet season. These conditions remain fairly constant for approximately two to three months, after which the basin drains quite rapidly. However, in addition to the peak flood attained, the timing, rise and duration of the flooding are very important factors influencing the environment, and particularly, the fisheries.

In terms of seasonality, the model showed that there are three main periods:

Pre-monsoon - April to June: There is a rapid rise in the water level. Early spawning migration, breeding and first stage development of fish eggs and larvae takes place.

Monsoon - July to late September: Main river water reaches peak levels and there is prolonged flooding partly due to backing up from the main rivers and reduced gradients for local rainfall.

Post-monsoon - late September to November : Drainage occurs.

In addition to these flood periods, the general categories under which flooding in the project area can be considered are:

-   Flash floods from those rivers rising in the Tripura Hills (India) to the east of the region (minor)
-   Flooding as a result of heavy and intense rainfall (major)
-   Floods resulting from storm surges in the Bay of Bengal (minor)

Details of the model are provided in full in the Hydrology Annex B.

The model was run for without (WO) and with project (WI) scenarios.

Figure F.2.4
Extent of Rising Flood, 1 in 2 Year

Figure F.2.5
Extent of Falling Flood, 1 in 2 Year

CHAPTER F.3

FISHERIES PRODUCTION IN THE NOAKHALI NORTH PROJECT AREA

F.3   Fisheries Production in the Noakhali North Project Area

Fish production in the Thanas within the Noakhali North Project Area has been estimated from unpublished data for 1991-92 from the Thana Fisheries Offices (TFO).   Table 3.1 shows the catches for 1991-92 and the corresponding dominant species in the catch per Thana.   The combined total catch of the eleven Thanas was 43,299 MT which was made up mainly by cultured fisheries (73%) and the remaining 27% from capture fisheries.   The contribution of the Thana catch to the project area was 18,510 MT but it should be noted that this figure includes capture and culture fisheries.   Of this yield the largest proportion corresponded to Begumganj with 28% (5,238 MT), although the entire catch was reportedly from ponds.   The Thana which contributed the lowest proportion to the project area was Ramgati but this is not surprising since only 5% of this Thana is within the study area.

Table F3.2 shows the area and production of ponds by Thana and, by proportion, the production in the project area. This suggests that just 19% of the Thana catch is from capture fisheries and 81% from pond fishereis.

Overall, the major carps dominated the catch with Rui, Migral and Catla yields representing approximately 12% of the catch each.   Punti, Koi and Small Shrimps contributed over 6% to the total catch.   The rest of the catch was made up of a wide variety of species (38 species, including 3 types of shrimp).   It can only be assumed that most of the major carps reported for this area may be coming from ponds and that it is possible that the catch for small species goes unrecorded being consumed by occasional fishermen.

F.3.1   Fish Production per Thana

A summary of the annual fish production reported by the eleven Thanas within the project area during 1991-92 is given below:

Lakshmipur

Overall, the annual fish production in Lakshmipur for the year 1991-92 was reported to be 1,040 MT of which nearly 43% came from open water fisheries.   The actual contribution of this catch to the project area was 738 MT.   Carps dominated the catch contributing 61% of the total yield, among which, Rui *Labeo rohita* constituted 15% (111 MT).   Among the minor carps *Puntius* spp. contributed 8% (59 MT).

Chatkhil

The annual catch for the Thana of Chatkhil was 3,451 MT, of which 24% (825 MT) was comprised by floodplain fisheries.   Punti was the largest catch representing 20% (690 MT) of the total yield.   In general, the major carps contributed 55% to the total production (1,900 MT) as the catch was dominated by Rui, Catla and Bighead which contributed 15% each to the total production.

TABLE F.3.1

Catch Species Composition in MT by Thana in the Noakhali North Project Area During 1991-92

Name of fisheries	Lakshmipur	Chatkhil	Ramganj	Begumganj	Sudharam	Senbagh	Ramgati	Laksham	Shahrasti	Faridganj	Hajiganj	Total Catch (MT)
Rui	111	518	290	367	180	65	0	78	443	100	148	2299
Catla	74	518	217	471	60	115	0	87	295	50	148	2036
Mrigal	74	173	290	943	60	65	0	87	369	25	148	2232
Kalbaus	7	0	0	0	0	0	0	0	74	5	0	86
Silver Carp	59	173	145	236	0	46	0	104	74	75	0	911
Bighead	74	518	72	733	120	23	0	87	44	60	0	1732
Common Carp	37	0	14	105	0	9	0	52	74	10	0	301
Grass Carp	7	0	0	0	0	0	0	0	0	5	0	12
Mirror Carp	15	0	7	0	0	0	0	0	0	10	0	32
Punti	59	690	72	367	60	0	0	0	0	25	0	1274
Carps	0	0	0	0	0	0	76	0	0	0	0	76
Shol	37	0	14	105	60	2	2	0	0	25	296	539
Gazar	0	0	7	105	24	2	2	0	0	25	148	311
Taki	37	0	43	0	0	0	0	0	0	0	0	80
Boal	0	0	0	0	0	0	0	0	0	0	444	444
Aire	0	0	0	0	0	0	0	0	0	0	0	0
Tengra	15	0	43	236	60	0	3	17	0	0	0	375
Shinghi	18	173	72	236	60	9	2	52	0	18	0	640
Magur	18	173	14	210	0	9	2	26	0	18	0	469
Catfishes	0	0	0	0	0	0	0	0	44	0	0	44
Koi	22	345	72	236	96	14	0	52	0	38	296	1171
Colisha	0	0	0	157	0	0	0	0	0	0	0	157
Tilapia	37	0	29	0	0	0	0	61	30	0	0	156
Hilsha	0	0	0	0	120	0	67	0	0	0	0	188
Poa	0	0	0	0	0	0	8	0	0	0	0	8
Pangaus	0	0	0	0	0	0	2	0	0	0	0	2
Shilon	0	0	0	0	0	0	2	0	0	0	0	2
Coral	0	0	0	0	60	0	0	0	0	0	0	60
Iloi	0	0	0	0	0	0	0	0	0	0	0	0
Mola	0	173	0	0	0	0	0	0	0	0	0	173
Mudskeeper	0	0	0	0	120	0	0	0	0	0	0	120
Others	37	0	43	105	60	83	3	0	30	13	0	374
Ruti	0	0	0	0	0	23	0	0	0	0	0	23
Baim	0	0	0	0	0	0	0	0	0	0	296	296
Phali	0	0	0	0	0	0	0	0	0	0	148	148
Small Shrimp	0	0	130	471	0	0	0	104	0	0	444	1150
Big Shrimp (Golda)	0	0	43	157	30	0	0	0	0	0	444	674
Bagda Shrimp	0	0	0	0	30	0	0	61	0	0	0	91
Total Catch (MT)	738	3451	1449	5238	1203	461	168	868	1476	501	2957	18510

B:\Noakhali Fisheries\tabf31

TABLE F.3.2

Area and Production of Ponds in Noakhali

Thana -	Area (ha)	Production (MT)	Area in Project (ha)	Production within Project (MT)
Hajiganj -	2003	6991	741	2586
Sharasti -	1874	2173	656	761
Faridganj -	1434	3842	129	346
Senbag - 1	537	950	204	361
Ramgati -	1298	1600	65	80
Ramganj -	445	2000	307	1380
Sudharam -	2149	3654	408	694
Begumganj - 1	3674	5400	3564	5238
Chatkil	905	2626	878	2548
Laksam	1317	1780	435	588
Lakshmipur Sadar	883	595	627	422
	16519	31611	8014	15004

Zone	Area (ha)	Prod (MT)
A	692	502
B	2292	3,494
C	2323	4,073
D	2707	6,935
	8014	15,004

Average Production level for all thanas = 1914 Kg/ha.

Average Production level for all Thanas within the project = 1872 Kg/ha.

Ramganj

The annual catch for Ramganj was 2,100 MT, of which only about 5% came from the open water fisheries. The contribution from this catch to the project area was estimated to be 1,449 MT. Rui, Mrigal and Catla were the dominant species in the catch contributing 20% and 15% to the catch (290 MT).

Begumganj

The total annual fish catch from Begumganj Thana was reported to be 5,400 MT resulting entirely from culture fisheries, of which 97% (5,238 MT) were within the project area. Carps were the dominant group comprising 55% (2,855 MT) of the total production. The bottom dwelling Mrigal *Cirrhinus mrigala* was found to be the dominant species contributing nearly 20% to the production (943 MT). Catfishes and Small Shrimps were also important.

Sudharam

The total fish catch in the Thana of Sudharam was reported to be 6,331 MT, with 42% (3,654 MT) coming from open water fisheries and 19% of this catch (1,203 MT) being contributed by the project area. Rui was found to be the dominant species with a production of 180 MT (15%) and Hilsha amounted to 120 MT within the project area.

Senbagh

The total annual fish catch in the Thana of Senbagh was 1,213 MT, with ponds, canals and floodplains producing 950, 90 and 173 MT of fish respectively. The actual amount contributed to the catch within the project area being 461 MT. The surface feeder *Catla catla* was the dominant species contributing 25% (115 MT) to the catch within the project.

Ramgati

Overall, the annual catch in the Thana of Ramgati amounted to 3,363 MT of fish in 1991-92 with over 52% coming from open water fisheries. The contribution of the Thana catch to the project area was only 5%. Hilsa was the dominant species amounting to 40% of total production.

Laksham

The Thana of Laksham yielded 2,630 MT of fish in 1991-92, with ponds producing 1,980 MT (68%) whereas rivers and canals produced 850 MT (32%). The actual contribution to the project area was 868 MT. The bulk of the catch was made up by Silver Carp and Small Shrimps amounting to 12% of the total annual catch each.

Sharasti

The total catch in Sharasti was 4,218 MT, with ponds producing 2,173 MT and the open waters yielding 2,045 MT. The actual contribution of the Thana catch to the project area was 1,476 MT with Rui being the dominant species contributing forming 30% to the annual production.

Faridganj

The Thana of Faridganj reported an annual catch of 5,562 MT, with 3,842 MT coming from ponds, whereas the fish production from rivers was reportedly 1,589 MT. Overall, the contribution of open water fisheries was 31% (1,720 MT) with an actual contribution to the project area of approximately 500 MT. Catla dominated the catch.

Hajiganj

The annual production of Hajiganj was found to be 7,991 MT, ponds yielding over 87% (6,991 MT) of fish and open water fisheries producing 1,000 MT. The actual catch contributed by the project area was 2,957 MT with Small and Big Shrimps being the major contributors to the catch.

F.3.2   Fisheries Development Programmes at Thana Level

According to the Thana Fishereis Office survey carried out during this study, there are 8 development programmes under the Second ADB Programme and the Thanas were these are being carried out are shown in Table F.3.3. In contrast, there are only 3 programmes being developed under the Thana Parishad and these are in Chatkil, Begumganj and Senbag. Chatkil and Faridganj reported NGO involvement in their Thanas.

Thana fisheries personnel include one Thana Fisheries Officer, one Assistant Thana Fisheries Officer and one Field Assistant. An office assistant provides support to these officers. In addition, there may be a Thana Rural Development Officer (TRDO), a Thana level section of BRDB which also initiates fisheries activities through several landless and fishermen groups in each Thana.

F.3.3   Problems Related to Fisheries at Thana Level

The main problems related to fisheries according to the Thana Fisheries Offices were the lack of funding for fisheries developments and multiple ownership of ponds as shown in Table F.3.4. Neither of these two problems are surprising given that the area is relatively well developed as far as pond culture is concerned. Other reported problems of note were the lack of extension services and the execution of the Fish Act. The Thanas which reported most problems were Sudharam and Sharasti, while those that reported the least problems were Senbag and Laksham.

Interestingly, those Thanas which reported weeds in rivers also reported fish diseases, the latter have already been linked to the lack of water exchange and oxygenation. Clogging of the water bodies by aquatic plants may also result in stress for the fish which in turn is believed to encourage disease.

TABLE F.3.3

Fisheries Development Programme By Thana In the Noakhali North Project Area

Name of Thana	Development Programme Under Thana Parishad	Development Programme Under 2nd ADB	Other/NGO
Lakshmipur		√	
Chatkhil	√	√	√
Ramganj		√	
Begumganj	√	√	
Sudharam			
Senbagh	√	√	
Ramgati		√	
Laksham		√	
Shahrasti			
Faridganj		√	√
Hajiganj			

Source: Thana Fisheries Office Survey carried out during this study

TABLE F.3.4

Fisheries Problems According To The Thana Fisheries Offices

Name of Thana	Lack of Extension Services	Weeds in River	Lack of Hatcheries	Lack of Funding	Lack of Transport Facilities	Multiple ownership of Pond	Disease	Execution of the Fish Act
Lakshmipur	√			√		√		√
Chatkhil			√	√	√	√		
Ramganj	√			√		√		√
Begumganj	√			√		√		√
Sudharam	√		√	√		√		√
Senbagh						√		√
Ramgati			√	√	√			
Laksham	√					√		
Shahrasti		√	√	√		√	√	
Faridganj		√		√			√	
Hajiganj		√		√		√	√	

Source: Thana Fisheries Office Survey carried out during this study

Fisheries problems reported during the public participation meetings are shown in Table F.3.5, and it can be seen that the problems are similar. Further problems reported by Lakshmipur included blockage by the regulator, shortage of water and lack of fingerling availability.

TABLE F.3.5

Fisheries Problems Reported During the Public Participation Meetings In The Noakhali North Project Area

Meeting Villages	Problems in Fisheries							
	Blockages by Regulator	Lack of Funding	Lack of Extension Services	Shortage of Water	Flooding	Multiple ownership of Ponds	Non Availability of Fingerling	Disease
Char Mansha Lakshmipur				√			√	
Dighali Lakshmipur	√		√				√	
Binod Dharmapur Lakshmipur			√				√	
Shakchar Lakshmipur					√			
Hasanpur Lakshmipur			√	√				√
Nayakhola Noakhali							√	
Rampur Lakshmipur							√	
Hatgoan Begumganj			√					
Darbeshpur Ramganj			√			√		√
Pearatali Laksham		√	√					
Chandpur Shaharasti		√	√			√		

Source: Public participation meetings carried out during this study

F.3.4   Hatcheries and Nurseries per Thana in the Noakhali North project Area

Table F.3.6 shows the number of hatcheries and nurseries per Thana in the project area. Clearly, the existing hatcheries are concentrated in the Thanas of Laksham, Begumganj, and Lakshmipur with private hatcheries outnumbering public ones both in number of hatcheries and in production.

A similar situation can be seen regarding nurseries where public ones amount to only 8 whereas private ones total 304. The production of the public nurseries is less than 4% of that from the private sector. Fingerlings produced are mainly carp, however, some nurseries are also producing Sar Punti and African Magur fingerlings. These nurseries have the capacity of producing 100 million fingerlings per year.

TABLE F.3.6

Number Of Fish Hatcheries, Nurseries And Their
Production By Thanas In The Noakhali North Project Area

Name of Thana	Number of Hatcheries				Number of Nurseries			
	Public	Production in kg	Private	Production in kg	Public	Fingerling Production in Lacs	Private	Fingerling Production in Lacs
Lakshmipur	1	50	5	419	-	-	37	51
Chatkhil	-	-	-	-	-	-	17	24
Ramganj	-	-	-	-	-	-	12	90
Begumganj	1	54	7	233	6	25	68	224
Sudharam	-	-	-	-	-	-	34	71
Senbagh	-	-	-	-	-	-	17	20
Ramgati	-	-	-	-	-	-	10	25
Laksham	1	20	12	750	1	1	73	165
Shahrasti	-	-	-	-	-	-	12	28
Faridganj	-	-	2	128	1	10	14	140
Hajiganj	-	-	-	-	-	-	13	133
Total	3	124	26	1530	8	36	304	971

Source: Thana Fisheries Office survey carried out during this study

F.3.5 NGO Fisheries Programmes

A number of NGOs both national and foreign are involved in fisheries activities in the project area. Some of these include MCC, Comilla Proshika, BRAC, the Grameen Bank, Ghandi Assaram, CARE, Bandhan, Dishari and CODEK. Table F 3.7 shows details of these NGOs.

TABLE F.3.7

Names and Areas of Operation of the NGOs Involved in Fisheries Activities Within the Noakhali North Project Area

Name of NGOs	Area of Operation
CARE	All Thanas
Grameen Bank	All Thanas
M.C.C	Begumganj, Sudharam, Lakshmipur
Rural Development Foundation	Laksham
Seba Manobik Unnayan	Laksham
Gandhi, Ashram	Chatkhil, Begumganj
Bandhan	Noakhali Sadar
Dishari	Sudharam, Ramgati
Sagorika Samaj	
Unnayan Sanstha	Sudharam
Codek - Ramgati	Ramgati
Sepiret	Lakshmipur, Ramganj.

CHAPTER F.4

CATCH ASSESSMENT SURVEY FINDINGS

F.4.1   Introduction

As stated earlier, the aims of the catch assessment survey were to provide baseline data on the capture floodplain fisheries in the study area by zone. The field study was carried out during the period from mid October to the beginning of December 1992.

The results of the catch assessment survey are presented in Table F.4.1 and they show that the combined catch recorded over 4 days (observed catch during sampled day plus 3-day recall data from fishermen) for all zones in the Noakhali North study area in the eight-week period was over 23 MT, of which 12.7 MT are attributed to Zone A, 1.7 MT to Zone B, a meagre 0.3 MT to Zone C and the remaining 7.5 MT to Zone D. The higher catches in Zones A and D can be explained on the basis that because 1992 was an extremely dry year, fish were concentrated in the larger permanent water bodies such as the Dakatia and Rahmatkhali Khal. More than half the catch in Zone A (8.6 MT) was observed downstream of the Rahmatkhali regulator and it provides an indication of the potential fish catch that might have entered the system had the gates in the existing regulator been more suitable for fish. In addition, the apparently high catch observed in the Rahmatkhali Khal just upstream of the regulator (4 MT), may well be a result of a 'crowding' effect since the floodplain during 1992 was virtually non-existent and fish were forced to remain in the deeper parts of the channels.

The largest single 4-day catch (2 MT) was recorded on the Meghna River, which was not surprising since this river is one of the most productive in the country. This catch was observed towards the end of October.

F.4.2   Calculation of Fish Production from Catch Data

Data resulting from this survey have been analyzed in more detail in order to attempt to estimate total fish production in the project area. To do this, actual catch observed on the sampled day per system (rivers and Khals) were analyzed in relation to fishing gears for each Zone. In an attempt to reduce the margin of error, information on the catch reported over a 4-day period was not used, as it included recall data over the previous three days. The mean number of days that a particular fishing gear was used in the Noakhali North project area was calculated from the catch assessment questionnaires and was used for the analyses.

Thus:

$$P = \frac{\text{catch on sample day/area surveyed}}{\text{total area of system}} \times \text{No days per fishing gear}$$

This procedure was followed for each zone, fishing system and gear. In addition, it was decided to analyse the katta catches separately as they were fairly high. Katta catches were only recorded in Zone D and were further isolated and analyzed for the relevant gears. Results were incorporated to the estimated total catch for each zone (Table F.4.2).

TABLE F.4.1

Catch in the Noakhali North Study Area Over a Period of 4 Days

Total Catch (Kg) in Zone A per Week

Zone : A

Week	Meghna River			Rahmatkhali Khal		
	Other	Kata	Total	Other	Kata	Total
W1	644.00		644.00			
W2	2130.00		2130.00			
W3	1150.00		1150.00	414.00		414.00
W4	1447.00		1447.00	682.00		682.00
W5	619.00		619.00	531.00		531.00
W6	1170.00		1170.00	953.00		953.00
W7	691.00		691.00	683.00		683.00
W8	779.00		779.00	833.00		833.00
Total	8630.00		8630.00	4096.00		4096.00

Total Catch (Kg) in Zone B per Week

Zone : B

Week	Baskhali Khal			Wapda Khal			Kata Khal			Jadumundi Khal		
	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total
W1												
W2												
W3							106.00		106.00			
W5										304.00		304.00
W6							224.50		224.50			
W7												
W8	111.50		111.50	188.00		188.00						
Total	111.50		111.50	188.00		188.00	330.50		330.50	304.00		304.00

Total Catch (Kg) in Zone B per Week

Zone : B

Week	Dabipur Khal			Atiabari Khal			Cowmuhoni Khal			Tulatuli Khal		
	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total
W1							102.00		102.00			
W2				76.50		76.50				66.00		66.00
W3												
W5	137.50		137.50									
W6												
W7												
W8												
Total	137.50		137.50	76.50		76.50	102.00		102.00	66.00		66.00

Total Catch (Kg) in Zone B per Week

Zone : B

Week	Kalamunshir Khal		
	Other	Kata	Total
W1			
W2			
W3			
W5	178.00		178.00
W6	256.00		256.00
W7			
W8			
Total	434.00		434.00

(continued)

TABLE F.4.1 (Contd.)

Catch in the Noakhali North Study Area Over a Period of 4 Days

Total Catch (Kg) in Zone C per Week

Zone : C

Week	Sonaimuri Khal			Zazaria Khal		
	Other	Kata	Total	Other	Kata	Total
W1				192.40		192.40
W4	107.50		107.50			
Total	107.50		107.50	192.40		192.40

Total Catch (Kg) in Zone D per Week

Zone : D

Week	Wabda/Sonaimuri Khal			Noadona/Bakesganj Khal			Panchgao Khal			Dakatia/Noadona River		
	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total
W1												
W2	10.50		10.50									
W3							89		89			
W4										473.70	556.00	1029.70
W5				753		753						
W6										888	243	1131
W7				129.00		129.00					461.50	461.50
W8										111.00	475.00	586.00
Total	10.50		10.50	882.00		882.00	89.00		89.00	1472.70	1735.50	3208.20

Zone : D

Week	Bighanondi Khal			Shonapur Khal			Boaljori Khal			Dakatia River		
	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total	Other	Kata	Total
W1											457.00	457.00
W2							68.00		68.00			
W3				52.00		52.00						
W4											259.00	259.00
W5											311	311
W6	191.50		191.50									
W7										104.00	671.00	775.00
W8											1230.50	1230.50
Total	191.50		191.50	52.00		52.00	68.00		68.00	104.00	2928.50	3032.50

F.4.3 Estimated Catch per Zone per Fishing System Sampled

From Table F.4.2 it can be seen that Zone A had the largest catches (28.9 MT) with approximately 92% coming from the Meghna River and nearly 8% from Rahmatkhali Khal. The riverine catch from Zone D was also important contributing 85% to the total catch in that zone. In addition, approximately 50% of the riverine catch was harvested from Katta fishing. The catches in Zones B and C were fairly poor and may be explained on the grounds of the very limited floodplain during the year end or possible to poor enumerator procedure. It may also be pointed out that these catches tender to confirm the Thana information.

F.4.4 Production Levels from Thana Catch

Given that 1992, the year when this study's short fishery survey was carried out, was an unusually dry year and the floodplain in the Noakhali North project area was nearly non-existent resulting in extremely low catches, the Thana catch for 1991-92 reported in the Thana Fisheries Office survey has been used to provide an indication of more 'normal' yields in the study area. For this analysis, only the catch from open waters within the project area was used and was related to the area of floodplain estimated from the output of the MIKE 11 hydraulic model (Table F.4.3). Since the Thana catch was expected to only represent the subsistence catch in accordance with the rest of the DOF statistics, these were adjusted to include the commercial catch as reported by FAP 17 (FAP 17, 1993). This resulted in a production level of 109 kg/ha.

F.4.5 Estimated Production Levels from Catch Data

Production levels per system surveyed (internal rivers and Khals) per zone were calculated and are shown in Table F.4.2. The production levels in Zone A were the highest, although it must be pointed out that it was extremely difficult to attempt to evaluate the catch from the Meghna River. For this reason and also because the Meghna river is outside, and separated from, the project area those results were not included in the analysis. Also the project intervention is most unlikely to affect the Meghna catch. Overall, the floodplain (which included internal rivers/Khals and all land flooded to a depth greater than 30 cm) production was estimated to be 33.5 Kg/ha over an area of peak floodplain of 74,000 ha. However, as it has been mentioned previously, during 1992, when these data were collected, there was very little floodplain and thus, the area of floodplain was assumed to represent at most 30% of a 'normal' year, which was considered a more realistic situation. The resulting production level of 112 Kg/ha compared very favourably with that from the Thana catch which was 109 Kg/ha. Therefore for the purpose of the impact analysis, a production level of 110 Kg/ha for the floodplain was utilised. Since internal rivers and Khals are components of the floodplain, the same figure was used for these systems.

F.4.6 Estimated Fish Production in the Noakhali North Project Area

Fish production in the project area was also calculated using national production levels (provided by FAP 17 based on DOF data, 1988-89) and compared with production levels calculated in this study.

Table F.4.4 shows that when using national production levels, the estimated annual capture fisheries production in the Noakhali North project area amounts to 7,228 MT with the largest catch corresponding to Zone D. Pond production appears to be relatively low in Zone A but similar in the other three zones, amounting to 8,455 MT per year. Overall, estimated production including ponds totalled 15,682 MT.

TABLE F.4.2

Estimated Catch and Production Levels in Noakhali North per Fishing System Sampled

Fish Catch per Zone with Main Fishing Gears in Various Habitats in Noakhali North

	Catch per day per Gear per Habitat									Production
	Gill Net	Seine Net	Lift Net	Katta	Bag Net	Cast Net	Clap Net	Traps	Total	Kg/ha
Zone A										
River	254	143			34	8.5		18.75	458.3	0.08
Khal	34.5	124	204		47			31	440.5	2
Zone B										
River										
Khal	10	7.6	51			8		20	96.6	0.37
Zone C										
River										
Khal		23	14.5						37.5	0.17
Zone D										
River		189	87	488	41				805.0	1.36
Khal	5	30	57.3			5			97.3	0.20

Production Estimates Considering the Number of Days Fished by Gear, in each Fishing System										
	Gill Net	Seine Net	Lift Net	Katta*	Bag Net	Cast Net	Clap Net	Traps	Total	Kg/ha
Zone A										
River	16,085,312	7,357,922			1,614,864	538,288		1,113,188	26,709,574	4,499
Khal	190,834	557,291	1,128,411		194,983			160,757	2,232,277	9,224
								Subtotal	28,941,851	4,684
Zone B										
Khal	6,400	3,952	32,640			5,120		12,000	60,112	228
Zone C										
Khal		30,715	23,833						54,548	241
Zone D										
River		202,703	114,840		40,590				358,133	603
Khal	7,040	34,320	80,678			7,040			129,078	267
								Subtotal	487,211	452

* Excludes Katta Fishing

Zone D – Katta Fishing with Seine and Lift Nets over 90 Days					Production		Total	Production
	Seine Net	Lift Net		Subtotal	Level Kg/ha			Kg/ha
River	268,043	94,298		362,340	610		720,473	1,213
					Total Zone D		849,551	788
				Including Rahmatkhali Khal but excluding Meghna.	Grand Total 1		3,196,488	1,766
				Excluding the Dakatia and Meghna	Grand Total 2		2,476,016	2,036
				Including Meghna River	Grand Total 3		29,906,062	3,860

Calculation of Floodplain Production Farm Catch Data:

Flood Plain	Flood Plain Production (Kg/ha)	
Area (ha)	Excluding Meghna	Excluding Meghna and Dakatia River
73,984	43.21	33.47

TABLE F.4.3

Capture Fish Production per Thana in the Noakhali North Study Area in 1991

| Thana | Total Capture Fish Production | | | Fish Production per Zone (Tons) | | | | |
	Reported	Adjusted*	per ha	A	B	C	D	Total
Lakshmipur	445.00	1023.50	27.00	441	0	149	137	2223
Ramganj	100.00	230.00	20.67	0	0	0	160	511
Ramgati	1763.00	4054.90	96.77	188	0	0	0	6103
Sudharam	2677.00	6157.10	96.26	231	1028	6	0	10195
Senbag	263.00	604.90	48.43	0	57	172	0	1145
Chatkhil	825.00	1897.50	188.65	0	0	406	1446	4763
Begumganj	0.00	0.00	0.00	0	0	0	0	0
Chandpur	0.00	0.00	0.00	0	0	0	0	0
Hajiganj	1000.00	2300.00	157.52	0	0	0	717	4175
Faridganj	1720.00	3956.00	227.75	0	0	0	375	6279
Shahrasti	2045.00	4703.50	388.69	0	0	0	1947	9084
Laksham	850.00	1955.00	60.00	0	0	0	662	3527
Total	11688.00	26882.40		860	1085	733	5444	46692
Per ha of NCA in Kg/ha				37	51	33	128	–
in"Production level kg/ha				3556	64	55	124	3675

(Including Int Rivers/Khals
and Floodplain)

* Adjustment = Reported x 152/66
where 152 kg/ha= FAP 17 estimated national average floodplain production
and 66 kg/kha = DOF estimated national average floodplain production.

TABLE F.4.4

Fish Production per Zone in MT in the Noakhali North Study Area
Using National Production Levels for 1988-89

Fishery System	Zones (MT)				Production per	
	A	B	C	D	Total System	(Kg/ha)
Meghna River	1,045	0	0	1,061	2,106	176
Dakatia River	0	0	0	105	105	176
Int Rivers & Khals	43	46	40	85	214	176
Floodplains*	0	1,105	864	2,834	4,803	66
Subtotal	1,088	1,151	904	4,085	7,228	
Ponds#	730	2,418	2,451	2,856	8,455	1,055
Total	1,818	3,569	3,355	6,941	15,682	

* Area calculated from the MIKE 11 hydraulic model

Using the production levels for floodplain estimated during this study (110 Kg/ha) and the average pond production levels reported by the TFO (1,914 kg/ha), the results are very different. The overall estimated fish production in the Noakhali North project area including ponds was 25,688 MT in a total area of water bodies of 94,560 ha, which includes a portion of the Meghna River, resulting in a production level of 272 Kg/ha (Table F.4.5). If only capture fisheries are considered, the estimated total production is 10,349 MT (including lower Meghna catch) over an area of 86,546 ha, resulting in a production level of 120 Kg/ha. These levels of production are comparable to other yields reported for other tropical countries (Lowe-McConnell, 1987).

In general, the production in Zones A, B and C was similar but they were approximately one third of the catch in Zone D. The higher production in the Dakatia River in believed to be a direct result of better access for fish to the floodplain in the project area. As mentioned in Sections F.4.2 and F.4.4, the catches outside the regulator in Rahmatkhali Khal were the highest, providing an indication of the potential for increased fish production within the project area if the gates in the regulator were to be re-designed and allowances made for fish to enter the area more freely and timely.

F.4.7   Catch Species Composition in the Noakhali North Project Area

Of the 260 species of freshwater fish reported for Bangladesh, approximately 30 (11.5%) were observed in the catches in the study area. However, a preliminary list of species occurring in the area compiled from the catch surveys and fishermen's reports amounted to 76 species which represent nearly 30% of the fish species reported for the country. Appendix F.3 shows the preliminary list of fish and prawn species occurring in the Noakhali North project area.

TABLE F.4.5

Fish Production per Zone in MT in the Noakhali North Study Area
Using Production Levels Estimated During this Study

Fishery System	Zones (MT)				Production per	
	A	B	C	D	Total System	(Kg/ha)
Meghna River	1,045	0	0	1,061	2,106	176 #
Dakatia River	0	0	0	105	105	176 #
Int Rivers & Khals	27	29	25	53	134	110 *
Floodplains	0	1,841	1,441	4,723	8,004	110 *
Subtotal	1,072	1,870	1,466	5,942	10,349	
Ponds@	1,324	4,387	4,446	5,181	15,339	1,914@
Total	2,396	6,257	5,912	11,123	25,688	

\#   Production level estimated by FAP 17 based on DOF data for 1988-89

*   Production level estimated from this study's catch assessment and Thana surveys (1991 and 1992

@   Average Pond Production from Thana Fisheries Office Survey. Includes 'Cultured' Ponds only

Tables F.4.6, F.4.7, F.4.8 and F.4.9 show the catch species composition in each of the fishing systems per zone. In general, more species were recorded in Zones A and D than in Zones B and C, which was not surprising given that the main access routes for fish to the project area are in these zones. An interesting finding was the similarity in the number of species upstream and downstream of the Rahmatkhali regulator. The highest catch in this zone was for Hilsa, but again, this was expected since this migratory fish makes a large contribution to the catch at the national level.

In Zone B, Small Shrimps and Punti were the dominant species contributing approximately 14% to the total observed catch in the zone. In Zone C, the catch overall was fairly poor and it is not easy to determine if it was due to the extremely limited floodplain which existed during the year or to a weakness in the sampling procedure. In Zone D, the total number of species observed was 28, with a very similar number in rivers and Khals. The main difference were the major carps which were recorded in the Dakatia but not in the Khals within the zone. Obviously these migratory species were able to enter the river but were not able to disperse in the floodplain this year.

TABLE F.4.6

Total Catch of Species in Kg by Zone

Zone : A

Species	River		Canal/Khal		Total	
	Kg	%	Kg	%	Kg	%
Ruhi	30.00	1.21	55.00	5.11	85.00	2.40
Catla	29.00	1.17	41.50	3.85	70.50	1.99
Mrigal	25.00	1.01	20.00	1.86	45.00	1.27
Kalbasu	41.00	1.66	60.50	5.62	101.50	2.86
Ghainna	4.00	0.16	5.00	0.46	9.00	0.25
Boal	80.00	3.24	27.00	2.51	107.00	3.02
Air	138.00	5.59	13.50	1.25	151.50	4.27
Pangas	152.00	6.15	16.50	1.53	168.50	4.75
Shol/Gazar			159.00	14.76	159.00	4.48
Chital/Phali	38.00	1.54	47.00	4.36	85.00	2.40
Koi			36.50	3.39	36.50	1.03
Singi/Magur	2.00	0.08	41.50	3.85	43.50	1.23
Sar Punti	12.00	0.49	8.00	0.74	20.00	0.56
Big Shrimps	87.00	3.52	95.00	8.82	182.00	5.13
Small Shrimps	82.00	3.32	113.50	10.54	195.50	5.51
Tengra			23.00	2.14	23.00	0.65
Pabda						
Punti	56.00	2.27	72.00	6.69	128.00	3.61
Miscellaneous	63.00	2.55	65.50	5.99	127.50	3.59
Chela			65.50	6.08	65.50	1.85
Hilsha	1425.00	57.69			1425.00	40.17
Baim			19.00	1.76	19.00	0.54
Baila	35.00	1.42			35.00	0.99
Taki			7.00	0.65	7.00	0.20
Sheda						
Chewa/Chering	42.00	1.70			42.00	1.18
Coral	7.00	0.28			7.00	0.20
Carpio						
Talapia						
Mola						
Gutum						
Colisha						
Baicha						
Chapila	12.00	0.49			12.00	0.34
Chanda						
Poa	40.00	1.62			40.00	1.13
Rita			2.00	0.19	2.00	0.06
Bacha	70.00	2.83	84.50	7.85	154.50	4.36
Cutcutia						
Total	2470.00	100.00	1078.00	100.00	3547.00	100.00

TABLE F.4.7

Total Catch of Species in (Kg) by Zone

Zone : B

Species	River		Canal/Khal		Total	
	Kg	%	Kg	%	Kg	%
Ruhi						
Catla						
Mrigal			3.00	0.69	3.00	0.69
Kalbasu						
Ghainna			3.00	0.69	3.00	0.69
Boal			43.50	9.97	43.50	9.97
Air			5.50	1.26	5.50	1.26
Pangas						
Shol/Gazar			51.00	11.68	51.00	11.68
Chital/Phali			6.00	1.37	6.00	1.37
Koi			33.00	7.56	33.00	7.56
Singi/Magur			13.50	3.09	13.50	3.09
Sar Punti			1.00	0.23	1.00	0.23
Big Shrimps			40.50	9.28	40.50	9.28
Small Shrimps			61.00	13.97	61.00	13.97
Tengra			19.00	4.35	19.00	4.35
Pabda						
Punti			59.00	13.52	59.00	13.52
Miscellaneous			60.00	13.75	60.00	13.75
Chela						
Hilsha						
Baim			1.50	0.35	1.50	0.34
Baila			7.00	1.60	7.00	1.60
Taki			18.50	4.24	18.50	4.24
Sheda						
Chewa/Chering			4.00	0.92	4.00	0.92
Coral						
Carpio			1.00	0.23	1.00	0.23
Talapia						
Mola						
Gutum						
Colisha			5.50	1.26	5.50	1.26
Baicha						
Chapila						
Chanda						
Poa						
Rita						
Bacha						
Cutcutia						
Total			436.50	100.00	436.50	100.00

TABLE F.4.8

Total Catch of Species in (Kg) by Zone

Zone : C

Species	River Kg	River %	Canal/Khal Kg	Canal/Khal %	Total Kg	Total %
Ruhi						
Catla						
Mrigal						
Kalbasu						
Ghainna			0.50	0.67	0.50	0.67
Boal			6.00	8.05	6.00	8.05
Air			1.00	1.34	1.00	1.34
Pangas						
Shol/Gazar			7.50	10.07	7.50	10.07
Chital/Phali			2.00	2.68	2.00	2.68
Koi			5.30	7.05	5.30	7.05
Singi/Magur			2.00	2.68	2.00	2.68
Sar Punti						
Big Shrimps						
Small Shrimps			4.00	5.37	4.00	5.37
Tengra			1.30	1.68	1.30	1.68
Pabda			0.50	0.67	0.50	0.67
Punti			33.50	44.97	33.50	44.97
Miscellaneous			8.50	11.41	8.50	11.41
Chela						
Hilsha						
Baim			1.30	1.68	1.30	1.68
Baila						
Taki						
Sheda						
Chewa/Chering						
Coral						
Carpio						
Talapia						
Mola						
Gutum			1.30	1.68	1.30	1.68
Colisha						
Baicha						
Chapila						
Chanda						
Poa						
Rita						
Bacha						
Cutcutia						
Total			74.70	100.00	74.70	100.00

TABLE F.4.9

Total Catch of Species in (Kg) by Zone

Zone : D

Species	River Kg	River %	Canal/Khal Kg	Canal/Khal %	Total Kg	Total %
Ruhi	27.00	1.16			27	1.03
Catla	21.00	0.90			21	0.8
Mrigal	12.00	0.51			12.00	0.46
Kalbasu	7.00	0.30			7.00	0.27
Ghainna						
Boal	241.50	10.36	5.50	1.85	247.00	9.40
Air	147.00	6.31	1.00	0.34	148.00	5.63
Pangas						
Shol/Gazar	312.50	13.41	19.00	6.40	331.50	12.62
Chital/Phali	94.00	4.03			94.00	3.58
Koi	55.50	2.38	10.00	3.37	65.50	2.49
Singi/Magur	36.50	1.57	10.00	3.37	46.50	1.77
Sar Punti						
Big Shrimps	265.00	11.37	2.00	0.67	267.00	10.16
Small Shrimps	128.00	5.49	4.50	1.52	132.50	5.04
Tengra	163.00	6.99	19.80	6.66	182.80	6.96
Pabda	58.50	2.51	0.50	0.17	59.00	2.25
Punti	309	13.26	84	28.31	393	14.96
Miscellaneous	49.50	2.12	22.50	7.58	72.00	2.74
Chela						
Hilsha						
Baim	78.00	3.35	22.50	7.58	100.50	3.83
Baila			4.50	1.52	4.50	0.17
Taki	99.50	4.27	20.00	6.74	119.50	4.55
Sheda	24.00	1.03	6.00	2.02	30	1.14
Chewa/Chering			3.50	1.18	3.50	0.13
Coral						
Carpio	5.00	0.21			5.00	0.19
Talapia						
Mola	38.00	1.63	11.00	3.71	49.00	1.87
Gutum	26.50	1.14	2.50	0.84	29.00	1.10
Colisha	72.00	3.09	24.00	8.09	96.00	3.65
Baicha	30.00	1.29	8.00	2.70	38.00	1.45
Chapila						
Chanda	30.50	1.31	13.00	4.38	43.50	1.66
Poa						
Rita						
Bacha			3.00	1.01	3.00	0.11
Cutcutia						
Total	2330.50	100.00	296.80	100.00	2627.30	100.00

In the Gumti Phase II fisheries study, a similar study to this one also located within the South East Region, the similarity in species composition in the different systems was interpreted as an indication of the ability of the various species to freely move within the floodplain area to reach different habitats within it. However, in the case of the Noakhali North study, this similarity is seen only in the rivers and Khals which has been attributed to the fact that there was no floodplain for fish dispersal in 1992. Figures F.4.1, F.4.2 and F.4.3 show some of the major species occurring in the region.

Results from other fisheries studies in the country have suggested that fish species in the floodplain can be habitat-specific, such as in the Tangail Compartmentalization Pilot Project (de Graaf, personal communication) located in the Jamuna/Dhakatia Floodplains. However, it is not easy at present from the field data to identify these species with certainty in the Noakhali North project area. In addition, the basic hydrology of Tangail is very different to that of Noakhali, the latter being a series of major and minor Khals. Nevertheless, results from the Noakhali North study appear to indicate that the major carps caught in Zone A and D came from the main rivers most likely entering the system through the Rahmatkhali Regulator and the Dakatia River.

A full study on migration and dispersal of fish throughout the Noakhali North study area as well as on the Meghna/Dakatia Rivers is needed before definite assumptions are made in this regard. Ideally these should be carried out before development projects are implemented which will change the extent and duration of the floodplain area, which is the key to the fish productivity of the area.

F.4.8   Gear Species Selectivity

Around 15 different types of fishing gears were found to be in use in the project area (see summary in Appendix F.4). Thus, in order to analyse the catch in relation to gear type, gears were grouped under six main gear categories (Table F.4.10). The catch species composition per zone and habitat type was summarized (Tables F.4.11 to F.4.16). However, it should be noted that this survey did not cover any seasonal changes in species composition or abundance.

The main gear types in use in Zone A, downstream of the regulator, were gill nets and seine nets, while in Rahmatkhali Khal, although in general the gears were similar, lift nets were more important than any other gear. Hilsa made up 80% of the catch which was captured with gill nets in the Meghna (Table F.4.11 and F.4.12). In Zone B, most of the harvest was caught with lift nets, which is not unexpected since they were observed in fairly large numbers in the Khals in this zone. Main species caught in this type of gear were Shol/Gazar, Small Shrimps, Punti, Boal and Big Shrimps (Table F.4.13). In Zone C only seine nets and lift nets were observed. Most of the catch from seine nets comprised Punti (57%), while the catch with lift nets was made up by a Punti (20.7%), Shol/Gazar (15.5%), Boal (13.8%) and others (17%) (Table F.4.14). In Zone D there were mainly seine nets and lift nets with a few bag nets. Big Shrimps and catfishes made up the bulk of the catch harvested with seine nets in the Dakatia with nearly 17% and a combined 33% respectively. Punti and Shol/Gazar were the dominant species in the lift nets with 26% and 12% respectively, while Tengra amounted to nearly 50% of the catch by bag nets. In the Khals, the bulk of the catch was harvested with lift nets and Punti was again the dominant species making up to 27% of the total catch (Table F.4.15 and F.4.16).

Major Fish Species Occurring in Noakhali North Project Area

Carps, Barbs and Minnows

Rui

Catla

Mrigal

Punti

Silver Carp

Kalbasu

Common Carp

Mirror Carp

Grass Carp

Ghonia

Sar Punti

Bhagna

Mola

Tit Punti

(Not to Scale)

Major Fish Species Occurring in Noakhali North Project Area

Catfishes

Boal

Magur

Shingi

Tengra

Ayre

Bajari Tengra

Madhu Pabda

Batasi

Snakeheads

Shol

Taki

Featherbacks

Chital

Foli

(Not to Scale)

Major Fish and Prawn Species Occurring in Noakhali North Project Area

Climbing Perches

Koi

Khalisha

Shads, Herrings

Hilsha

Chapila

Loaches

Gutum

Gobies

Bailla

Spiny Eels

Baim, Pankal

Mud Perch

Meni, Bheda

Gars

Karikka

Big Shrimp

Golda Icha

Glass Perch

Nama Chanda

(Not to Scale)

TABLE F.4.10

Total Species Catch (Kg) by Gear

Zone : A

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River	1775	570		34	17			75		2470
Canal/Khal	69	618	204	94				92		1077
Total	1844	1188	204	128	17			167		3547

Total Species Catch (Kg) by Gear

Zone : B

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River										
Canal/Khal	10	23	358		8			40		437
Total	10	23	358		8			40		437

Total Species Catch (Kg) by Gear

Zone : C

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River										
Canal/Khal		46	29							75
Total		46	29							75

Total Species Catch (Kg) by Gear

Zone : D

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River		1821	388	122						2331
Canal/Khal	10	30	252		5					297
Total	10	1851	640	122	5					2628

TABLE F.4.11

% of Estimated Total Species Catch (Kg) by Gear in Zone A

River

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Ruhi	0.25	4.30						1.34		1.21
Catla	0.34	3.51			3.03			3.36		1.17
Mirgal	0.23	2.98		2.94				4.03		1.01
Kalbasu	0.37	4.82		2.94				8.05		1.66
Ghainna	0.60	0.35						1.34		0.16
Boal	2.14	6.67			6.06			4.03		3.24
Air	5.24	6.14		2.94				12.08		5.59
Pangas	6.25	5.70		8.82	3.03			6.71		6.15
Shol/Gazar										
Chital/Phali	0.23	5.18		2.94	3.03			4.03		1.54
Koi										
Singi/Magur		0.35								0.08
Sar Punti	0.06	1.93								0.49
Big Shrimps	0.17	10.18		8.82	12.12			28.19		3.52
Small Shrimps	0.51	12.11			6.06			4.03		3.32
Tengra										
Punti	0.06	9.30			12.12					2.27
Miscellaneous	0.85	6.67		2.94	36.36			4.03		2.55
Chela										
Hilsha	80.28									57.69
Baim										
Baila	0.39	2.98		20.59				5.37		1.42
Taki										
Chewa/Chering		6.32		17.65						1.70
Coral	0.11	0.88								0.28
Chapila	0.45	0.53		2.94						0.49
Poa	0.90	2.81		14.71				4.03		1.62
Rita										
Bacha	1.13	6.32		11.76	18.18			9.40		2.83
Total	100.00	100.00		100.00	100.00			100.00		100.00

TABLE F.4.12

% of Estimated Total Species Catch (Kg) by Gear in Zone A

Canal/Khal

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Ruhi	7.14	5.05	4.90	5.67				3.16		5.05
Catla	1.43	3.93	4.90	3.09				3.16		3.81
Mirgal		2.08	1.96					3.16		1.83
Kalbasu	4.29	6.73	5.39	2.58				2.11		5.55
Ghainna		0.64						1.05		0.46
Boal	2.86	2.16	2.94	4.64				1.05		2.48
Air	2.86	0.72	1.96	2.06				1.05		1.24
Pangas	1.43	1.44	1.96	1.55				1.05		1.51
Shol/Gazar	5.71	15.87	8.33	16.49				24.21		14.59
Chital/Phali	4.29	4.01	4.90	6.19				3.16		4.31
Koi	2.86	3.29	4.90	2.06				2.11		3.35
Singi/Magur	2.86	3.61	1.47	3.09				11.58		3.81
Sar Punti		0.32	2.94							0.73
Big Shrimps	8.57	7.69	8.82	11.34				12.63		8.72
Small Shrimps	12.86	10.98	11.27	12.37				1.05		10.41
Tengra	2.86	2.72	1.96							2.11
Punti	17.14	7.85	2.94					5.26		6.61
Miscellaneous	4.29	4.09	18.14	6.19				6.32		7.11
Chela	8.57	5.21	10.29	5.15				1.05		6.01
Hilsha										
Baim		1.60		4.12				5.26		1.74
Baila										
Taki		0.64						3.16		0.64
Chewa/Chering										
Coral										
Chapila										
Poa										
Rita		0.32								0.18
Bacha	10.00	9.05		13.40				8.42		7.75
Total	100.00	100.00	100.00	100.00				100.00		100.00

TABLE F.4.13

% of Estimated Total Species Catch (Kg) by Gear in Zone B

Canal/Khal

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Mrigal	10.53		0.56							0.70
Ghainna			0.84							0.70
Boal		20.00	8.95					16.92		9.78
Air			1.26					3.08		1.28
Shol/Gazar	15.79		11.75		20.00			14.62		11.58
Chital/Phali		4.44	1.26					1.54		1.40
Koi	5.26	13.33	7.55					6.15		7.57
Singi/Magur	15.79	2.22	2.24					10.77		3.14
Sar Punti		4.44								0.23
Big Shrimps			8.53					26.15		9.08
Small Shrimps	10.53	13.33	14.41		6.67			11.54		13.91
Tengra	5.26	6.67	4.76							4.42
Punti	10.53	15.56	14.27		33.33			3.08		13.74
Miscellaneous	10.53	11.11	15.52		6.67			0.77		13.91
Baim			0.14		6.67			1.54		0.35
Baila	5.26		1.40					2.31		1.46
Taki	5.26	6.67	4.20		20.00					4.31
Coral		2.22	0.98							0.93
Talapia			0.28							0.23
Baicha	5.26		1.12		6.67			1.54		1.28
Total	100.00	100.00	100.00		100.00			100.00		100.00

TABLE F.4.14

% of Estimated Total Species Catch (Kg) by Gear in Zone C

Canal/Khal

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Ghainna		1.02								0.47
Boal		4.08	13.79							9.35
Air		2.04	1.72							1.87
Shol/Gazar		7.14	15.52							11.68
Chital/Phali		2.04	3.45							2.8
Koi		6.12	11.21							8.88
Singi/Magur		1.53	4.31							3.04
Small Shrimps		4.08	8.62							6.54
Tengra		1.53	1.72							1.64
Pabda		1.02								0.47
Punti		57.14	20.69							37.38
Miscellaneous		8.16	17.24							13.08
Baim		2.04	0.86							1.4
Gutum		2.04	0.86							1.4
Total		100.00	100.00							100.00

TABLE F.4.15

% of Estimated Total Species Catch (Kg) by Gear in Zone D

River

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Ruhi		1.37	0.56							1.16
Catla		1.04	0.28							0.86
Mrigal		0.35	0.28							0.32
Kalbasu		0.62								0.49
Boal		12.94	8.74	0.78						11.67
Air		6.77	4.47	10.68						6.52
Shol/Gazar		13.66	12.14							12.80
Chital/Phali		6.70	0.84							5.37
Koi		1.38	3.33							1.67
Singi/Magur		0.93	1.93							1.07
Big Shrimps		16.88	8.93	1.55						14.80
Small Shrimps		8.70	1.67							7.07
Tengra		5.21	5.44	48.64						7.11
Pabda		4.02	0.56							3.23
Punti		5.92	26.00	19.51						10.09
Miscellaneous		2.54	2.65	4.08						2.63
Baim		2.75	3.42	9.71						3.17
Baila										
Taki		2.40	6.30							3.00
Bheda		1.05	0.56							0.92
Chewa/Chering										
Carpio		0.16								0.12
Mola		0.93	2.33							1.14
Gutum		0.61	0.56	4.66						0.77
Colisha		1.54	5.86	0.39						2.26
Baicha		0.77	1.53							0.87
Chanda		0.77	1.63							0.89
Cutcutia										
Total		100.00	100.00	100.00						100.00

TABLE F.4.16

% of Estimated Total Species Catch (Kg) by Gear in Zone D

Canal/Khal

Species	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
	%	%	%	%	%	%	%	%	%	%
Ruhi										
Catla										
Mrigal										
Kalbasu										
Boal	5.00	3.33	1.49							1.70
Air		3.33								0.25
Shol/Gazar	15.00	3.33	5.52		19.05					5.77
Chital/Phali										
Koi	15.00	3.33	2.50		9.52					2.96
Singi/Magur	15.00	3.33	2.88							3.18
Big Shrimps			0.69							0.62
Small Shrimps			2.26							2.01
Tengra		6.67	7.04		4.76					6.81
Pabda			0.17							0.15
Punti	20.00	33.33	27.18		19.05					27.35
Miscellaneous	5.00	3.33	8.25		9.52					7.83
Baim		10.00	7.49		9.52					7.52
Baila			2.37							2.11
Taki	20.00	3.33	6.56		9.52					6.69
Bheda			3.31							2.94
Chewa/Chering			1.86							1.66
Carpio										
Mola		10.00	3.24							3.62
Gutum		3.33	0.52							0.71
Colisha	5.00	6.67	7.76		9.52					7.63
Baicha		3.33	2.26		9.52					2.38
Chanda		3.33	4.90							4.60
Cutcutia			1.74							1.54
Total	100.00	100.00	100.00		100.00					100.00

F.4.9 Biodiversity in the Study Area

The term 'Biodiversity' as defined in the Global Biodiversity Strategy (WRI/IUCN/UNEP, 1992) includes the totality of genes, species and ecosystems in a region or the world. It is divided into three hierarchical categories: genetic, species and ecosystem diversity.

The importance of the Noakhali North study area lies not only in its fish productivity, but also on the wide number of aquatic species, of which fish occupy a significant place. This was confirmed by the high number of fish species recorded, both directly during the catch surveys as well as indirectly from fishermen's reports. It is believed that this number of species could increase if a longer study were to be carried out in the area.

F.4.9.1 Fish Diversity

Around 76 species belonging to 10 Orders and 32 Families were recorded during the study. Approximately 12% of which were actually observed in the catch (Appendix F.3), the rest were reported by the fishermen of the area. This represents around 30% of the total number of freshwater fish species currently known in the country.

It is very likely that this figure may increase after a more in depth analysis of this fauna, especially if all species are considered and not just the commercial ones.

F.4.9.2 Crustaceans

Only *Macrobrachium rosenbergii* and *M. styliferus* were recorded in the catch. However, according to fishermen's reports, 8 species of palaemonidis also occur in the area (Appendix F.3). Clearly, the number of invertebrates, with both economical as well as ecological importance, found in this area is also expected to increase after due consideration is given to this important aspect of the ecology of the area.

F.4.10 Fish Marketing

Traditional fish marketing systems have evolved over the centuries in Bangladesh. Although most of the fishermen in the past have been Hindus, the fish traders have been predominantly Muslims.

In general, the marketing system works as follows, mobile fish assemblers known as Mohajans visit fishermen and collect their catch, often providing fishermen with credit early in the season to guarantee their business. Mohajans occasionally get local agents (Dalals) to collect and purchase the fish for them on a commission basis. In the case of river fisheries, Mohajans also carry ice to the fish landing centres to preserve the purchased fish. Mohajans then transport the fish to nearby markets and sell the catch to local retailers (Nikaries), wholesalers (Paikers), and distributors (Beparis) through commission agents known as Arotdars.

The way this is done is by public auction, where Arotdars sell fish to the highest bidders receiving 3 to 6% commission of sale value. The process can then be repeated when Beparis transport the fish to markets in other Districts or Thanas for resale by Arotdars to local retailers or wholesalers. This system continues until fish reach the smaller rural markets for final sale to consumers.

There are many variations on the above pattern and fishermen often bypass fish traders, taking fish directly to local markets when fish prices are high. However this is only done when it is cost effective because fishermen prefer to sell on site so they can spend more time actually fishing. Quite often, Paikers (wholesalers) also act as assemblers on fishing grounds and operate boats day and night to purchase fish from several fishing units.

In the Noakhali North project area, fish are sold in the markets of most towns. More important retail and wholesale fish markets occur in all District Headquarters towns, from where fish are either sent to secondary markets of smaller towns, to the larger markets of Dhaka, or sold directly to consumers. Little information was obtained in this study on the quantities of fish distributed through the regional marketing system.

F.4.10.1 Fish Market Survey

A total of 13 markets were sampled in the eight week period. Figure F.2.2 shows the location of the sampled markets. The thirteen Bazaars (markets) sampled per zone were:

Zone A: Lakshmipur

Zone B: Choumuhoni, Maijdee

Zone C: Sonaimuri

Zone D: Hajiganj, Bolakhal, Pal, Chandana, Bakila, Kalibari, Monoharganj, Sonapur, Bara Station

Table F.4.17 Shows the number and type of fish dealers per zone. Interestingly, in Zone A, there were only retailers, while in Zones B and D all types of dealers were represented. Overall there were nearly 2,000 dealers in all zones during the study period, with retailers representing nearly 70% of the total, wholesalers 12.5%, part time dealers 11% and Arotdars 6.5%.

Table F.4.17

Total Number and Type of Fish Dealers by Zone in the Noakhali North Study Area

Type of Dealer	Zone A	Zone B	Zone C	Zone D	Total
Arotdar/Stockist		102		25	127
Wholesaler		131	2	110	243
Retailer	294	623	93	341	1351
Part Time Dealer		97	42	81	220
Total	294	953	137	557	1941

Source: Fish Market Survey carried out during this study

F.4.10.2 Fresh Fish

There were approximately 50 species being sold as fresh produce (Table F.4.18). Overall, the largest number of fish species for sale was found in Zone B which had 41, with Zones D and A selling 34 and 30 species respectively, while Zone C only had 22 species for sale in the eight week period.

Species found for sale in Zone A only, included Kakila, Taposi, Paukal and Bacha. In Zone B, these included Ghonia, Sar Punti, Chewa/Chering, Keski, Chapila and Rup-Chanda. In Zone C, there was only one species for sale there and not in the other zones and this was Surma, while Rita and Cutcutia were only found in Zone D.

Table F.4.18 shows the total weight and average price of the fish species for sale per zone. It can be seen that the prices, although very similar in general, showed a tendency to be higher in Zones A and D. Prices discrepancies were observed in the cost of Pangas, which was much lower in Zone A than in Zone D; Chital/Phali, which was around 55 Tk/kg in Zones A and B and only 37 Tk/kg in Zone D; Small Shrimps, which were 64 Tk/kg in Zone D and only 19 Tk/kg in Zone C; Chela, which was less than half in Zone D than in Zone A. Coral went from 100 in Zone A to 60 Tk/kg in Zone B. Substantial differences were also found for Gutum and Poa. Plates F.3 and F.4 show a sample of the fish diversity found in the project area.

These market prices have been used to estimate the economic value of the fish production in the project area.

F.4.10.3 Estimated Market Value of the Fish Catch

To obtain an estimate of the market value of the catch in the Noakhali North area, the information collected during the eight week market survey was linked by species to the catch data. Following this procedure, it was possible to separate the fish data from the catch assessment survey into three categories: high, medium and low value fish. From the market price survey, an average price for fish was obtained for each of these categories as follows: high value: 75 Tk/Kg, medium value: 40 Tk/Kg and low value: 22 Tk/Kg.

Table F.4.19 shows the proportion of the different value fish in each of the sampled zones. From this table, it can be seen that the vast majority of high value fish was caught in Zones B and D, followed by catches in Zone C and A. The bulk of the medium value fish was caught in Zone A with relatively similar proportions in the other zones. The low value fish was caught mainly in Zones C and D with extremely few in Zone A.

Therefore, the current market value of the capture fisheries production including the lower Meghna (10,349 MT) can be estimated to be **Tk 526 million**, of which by **Tk 272 million** was contributed by the high value species, **Tk 236 million** by the medium value species and only **Tk 18 million** by the low value species.

It is thus clear, that any proposed intervention will need to take into account the loss of income to the members of the intricate local economic web such as the fishermen, market dealers, Jalmahal leaseholders, boat builders, net and trap makers, as well as those who benefit by supplying transport, ice and other services. It is probable that many fishermen would have already been performing several of these tasks themselves. However, it is unquestionable that any disruption created to the fishing system and hence to its dependent community will have consequences to the local economy.

Plate F.3 Fresh Fish at Market.
Note Diversity of Species

Plate F.4 Fresh Fish at Market.
Note the Difference in Species and Sizes

TABLE F.4.18

Average Price and Total Weight (Kg) of Species by Zone

SPECIES	ZONE							
	A		B		C		D	
	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)
Ruhi	132.0	68.8	770.0	58.8	70.0	60.0	35.0	73.0
Catla	124.0	67.9	775.5	52.5	110.0	46.3	75.0	58.6
Mrigal	60.0	63.0	265.0	45.6	32.0	50.0	16.0	58.3
Kalbasu	83.0	65.0	15.0	40.0				70.0
Ghainna			35.0	20.0				
Boal	66.0	61.7	38.0	52.1	30.0	55.0	44.0	57.5
Air	77.5	60.7	18.0	51.7	6.0	55.0	83.0	60.0
Pangas	90.0	66.2					160.0	95.0
Shol/Gazar	206.0	45.1	190.0	41.4	97.0	36.3	62.5	34.5
Chitel/Phali	51.0	54.2	12.0	56.7			7.0	36.7
Koi	42.0	62.5	190.0	60.6	161.5	58.8	83.0	63.0
Singi/Magur	48.0	58.8	265.0	73.8	82.0	68.0	50.5	66.4
Sar Punti			37.5	56.3				
Big Shrimps	25.0	168.0	5.0	200.0			56.5	201.7
Small Shrimps	64.0	39.3	192.0	40.6	35.5	19.5	32.5	64.3
Tengra	24.0	51.7	87.0	37.5	10.5	40.0	61.5	34.2
Pabda			13.0	82.5	4.0	48.3	1.0	60.0
Punti	74.0	31.0	202.0	25.7	272.5	23.5	163.0	28.9
Miscellaneous	21.0		168.0	24.3			23.0	21.0
Chela	32.0	52.7					7.0	22.5
Kakila	4.0	40.0						
Hilsha	2350.0	48.5	1216.0	44.0	590.0	53.3	339.0	46.7
Baim	44.0	46.0	46.0	45.8	11.5	21.8	38.5	36.9
Baila	20.5	40.0	34.0	50.3				
Taki	55.0	35.6	128.0	32.9	61.0	30.0	49.0	27.9
Bheda			4.0	50.0			8.5	40.0
Chewa/Chering			113.0	52.9				
Coral	0.5	100.0	78.0	60.1			25.0	90.0
Taposi	5.5	40.0						
Sakra	5.5	25.0	25.0	25.0				
Silver Carp	13.0	50.0	229.0	50.8			73.0	41.3
Carpio			85.5	55.8	45.0	60.0	11.0	40.0
Talapia			201.0	49.0			3.0	45.0
Mola			29.0	37.0	19.0	26.7	13.0	27.5
Bighead			466.0	44.4	148.5	40.0	22.0	40.0
Gutum			18.0	50.0	5.0	27.5	5.5	27.5
Colisha			6.0	35.0	16.0	33.8	11.5	33.3
Baicha			19.0	17.0	4.0	25.0	0.5	30.0
Keski			39.0	22.5				
Chapila			48.0	41.2				
Chanda			20.0	17.5			9.0	21.7
Surma					8.0	35.0		
Rup-chanda			10.0	150.0				
Loitta	54.0	42.3	35.0	30.0				
Poa	65.0	55.3	70.0	30.0				
Batta			25.0	40.0			6.0	45.0
Rita							12.0	80.0
Paukal	9.0	57.5						
Bacha	72.0	58.1						
Cutcutia							4.0	15.0

TABLE F.4.19

Proportion of Estimated Fish Production with Different Market Value in the Noakhali Study Area

| Market Price | ZONES | | | | | | | | TOTALS | |
| | A | | B | | C | | D | | | |
	Kg	%	Kg	%	Kg	%	Kg	%	Kg	%
High	829	21	2678	43	540.5	30	652	41	4700	35
Medium	2988	76	3036	49	1002	55	739.5	46.5	7766	57
Low	101	3	508	8	276.5	15	199.5	12.5	1085	8
Total	3918	100	6222	100	1819	100	1591	100	13551	100

Source: Catch assessment and market surveys carried out during this study

CHAPTER F.5

PROPOSED INTERVENTIONS AND IMPACT ASSESSMENT RATIONALE

F.5.1   Introduction

The proposed intervention seeks to build on the works carried out in the early 1970s under the Noakhali Comprehensive Drainage Scheme by deepening and widening the main Khal system and also by enlarging the Rahmatkhali regulator. The design of the scheme is based upon a completely free flowing 'natural' drainage system so that there is minimal opportunity for obstruction and mal-operation.

Under this intervention it is intended to ensure that drainage is balanced so that no area suffers higher water levels as a result of improvements elsewhere. Increased drainage will be achieved mainly through lower water levels which will be reached by flattening water gradients. This is expected to produce lower channel velocities which will reduce bank erosion.

In addition, part of this intervention includes re-excavation of the larger secondary Khals to provide a more comprehensive drainage system which will assist in draining a wider area within the study boundaries, which for the fish populations and the fisheries, as well as the rest of the aquatic flora and fauna, in the area represents serious disturbance and loss of the floodplain and key breeding, feeding and nursery areas for fish and crustaceans. Figure F.5.1 shows the proposed intervention and khal depth modelling points.

The proposed scheme will also allow water from the Meghna River into the Khal system during the dry season on a massive scale to provide increased areas of irrigation. The Khal system is intended to operate as a tidal storage system allowing maximum water entry and the widest distribution possible. The entire scheme will operate automatically without power requirements and only minimal operation activities are required on a seasonal basis at the regulator. This seasonal operation would be arranged to provide access for fish during April and May up until rising water levels in the Meghna require the closure of the drainage flaps.

This situation will allow better access for fish while the gates are opened but this access will only be conditional to the agricultural patterns in the area. Therefore, although access for fish might be improved through a better set of gates, it will still be limited and secondary to agricultural activities in the area. Furthermore, although the fish will be able to enter the Khal system, they will not be able to reach their breeding, feeding and nursery grounds on the floodplain since this would have been mostly drained. Under this situation, it is debatable that there can be any benefits to the fish production accrued from this intervention. Further study is thus recommended before the strategy is implemented. Details of the re-excavation scheme and gate design and operation are provided in the Engineering Annex I and are described in Chapter II.

Figure F.5.1

Proposed Intervention & Khal Depth Monitoring Points

Legend :

Thana H.Q. ■ River
District H.Q. ■ Khal
Other Important Places ●
Modelled Water Depth Point ◭
Khals to be Deepened
Railway
Road
Project Boundary
International Boundary
Embankment

Scale: 0 5 10 km

C:\HABIB\NNP\Fig F5_1.drw

KAZIRHAT REGULATOR

OLD COASTAL EMBANKMENT

CROSS DAM Nr 2

CROSS DAM Nr 1

RAHMATKHALI REGULATOR

F.5.2 **Rationale for Estimating Fisheries Losses Due to the Proposed Intervention in the Noakhali North Study Area**

The proposed intervention for the Noakhali North Study Area includes Khal re-excavation of approximately 17% of the total Khals in the area. The existing regulator will be altered and the gates will be replaced with gates which open wide under low heads and with low velocities. However, the main intention of this scheme is to drain a large proportion of the floodplain in the area to improve conditions for agriculture. It should be pointed out that this area has already been impacted to a certain degree and that any further alterations to the habitat, such as increased drainage will only contribute to its further degradation as a fisheries system.

F.5.2.1 **Main Rivers**

It has been assumed that major rivers such as the Meghna (to the west of the project area) and the Dakatia, to the north, will not be affected by this scheme. However, it is clear that even if such is the case, migratory fish entering the system will not be able to thrive without the floodplain. Furthermore, fishermen in the area will most likely take advantage of the situation and will over-fish the Khals and rivers where most of the fish are expected to be concentrated.

F.5.2.2 **Internal Rivers and Khals**

The total length of main and secondary Khals in the project area is approximately 1,008 km of which 172.5 km (17%) will be re-excavated under the proposed intervention. Difficulties in estimating changes in fish production are due to the lack of information on the distribution and abundance of the fish species in the study area. It has been assumed that there is a direct relationship between water volume and fish production and thus, fish production has been increased or decreased by the appropriate proportion.

In order to calculate the change in depth of water due to Khal re-excavation, existing bed and water levels, and therefore mean water depths were analyzed for each month throughout the year for a without project and a with project situation. From this analysis it was possible to estimate that under this intervention there will be an overall increase of 84% in the mean depth in those Khals that are going to be excavated, whereas there will be a decrease of 19% in water depths in those Khals which are not. Most of the re-excavated Khals (around 50%) lie within Zone A, with approximately 10% of these in Zone B, 30% in Zone C and 10% in Zone D. An analysis of the changes in production due to the re-excavation of Khals was carried out taking into account the proportion of the increase in fish production which corresponded to each zone.

F.5.2.3 **Floodplain**

Under this intervention, the floodplain will be severely impacted. Overall, it has been estimated that 62% of the floodplain within the project area will be lost and a further 69% of the area of floodplain immediately outside the study area will also be lost. The area of floodplain lost in Zone A amounts to 100%, in Zone B to 81%, in Zone C to 62% and in Zone D to 34%. Fish losses have been related directly to the area of floodplain available to the fish.

F.5.2.4   Ponds

The fish production from ponds has been assumed to remain unchanged, although this will depend on the capacity of the ponds and on their ability to retain water. These ponds are thought to be affected by water levels and any decrease in the surrounding water levels may affect the levels inside the ponds.

F.5.2.5   Production Trends

Trends in Fish Production used in this study are similar to those used in the Jamalpur Priority {Project Study (FAP 3.1) and the Gumti Phase II Feasibility Study. These were - 1.5% per annum for production in open water systems and + 4.5% for pond production. A major review of DOF data is being carried out by FAP 17 and new production trends will emerge. Unfortunately they will be available too late for incorporation in this study.

CHAPTER F.6

ESTIMATED FISHERIES BENEFITS AND DISBENEFITS
UNDER THE KHAL RE-EXCAVATION SCHEME

F.6.1   Introduction

Table F.6.1 shows details of the changes in the estimated fish production for the intervention and for each of the fisheries systems. Overall, the open water fish production loss as a result of the scheme was estimated to be 3,626 MT representing a mean loss of 13.2% within the study area. Changes in estimated fish production for each fishery system are detailed below:

F.6.2   Internal Rivers and Khals

In general, the fish production for this system was very low with an estimated annual yield of 134 MT. Table F.6.1 shows the estimated fish production per Zone and the changes in production resulting from the intervention. Overall, there was a decline of less than 0.5% in the estimated fish production due to Khal re-excavation which was rather surprising as a more noticeable and positive change was envisaged. Unfortunately, despite the increase of 84% in the water levels in the re-excavated Khals, fish production was not benefited in any substantial manner as the initial production from this type of system was rather low representing around 10% of the total catch. Most benefits were estimated to occur for Zones A and C with nearly 36% and 28% increase by Year 6 representing 6 MT and 4 MT respectively.

F.6.3   Floodplain

By far the greatest losses in estimated fish production were incurred by the floodplain with an overall decline of nearly 50% representing a annual yield of 3,645 MT. The greatest floodplain loss in percentage terms was estimated to be 81% for Zone B representing a decline of 1,362 MT in the production by Year 6. Zone D was also severely affected with an overall loss of 1,467 MT by Year 6 representing a decline of 34%. The loss of the floodplain in this particular zone is more serious since this part of the floodplain is directly influenced by the Dakatia River, currently one of two main fish access routes to the area. The fact that most of the intervention is outside this particular Zone, makes this loss of more concern.

F.6.4   Social, Economic and Nutritional Implications to the Fishing Community in the Area

Most of the sections of rivers, Khals and Beels in the country are already leased by the government (Jalmahals) to specific groups of fishermen within the Thana Parishads, or within the Unions. Thus, fishermen who find that they have lost their livelihood as a result of FCD and/or FCDI schemes will not be able to easily move to new fishing grounds, since most areas are already taken by other fishermen's groups. Furthermore, currently productive Jalmahals which become empoldered will most certainly grow into poorer areas with the resulting loss in income for all concerned.

TABLE F.6.1

Change in Fish Production Estimates in the Noakhali North Study Area Due to the Proposed Intervention without Mitigation and Management

		NOW	% Total Catch	WO Year 6	% Total Catch	WI Year 6	% Total Catch	Difference in Year 6 WI and WO %
Zone A	River	0	0.00	0	0.00	0	0.00	0.00
	Khals	27	0.11	25	0.09	33	0.14	35.78
	Floodplain	0	0.00	0	0.00	0	0.00	0.00
	Ponds	1,324	5.61	1,724	6.27	1,724	7.23	0.00
	Subtotal	1,351	5.73	1,749	6.36	1,757	7.37	0.50
Zone B	Rivers	0	0.00	0	0.00	0	0.00	0.00
	Khals	29	0.12	26	0.10	26	0.11	−0.59
	Floodplain	1,841	7.81	1,681	6.11	319	1.34	−81.00
	Ponds	4,387	18.60	5,712	20.77	5,712	23.94	0.00
	Subtotal	6,257	26.53	7,420	26.98	6,058	25.39	−18.36
Zone C	Rivers	0	0.00	0	0.00	0	0.00	0.00
	Khals	25	0.11	23	0.08	29	0.12	27.60
	Floodplain	1,441	6.11	1,316	4.79	500	2.10	−62.00
	Ponds	4,446	18.85	5,789	21.05	5,789	24.27	0.00
	Subtotal	5,912	25.07	7,128	25.92	6,318	26.49	−11.36
Zone D	Rivers	105	0.45	96	0.35	96	0.40	0.00
	Khals	53	0.22	48	0.18	33	0.14	−32.02
	Floodplain	4,723	20.03	4,314	15.69	2,847	11.93	−34.00
	Ponds	5,181	21.97	6,746	24.53	6,746	28.28	0.00
	Subtotal	10,062	42.67	11,203	40.74	9,721	40.75	−13.23
Total	Rivers	105	0.45	96	0.35	96	0.40	0.00
	Khals	134	0.57	122	0.45	122	0.51	−0.43
	Floodplain	8,005	33.95	7,311	26.59	3,666	15.37	−49.85
	Ponds	15,338	65.04	19,970	72.62	19,970	83.72	0.00
Sub-Total (1)		23,582		27,499		23,854		−13.25
Floodplain Areas External to Project Area								
Dakatia River	Floodplain	862		787		680		−13.70
Eastern Side	Floodplain	1,725		1,575		945		−40.00
Sub-Total (2)		2,587		2,362		1,625		−31.20
Grand Total		**26,169**		**29,861**		**25,479**		**−14.67**

Under the present leasing system, middlemen engage fishermen under various sub-leasing arrangements which usually results in the exploitation of fishermen since the largest portion of the benefits go to the middlemen. With the decline of the fisheries resource, aggravated by FCD/FCDI interventions, the income of professional fishermen will decline sharply as the catch will be reduced but the middlemen's fees will not.

It is therefore mistaken to assume that fishermen will be able to become farmers or take up another profession immediately. In addition, the vast majority of the full time fishermen in the project area are low caste Hindus (as was the case in Meghna-Dhonagoda) and thus, traditionally hold jobs as fishermen and little else. Even if they were to change jobs, they will most likely be subjected to hardships, severe in most cases, before they are able to re-establish themselves.

In addition, after the project, the resulting species composition inside the area may be dominated by lower value species. A change in species composition in the floodplain is likely in a situation where the floodplain is much reduced, since the fish may be able to enter the system but not be able to disperse throughout the floodplain to breed, grow and feed.

The reduction in open water fish catch from Beels and floodplains has a major negative impact which has significant social implications. During the monsoon floods, fish are a **free common property resource** within the reach of all in the community, especially the poor in the rural society. The resulting subsistence fishing thus becomes an important activity for most when agricultural related works are naturally limited. Furthermore, fishing provides full time employment and is the main source of income for a small but significant number of households.

F.6.4.1 Number of Fishing Households

The number of fishing households in the Noakhali North project area has been estimated from information received from the Thana Fisheries Office survey. This indicates the number of fishermen per Thana and the number of households in the area as per 1991 estimates of population in the 1991 census (BBS, 1991). It has been assumed that there was one fisherman per fishing household and that these households were uniformly distributed through the project area. It would be valuable to verify these data from the full 1991 BBS census when this becomes available as it probably overestimates the numbers in Zones A and B because it includes Ramgati and Noakhali with large coastal areas which are outside the project area.

Table F.6.2 shows details of these results per zone. In total, there were 60,698 fishing households in the Noakhali North project area equal to 15% of the total households in the area. Of these, 16,352 (4.1%) were full time, 3,889 (1%) were part time and 40,457 (10%) were occasional. The proportion of fishing households varied from zone to zone and not surprisingly, the largest number of fishing households was found in Zone A, where the total number of fishing households was 9,957, representing 19.6% of the total number of households in that zone. It is assumed that the vast majority of these fishermen actually fish the waters of the Meghna River as shown by the proportion of full time fishermen in this zone as well as in Zone D. The overall number of fishing households in Zone C was higher than expected although in this zone, the proportion of occasional fishing households was the highest. It would appear that full time and part time fishermen concentrate their effort on the riverine areas such as Zones A and D, whereas occasional fishermen fish on the areas of floodplain.

TABLE F.6.2

Number of Fishing Households in the Noakhali North Study Area

| | Number of Fishing Households | | | | | | | | |
	Number of Households	Full - Time	%	Part - Time	%	Occasional	%	Total	%
Zone A	50,755	3,294	6.5	633	1.2	6,030	11.9	9,957	19.6
Zone B	114,383	927	0.8	393	0.34	12,081	10.6	13,401	11.7
Zone C	87,462	2,070	2.4	471	0.54	12,335	14.1	14,876	17
Zone D	145,841	10,061	6.9	2,392	1.6	10,011	6.8	22,464	15.4
Total	398,441	16,352	4.1	3,889	0.98	40,457	10.2	60,698	15.2

Source: 1991 estimates of population and BBS 1991 Census for Number of Households.
Noakhali North Thana Fisheries Office Survey for Number of Fishermen

F.6.4.2 Nutritional Contribution of Fish to the Human Diet in the Noakhali North Project Area

Fresh fish are by far the most important source of all protein with meat and dal consumption being very low indeed and virtually all dal being purchased rather than grown. Over 95% of all households surveyed (250) had eaten fresh fish within the previous week and over 45% at their last meal. This survey was carried out during the dry season and the results in the wet season could be expected to be higher.

Those zones showing the lower totals of fresh fish consumption (Zones A and B) also had the highest proportions of dried fish consumed.

F.6.4.3 Source of Fish

The same survey also questioned households concerning their source of fish. The main source of fresh fish was markets, but consumption from ponds was significant in Zone B. However the nutrition field studies were carried out in the dry season and consumption was only recorded from Khals and not floodplain sources since there would be no floodplain at this time. It would be expected that the percentage caught in khals and the floodplain would be higher in the monsoon season. Nevertheless it is significant that even in the dry season virtually all households in Zones A, C and D were prepared and able to purchase fish in the markets. The total of nearly 40% of households in Zone B obtaining fish from their ponds is interesting but may overstate their importance. Only in Zone A did khals exceed 5% as the source of fish in the dry season.

F.6.4.4   Land and Pond Tenure

The development of any fish farm practices in the region will only be feasible for those people with access to ponds. Land and pond tenure is thus believed to be a major issue for consideration as the vast majority of the existing ponds are the property of local farmers or land owners. Since mitigation measures should involve the development of pond culture practices, pond tenure, or leases/hire, must be taken into account.

The fish pond survey indicates that only 18% of ponds are sole owner operated but that 45% are multiple owned and that nearly 33% are rented in for cash or a share of the fish (mostly for catch). Reports from the social impacts assessment surveys also confirm that many owners (generally multiple owners) lease out their ponds for management by others, including to professional fishermen.

Therefore it is clear that the recommended future studies must endeavour to quantify the current scale of this phenomenon so that the numbers of professional fishermen, particularly in zones B and C who are already professionally fishing ponds can be identified and the numbers of capture fishermen can be more accurately identified.

It will also be important to identify the areas of derelict and currently uncultivated ponds for development of a professional fishermen's mitigation project.

CHAPTER F.7

POSSIBLE MITIGATION MEASURES

F.7.1   Introduction

In general, the main issues concerning possible mitigation measures centre around water and fisheries management. These two aspects have been described briefly below.

F.7.2   Water Management

Water resources management is, and will continue to be, possibly the most crucial factor in the development of any activities in the country, the region and the subregion. It will thus be vital to establish priorities as to how and where the water will be directed and for whom. It includes the following components and possibilities for fisheries.

F.7.2.1   Re-excavation of Khals

Possible re-excavation of Khals, and their interconnections, with an aim of ensuring free and timely flow of water and fish (both breeding adults and fry). This could be most important during the dry season when Khals become refuge areas for some species.

F.7.2.2   Gate Design and Operation

Gate design, operation and location of structures is extremely important. These would ensure the timely flow of water and fish, and would be crucial for maintaining water levels in the system throughout the year, and particularly at times critical for fish.

F.7.3   Improved Fisheries Management

The continued improvement of fisheries management in the area should receive the highest priority, especially for those activities and/or policies that should take place despite interventions. Some of these activities include:

F.7.3.1   Restocking with Fry and/or Fingerlings

Restocking of suitable areas such as specific sections of Khal with fry or fingerlings. However, this will need to take into account the ecology of the existing resident species in the area so as to prevent major environmental unbalance due to any introduction of species. Restocking programmes should therefore only be carried out using indigenous species which occur naturally in the selected areas.

F.7.3.2 Improvement of Culture Fisheries

Pond culture improvement, especially of those ponds at present under utilised. Leasing of existing ponds to fishermen groups, especially displaced ones. Use of borrow pits by displaced people who are the groups most likely to suffer the nutritional losses resulting from any reduction in their ability to fish. Training and extension programmes to ensure that suitable technology becomes available and to provide alternative sources of income for fishermen. Promotion of integrated farming schemes such as those underway in Comilla, as well as those such as the small/seasonal pond project in Mymensingh carried out by the Fisheries Research Institute (FRI) and ICLARM. The incorporation of local NGOs into the setting up and management of fishing groups could be instrumental in these type of fisheries projects.

F.7.3.3 Enforcement of Existing Fisheries Regulations

The enforcement of existing regulations should particularly be carried out in relation to important areas such as the Dakatia, Begumganj and Laksham floodplains along with any known breeding, nursery and feeding areas for fish and other commercially important groups such as shrimps.

The following section deals with possible mitigation measures specific to the intervention.

F.7.4 Specific Recommendations:

F.7.4.1 Gate Structures

In general, gates will restrict the passage of fish unless they are designed, operated and managed to minimise fish losses. Some of the possible measures to alleviate this problem include:

- Installation of overshot gates, to allow the passage of floating eggs, larvae, hatchlings, surface and midwater species.

- Timely opening of gates to coincide with critical migration periods for fish and other aquatic species, such as carps and shrimps which are commercially important.

- Careful timing of closure to coincide with the end of the monsoon when the floodplain starts to dry out.

F.7.4.2 Fish Bypasses

These must allow free and continuous access to the fish -both long and short distance migrants-, and/or their eggs and fry, especially during the main migration period, the early monsoon and the drawdown period.

F.7.5 Development Strategy

It is clear from the conclusions of various FAP Regional Studies and from reports by FAP 12 and FAP 17, that capture fisheries have suffered a considerable amount of avoidable damage from FCD interventions and illegal over fishing. It is also clear that unless appropriate action is taken, the future damage will only increase. An

effort is therefore needed to promote measures designed to restore part of the fishery losses. The principal components of such a strategy and action programme for achieving the reversal of the present downward trend in production have been outlined by FAP 12 and are summarised below (FAP 12 Appendix J):

- It is recommended that DOF and the Ministry of Fisheries and Livestock give urgent consideration to strengthening and enforcing legislation with the aim of stopping illegal or other damaging methods of fishing.

- The introduction of additional conservation measures to encourage a revival of natural fish stocks should be a priority. Strict controls on the collection of wild spawn and fry from rivers should be implemented. Further restrictions on fishing gears and net mesh sizes, close seasons and restrictive licensing are necessary.

- Top priority should be given to stop any further avoidable deterioration of fish stocks, especially in rivers as a preliminary to the restoration of production.

- It is important that all future FCD project planners give particular attention to the impacts on capture fisheries and ensure adjustments in placement and design of structures to minimise adverse effects. Mitigation of fish losses should be built into the project with the aim of assisting affected fishing communities and maintaining fish production as a sustainable resource. DOF must be fully involved throughout the project planning and implementation, and projects should provide for the rehabilitation of publicly owned water bodies to optimise fish production and minimise losses.

- Project managers should also aim to minimise conflicts between fishermen and other interests within the project area.

- It is recommended that all remaining public Beels Khals and other perennial water bodies should be preserved against drainage and that they be improved by re-excavation to increase capacity and thus increase fish production. All such water bodies should be subject to the New Fisheries Management Policy and leased only to bona-fide fishermen, with suitable arrangement for supervision, such as relevant NGOs. This will help to reduce the continuing loss of fishing grounds and catches from perennial Beels.

- Research is needed to determine the most effective means and the best species to use in the restocking of rivers and Khals with the aim of restoring their productive capacity. For example, stocking large numbers of carp fingerlings into rivers may not prove effective because juveniles are normally floodplain resident. It may be necessary to create conditions for fingerlings to grow to maturity before they are released into the rivers.

- It is strongly recommended that a review and reinforcement of DOF's agriculture extension services throughout the country be made to take maximum advantage of the opportunities provided by FCD for the expansion of fish culture production.

- Provision of a source of credit via established rural credit agencies such as Grameen Bank, for pond rehabilitation, to enable newly formed fishermen groups to take advantage of fish culture opportunities and technology. It is important that relevant NGOs assist in the setting up of such groups as many fishermen are poorly educated and illiterate and will need guiding and supervision.

Finally it is also recommended that present data collection and analyses be reviewed and improved due to the poor quantity of historical and existing baseline data. This is important to enable more accurate and reliable FCD planning, to ensure that fisheries development strategies are based on reliable information and to acquire accurate production statistics and trends for monitoring progress year to year.

F.7.6   Beneficiaries, Disbeneficiaries and the Role of NGO's

FCD projects have only provided limited fisheries benefits and these have been to those land owners whose property contains ponds which received protection from damaging flooding. In reality the potential benefit has been realised by relatively few pond owners because of a general lack of "know how" and DOF's inability to provide effective field extension support. It is important that pond culture is promoted and encouraged to realise the maximum benefits of FCD.

Capture fishermen and large numbers of occasional fishermen have invariably been the disbeneficiareis of FCD schemes and have received scant attention and no compensation from FCD designers, manager's and financial sponsors. Even where fishermen have formed groups and taken over the management of Jalmahals, with DOF and NGO assistance, the action has been a response to the fishermen's plight rather than a compulsory mitigation proposal attached to the FCD project.

It is proposed that FCD proposals should take the initiative to promote and finance at least some of the activities intended to mitigate and revive fish stocks. FCD projects should also assist the fishing communities to restore their traditional means of livelihood. These activities should be linked into the project cost benefit analyses to ensure that people who have lost access to a common good are fully compensated.

The action should be taken in active cooperation with DOF and the NGOs by providing the necessary resources to enforce their effects.

As well as benefiting full time and part time fishermen, a nutritional improvement programme should be initiated to replace and diminish the dependency on fish protein for subsistence fishermen and their families.

A number of NGO's are already actively supporting groups of fishermen and fish farmers including BRAC (Bangladesh Rural Advancement Committee), the Grameen Bank, TDH (Terredes Hommes), CARE, CARITAS, and PEP (Production Employment Programme) which operates under the umbrella of BRDB (Bangladesh Rural Development Board).

Typical projects include assisting small groups of fishermen to restore and operate formerly derelict fish ponds on long term leases, assisting other groups to operate Jalmahals by setting up their management systems and negotiating credit. Given sufficient resources, NGOs could provide an invaluable contribution by supporting business interests of groups in ways that a Government Department could not easily do.

CHAPTER F. 8

CONCLUSIONS AND RECOMMENDATIONS

F.8.1   General

It is clear that there is a serious conflict between agricultural development and existing capture fisheries in Bangladesh. The scope for developing these two activities conjunctively is difficult, if not impossible to achieve since the more efficient an FCD/I scheme is, the more damaging will be the result for the capture fisheries. In addition, the scope for mitigating against capture fisheries losses is limited because these losses do not only represent a decline in overall production in actual metric tonnes, but also depict irreversible losses in terms of the Biodiversity, i.e. the Natural Heritage of the country which cannot be compensated for.

Furthermore, even if increased aquaculture activities are able to boost culture fisheries, they mainly produce high value fish that poor people cannot afford. Restocking certain areas with fry and fingerlings is potentially feasible, but great care should be taken when doing so as they may unbalance existing fishing systems with detrimental results to the ecology and the people of those systems.

It should be realised that there are some areas which are suitable for agricultural growth but there are also others which are highly productive fisheries grounds and should be managed only for this purpose. Decisions will need to be made at the highest levels to try and reach a compromise and a balance in the future development in this country.

It should be noted that the estimated fisheries production in the project area during this study are partially based on a very short field survey which took place during an unusually dry year and thus, are likely to represent an equally unusual situation both in terms of catch and price. The fisheries impact analyses results and their financial valuation have been integrated into the overall economic analysis of the studied intervention. Even so, it is clear that the fisheries production and/or potential of the area is higher than was previously thought. Results from this study confirm that since the Noakhali North project area is located in the catchment area of the Lower Meghna River, the most productive river in Bangladesh, there is potential for increased open water fisheries by careful management of the water and fishery resources. Therefore, further studies should be carried out on the capture fisheries production of the project area targeted to mitigation of the proposed intervention as a matter of the highest priority before the intervention actually takes place.

A series of recommendations have been put forward regarding some of the main issues considered in this study.

F.8.2   Fisheries Management Programme

A Fisheries Management Programme should be developed jointly with the leading fisheries organizations in the area, such as the District and Thana Fisheries Offices and fishermen's cooperatives. Such a programme should include provisions for proper management of water bodies, fishing gears -including minimum mesh sizes, closed fishing seasons and fishing quotas. The actual details for these proposed provisions would need to be finalized after a more detailed study is carried out. The full implications of these management measures would have to be understood by the fishing community, including part time and occasional fishermen, if the scheme is to be successful.

Plate F.5   Typical Catch from Aquaculture in Ponds
            Same Species and Size

Plate F.6   Typical Floodplain Catch - Wide Variation
            in Species and Sizes. This Diversity Would
            Be Reduced Under Any Habitat Alterations

F.8.3 Surveillance of Important Fishing Areas

It is obvious that under the present situation in the project area, any protective measures will not be respected by the local population. Thus, a system of patrolling important natural fish breeding, nursery and feeding areas, will be needed. Such systems already occur unofficially in the project area, especially regarding Jalmahals, where the lease holder may have a group of fishermen patrolling the area before harvest time to ensure high catches. Surveillance will be most effective if carried out by local fishermen's groups.

F.8.4 Involvement of Local NGOs

In addition, the involvement of the various NGOs (such as the Comilla Rotary Club) in future activities should be an important factor in any future planning of the fisheries and aquaculture activities in the area. The development of projects targeted towards women, such as the Mymensingh Aquaculture Extension Project run by FRI and ICLARM should be promoted.

F.8.5 Aquaculture

Regarding aquaculture activities, it is important to note that substantial benefits may be obtained by improving pond culture, especially since there is already a large number of ponds currently under utilised. However, it must be emphasised strongly that pond culture should be an additional activity to the existing open water fisheries, and not a replacement of the latter.

Pond culture may help in reducing the overall losses in fish production in the project area, and indeed, of the region or the country as a whole. Nevertheless, by and large, it does not address the issue of displaced fisher-persons (which may include women and children) or the nutritional loss to the poor. Furthermore, aquaculture *per se* will never compensate for the loss of habitat and species diversity, which in the case of the floodplain in the Noakhali North project area, could to be severe (Plates F.5 and F.6).

F.8.5.1 Seasonal and Small Ponds for Aquaculture

The use of seasonal ponds to increase fish pond production has been tried successfully in the area of Mymensingh. They could provide alternative sources of income and protein to the landless people. Results from the FRI and ICLARM show that small ponds of approximately 0.032 ha stocked with Tilapia and Rajputi in July and harvested in December yielded 100 Kg. Under the same scheme, seasonal ponds holding fish for six months may yield an average of 1500 Kg/ha, while perennial ponds may yield 1000 Kg/ha.

This type of venture should certainly be promoted to use those seasonal and/or small ponds which are expected to be currently under-utilised in Noakhali North project area.

F.8.5.2 Rice-fish culture

The activities of the Comilla Rotary Club in this respect will be important for the development of integrated farming in the region. In addition, trials for direct rice-fish culture have been carried out by the FRI and ICLARM in other parts of the country (Mymensingh), with promising results. The possible development of this activity in the Noakhali North area should be considered. However, it must be pointed out that results per

hectare from this activity tend to be low (average of 92 Kg/ha) and that production cannot be guaranteed. Detailed knowledge of local hydrology is also required and this activity should thus be viewed as a complementary exercise mainly for farmers who will not suffer if the yields fail due to a bad year.

F.8.6   Structural Design and Operation of Gates

The use of the hydrodynamic model would be critical in deciding the location of these type of structures, if any, in the project area. In addition, given the general lack of understanding of the ecology and biology of the numerous fish groups in the area, it is imperative that further studies be carried out before final decisions are made in this regard.

F.8.7   Improved Knowledge on the Biology and Ecology of Fish Species

It is extremely important that research into the biology and ecology of at least the key species is carried out in order to provide specific information at the design and construction stages for wholly effective water resource management projects in this country.

F.8.8   Sustainable Use of the Biodiversity of the Area

Despite the short period of time allowed for this study, it was possible to establish that the Noakhali North project area is a productive floodplain region. This is not surprising given its proximity to the Meghna River, the most productive main river in the country (FAP 17, 1993). It is apparent, that besides utilising the fish resource available in the Noakhali North study area in a commercial and subsistence manner, the people in the region also use this ecosystem in other ways, such as for food (crustaceans, molluscs to feed their poultry, aquatic plants for self consumption or as animal feed, etc.) and as a source of construction materials for agricultural activities amongst many others.

It is also clear that at present, these natural resources are being utilised intensively by the human population in the region, as is the case throughout Bangladesh. Obviously, a considerable proportion of the people in the area are relying on their ability to use these free resources, especially fish, which are presently within their reach for their every day needs. Any intervention which may substantially alter this pattern will undoubtedly have serious consequences to their health and nutritional status, as well as their economic stability and livelihood.

It is important to establish that 'conservation' of such resources needs to be considered as a philosophy for the 'sustainable use of the resources'. Due to the high levels of human dependency on these resources it is thus imperative, that any developments in the region, and in the country as a whole, consider conservation as an intrinsic part of development. Interventions should now no longer take place without due consideration to changes to the environment.

Therefore, the integration of conservation and development activities in Bangladesh has become one of the greatest challenges for the international and national communities.

Glossary For Fisheries Annex

ADB	-	Asian Development Bank
asl	-	Above sea level
Arotdar	-	Fish market commission agent
Aus	-	Rice grown during the Kharif - 1 season
Bazar	-	Market
BBS	-	Bangladesh Bureau of Statistics
Beel	-	A natural depression which normally remains wet during the year
Beparis	-	Distributor of fish in markets
Boro	-	Rice grown during the Rabi season
Dalal	-	Local agent who collects and purchases fish on a commission basis
DANIDA	-	Danish International Development Agency
District	-	Administrative Unit comprising a number of Thanas under the charge of a Deputy Commissioner
DOF	-	Department of Fisheries
FAO	-	Food and Agriculture Organization of the United Nations
FAP	-	Flood Action Plan
FCD	-	Flood Control and Drainage
FCDI	-	Flood Control, Drainage and Irrigation
FPCO	-	Flood Plan Coordination Organization
FRSS	-	Fisheries Research Survey System
Ha	-	Hectares
Hapa		
HYV	-	High Yielding Variety
ICLARM	-	International Centre for Living Aquatic Resources
IUCN	-	The World Conservation Union
Jalmahal	-	Government leased fishing rights
Katta	-	Fish attracting device consisting of a frame made up of bamboo poles with brushwood in the middle
Kg	-	Kilogram
Khal	-	Natural drainage channel
Km	-	Kilometres
Kutcha	-	Thatched house made of straw or mud
Lac	-	100,000 units
Mohajans	-	Mobile collectors of fish for market
MT	-	Metric Tonnes - 1000 kg
NFMP	-	New Fisheries Management Policy
Nikaris	-	Local fish market retailer, middleman
NGO	-	Non-Government Organization
Paikers	-	Person who handles the wholesale of fish
SPARRSO	-	Space Research and Remote Sensing Organization
TFO	-	Thana Fisheries Officer
Thana	-	Administrative Unit, division of a District, formerly termed Upazila
Thana Parishad	-	Thana Council
Tk	-	Taka, Bangladesh Currency approximately 59 to the Pound Sterling
Union	-	Smallest administrative unit of local government (division of a Thana)
Wetland	-	Area of land saturated with or submerged under water

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APPENDIX F.I

FISH ACT OF 1985

The
Bangladesh Gazette

Extraordinary
Published by Authority

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF FISHERIES AND LIVESTOCK

NOTIFICATION

Dhaka, the 16th October, 1985

No. S.R.O. 442-L/85.—In exercise of the powers conferred by Section 3 of the Protection and Conservation of Fish Act, 1950 (E. B. Act XVIII of 1950), the Government is pleased to make the following rules, the same having been previously published as required by sub-section (5) of that section, namely :—

THE PROTECTION AND CONSERVATION OF FISH RULES, 1985.

1. **Short title.**—These rules may be called The Protection and Conservation of Fish Rules, 1985.

2. **Definitions.**—(1) In these rules, unless there is anything repugnant in the subject or context,—

(a) "form' means the form annexed to these rules ; and

(b) "Schedule" means a Schedule annexed to these rules.

(2) The words or expression used in these rules but have not been defined shall have the same meaning as assigned to them in the Act under which these rules are made.

3. **Erection of fixed engines prohibited.**—(1) No person shall erect or use fixed engines in the rivers, canals, khals and beels.

(2) Any fixed engine erected or used in contravention of sub-rule (1) and any fish caught by means of such engine may be seized, removed and forfeited.

(7637)

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4. **Construction of bunds, etc., prohibited for certain purpose.**—No person shall construct bunds, weirs, dams and embankments or any other structure, whether temporary or permanent, in, on, across or over the rivers, canals, khals or beels for any purpose other than irrigation, flood control or drainage.

5. **Destruction of fish by explosives, etc., prohibited.**—No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal territorial waters.

6. **Destruction of fish by poisoning prohibited.**—No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters.

7. **Catching and destruction of certain fish during certain period prohibited.**—No person shall, during the period from 1st day of April to 31st day of August each year, catch or cause to be caught or destroy fry of Shol, Gazar and Taki moving in clusters or the parent fish while guarding them in the rivers, canals, khals, beels or any other sheet of water which ordinarily has direct communication with any river, canal, khal or beel :

Provided that the prohibition shall not extend to the catching or destruction of the fry and the parent fish of the species named above for the purpose of carp culture.

8. **Catching of carp fishes prohibited in certain waters.**—(1) No person shall catch or cause to be caught carp fishes, that is Rui, Catla, Mrigal, Kalbaus and Ghania of any size in the waters of the rivers, khals, etc., specified in the First Schedule during the period mentioned in the said Schedule unless he has a licence therefor issued by a competent officer in this behalf :

Provided that no licence for catching of the abovenamed carp fish shall be allowed for purpose other than pisciculture.

(2) A licence issued under sub-rule (1) shall be issued in the form shown and shall be subject to the conditions as are specified on the face of the licence.

(3) There shall be collected a licence fee of Tk. 100 for each licence issued under this rule.

9. **Sale of fish prohibited.**—No person shall catch, carry, transport, offer, expose or possess fish of the species and sizes mentioned in columns 2 and 3 of the Second Schedule at any time during the period mentioned in column 4 thereof :

Provided that the prohibition shall not apply to the catching, carrying, sale, transport or possession of any fish for the purposes of, or in connection with, pisciculture.

FIRST SCHEDULE

[*see* rule 8(1)]

Sl. No.	Name of the river, canal, etc.	Period.
1	2	3
1	River Kushiara from the Fenchuganj Railway bridge up to village Lama Gangapur, Upazila Fenchuganj, District Sylhet.	From 1st April to 30th June in any year.
2	River Kushiara from its junction with Lula canal up to village Kakordi, Upazila Beanibazar, District Sylhet.	Ditto.
3	Lula canal from its junction with Kushiara river up to its junction with Hakaluki haor, Upazila Fenchuganj, District Sylhet.	Ditto.
4	Karchar Dala (flowing from the river Kalni also known as Beramohana) from village Karacha to Makalchandi haor, Upazila Baniachang, District Habigongj.	Ditto.
5	Chairer Khal (flowing from the river Kalni also known as Beramohana) from village Halalnagar up to Makalkandi haor, Upazila Baniachong, District Habigonj.	Ditto.
6	Bahushiar Dala (flowing from Bibiana) from village Bahusha up to Mokar haor, Upazila Nabiganj, District Habigonj.	Ditto.
7	Fatepur Khal (flowing from the river Shaka Kushiara) from village Fatepur up to Ghardiar Beel, Upazila Ajmirigonj, District Habigonj.	Ditto.
8	River Surma from its junction with Madhabpur Khal to its junction with Chenger Khal at the southern boundary of the village Parkal, Upazila Chhatak, District Sunamgonj.	Ditto.
9	River Surma from village Karirgaon up to the Chhatak Thanaghat, Upazila Chhatak, District Sunamgonj.	Ditto.
10	River Surma from its junction with Poinda river at the southern border of the Poinda village up to its junction with Rakiti River, Upazila Sunamgonj, District Sunamgonj.	Ditto.

10. **Disposal of forfeited fish.**—Any fish forfeited for a breach of any of these rules shall be disposed of by auction and the auction money thereof shall be deposited in such Head of Account of the Government as it may direct.

11. **Prohibition on catching, carrying, transporting, offering, exposing or possessing of frogs.**—Notwithstanding anything contained in these rules, the Government may, by notification in the official Gazette, prohibit the catching, carrying, transporting, offering, exposing or possessing of any frog dead or alive during such period in such area and with such exceptions as may be specified therein.

1	2	3
11	River Peain from its junction with Surma river up to village Pedar, Upazila Chhatak, District Sunamgonj.	From 1st April to 30th June in any year.
12	River Garakhal from its junction with river Peain up to its junction with Kurdhara, Upazila Chhatak, District Sunamgonj.	Ditto.
13	River Kataganj from its junction with river Peain up to its junction with Dala Dhalarmukh, Upazila Chhatak, Sunamgonj.	Ditto.
14	River Halda from its mouth in the river Karnafully near Kalurghat bridge up to Sadarghat ferry, Upazilas Panchlaish, Hathazari and Raozan, District Chittagong.	From 15th March to the 30th June in any year.
15	The undernoted channels flowing from the River Halda, within the jurisdiction of Hathazari and Raozan Upazilas, District Chittagong:	Ditto.

(1) Krishnakhali.

(2) Khondakia Khal.

(3) Katakhali.

(4) Madari Khal.

(5) Kumira Khal.

(6) Fragabalia Khal.

(7) Fatikka Khal.

(8) Khandarali Khal.

(9) Chengkhali Khal.

(10) Baizzakhali Khal.

(11) Daccakhali Khal.

(12) Mogdair Khal.

(13) Kagutia Khal.

(14) Sonai Khal.

| 16 | River Bengali (lower portion of which is locally known as Fuljore) from the northern extremity of village Chaknandan, Upazila Sariakandi, District Bogra, up to the southern extremity of village Simalbari, Upazila Sherpur, District Bogra. | From 1st April to 30th June in any year. |

1	2	3
17	River Karatoa (locally known as Fuljore) from the border of Serajgonj District up to river Baral, bounded on the north by the eastern extremity of village Chandaikona, Upazila Raigonj, District Sirajgonj and on the south by the southern extremity of village Dombaria, Upazila Shahzadpur, District Sirajgonj.	From 1st May to 31st July in any year.
18	River Ichamati from the border of Sirajgonj District up to river Karatoa bounded on the north by the northern extremity of village Brahmagacha and on the south by the southern extremity of village Nalka, Upazila Raiganj, District Sirajgonj.	Ditto.
19	River Tista from Tista Railway bridge near Kaunia Raliway junction up to Chilmari, Upazila Chilmari, District Kurigram.	From 15th May to 15th July in any year.
20	River Jumna falling in the districts of Bogra, Gaibandha, Pabna and Sirajgonj.	From 1st April to 31st July in any year.
21	River Brahmaputra falling in the District of Kurigram.	Ditto.
22	The canal known as Delbasania and Gazaria Khal from its mouth at Putimari river up to Bachadighi at Badekarapara in Bagerhat District.	From 1st October to 31st March in any year.
23	Gaguria khal from its origin from river Jumna up to river Bengali bounded on the east by the eastern boundary of village Simulbari and on the west by the northern extremity of village Sariakandi, Upazila Sariakandi, District Bogra.	From 1st April to 30th June in any year.
24	Belai Khal between rivers Jamuna and Bengali bounded on the east by eastern boundary of village Pakuria and on the west by the northern boundary of village Chhagaldhara, Upazila Sariakandi, District Bogra.	Ditto.
25	River Bengali from Maliandaha, Upazila Shaghata, District Gaibandha up to the border of Bogra District.	From 1st May to 31st July in any year.
26	River Haldia from village Gopinathpur up to Maliandaha Ghat, Upazila Shaghata, District Gaibandha.	Ditto.
27	River Baral from its origin in the river Padma up to the Railway bridge near Arani Railway Station in the District of Natore.	From 15th May to 31st July in any year.

APPENDIX F.II

SUPPORT CATCH AND MARKET DATA

AVERAGE PRICE AND WEIGHT (KG) OF SPECIES BY ZONE

ZONE : A

SPECIES	W1 KG	W1 (TK/KG)	W2 KG	W2 (TK/KG)	W3 KG	W3 (TK/KG)	W4 KG	W4 (TK/KG)	W5 KG	W5 (TK/KG)	W6 KG	W6 (TK/KG)	W7 KG	W7 (TK/KG)	W8 KG	W8 (TK/KG)
Ruhi	15.0	50.0	2.0	50.0	18.0	60.0	27.0	70.0	7.0	70.0	25.0	80.0	15.0	80.0	23.0	90.0
Catla			10.0	60.0	23.0	60.0	21.0	70.0	11.0	70.0	18.0	80.0	10.0	70.0	31.0	65.0
Mrigal			2.0	50.0	10.0	60.0					12.0	70.0	22.0	70.0	14.0	65.0
Kalbasu					3.0	60.0	10.0	65.0	9.0	65.0	10.0	70.0	25.0	70.0	26.0	60.0
Ghainna																
Boal	11.5	50.0	2.0		13.0	60.0	13.0	60.0	5.0	60.0	11.0	65.0	11.0	60.0	11.0	65.0
Air					6.0	60.0	18.0	65.0	3.0	65.0	5.0	65.0	21.0	60.0	13.0	60.0
Pangas			20.0	40.0	51.0	65.0			12.0	65.0	4.0	70.0	14.0	65.0	9.0	67.0
Shol/Gazar			1.0	50.0	35.0	50.0	32.0	45.0	31.0	45.0	29.0	45.0	28.0	45.0	31.0	46.0
Chital/Phali			2.0	70.0	14.0	50.0					15.0	50.0	10.0	55.0	8.0	55.0
Koi			3.0	50.0	7.0	60.0	11.0	75.0	3.0	65.0	2.0	60.0	7.0	55.0	13.0	55.0
Singi/Magur					18.0						2.0	65.0	10.0	60.0	15.0	60.0
Sar Punti																
Big Shrimps	3.0	180.0	5.0	40.0	11.0	35.0	3.0	200.0	5.0	40.0	5.0	160.0	5.0	160.0	9.0	140.0
Small Srimps							2.0	40.0			15.0	40.0	11.0	40.0	15.0	40.0
Tengra	7.0	40.0					7.0	60.0			10.0	55.0				
Pabda																
Punti			1.0	25.0	10.0	20.0					25.0	40.0	18.0	45.0	20.0	25.0
Miscellaneous			21.0													
Chela							5.0	58.0			22.0	45.0	5.0	55.0		
Kakila							4.0	40.0								
Hilsha	690.0	48.0	320.0	50.0	320.0	40.0	250.0	50.0	310.0	50.0	180.0	50.0	185.0	50.0	95.0	50.0
Baim	10.0	30.0					7.0	55.0			10.0	50.0	7.0	50.0	10.0	45.0
Baila	5.5	30.0									10.0	45.0			5.0	45.0
Taki			1.0	40.0			15.0	40.0	4.0	40.0	28.0	30.0			7.0	28.0
Bheda																
Chewa/Chering																
Coral	.5	100.0														
Taposi	5.5	40.0														
Kakra	3.5	20.0														
Silver carp	13.0	50.0							2.0	30.0						
Carpio																
Loitta	19.0	27.0							15.0	55.0			20.0	45.0	18.0	50.0
Poa							6.0	60.0			29.0	55.0	12.0	56.0		
Batta																
Rita																
Paukal																
Bacha			2.0	60.0	7.0	55.0	19.0	65.0	7.0	60.0	18.0	62.0	8.0	60.0	12.0	55.0
Cutcutia			2.0	55.0	6.0	50.0										

ZONE :   B

AVERAGE PRICE AND WEIGHT (KG) OF SPECIES BY ZONE

SPECIES	W1 KG	W1 (TK/KG)	W2 KG	W2 (TK/KG)	W3 KG	W3 (TK/KG)	W4 KG	W4 (TK/KG)	W5 KG	W5 (TK/KG)	W6 KG	W6 (TK/KG)	W7 KG	W7 (TK/KG)	W8 KG	W8 (TK/KG)
Ruhi	85.0	60.0	40.0	50.0	45.0	60.0	55.0	55.0	50.0	55.0	95.0	60.0	215.0	60.0	185.0	70.0
Catla	80.0	50.0	45.5	40.0	50.0	55.0	40.0	50.0	55.0	50.0	100.0	55.0	205.0	55.0	200.0	65.0
Mrigal	45.0	45.0	45.0	35.0	10.0	55.0	20.0	45.0	20.0	50.0	20.0	45.0	40.0	45.0	65.0	45.0
Kalbasu			15.0	40.0												
Ghainna	3.0	55.0	35.0	20.0	1.0	40.0	3.0	45.0								
Boal			10.0	60.0					4.0	40.0			7.0	60.0	10.0	65.0
Air							5.0	40.0							8.0	70.0
Shol/Gazar			15.0	45.0	15.0	35.0	11.0	35.0	5.0	45.0	25.0	40.0	56.0	45.0	52.0	50.0
Chital/Phali							3.0	50.0	16.0	40.0					6.0	70.0
Koi	16.0	70.0	25.0	55.0	25.0	55.0	16.0	55.0	3.0	50.0	26.0	65.0	35.0	65.0	35.0	65.0
Singi/Magur	15.0	62.5	40.0	62.5	54.0	92.5	16.0	62.5	12.0	55.0	53.0	77.5	45.0	85.0	24.0	85.0
Sar Punti	2.0		.5	45.0			20.0	60.0	18.0	62.5	3.0	60.0				
Big Shrimps	35.0	50.0	45.0	60.0	1.0	200.0	2.0	200.0	12.0	60.0	2.0	200.0				
Small Srimps	16.0	100.0	16.0	65.0	5.0	35.0	20.0	30.0	20.0	30.0	18.0	30.0	27.0	45.0	22.0	45.0
Tengra	5.0	25.0	8.0	15.0	20.0	25.0	8.0	35.0	15.0	35.0	3.0	35.0			9.0	45.0
Pabda	30.0	20.0														
Punti	16.0	45.0	40.0	20.0			18.0	25.0	25.0	25.0	20.0	25.0	35.0	30.0	34.0	35.0
Miscellaneous			50.0	45.0	15.0	40.0	15.0	20.0	20.0	20.0	22.0	20.0	5.0	30.0	25.0	40.0
Hilsha	195.0	45.0	225.0	45.0	394.0	30.0	172.0	45.0	230.0	45.0						
Baim	7.0	50.0	10.0	45.0	5.0	30.0			10.0	35.0			2.0	50.0	12.0	65.0
Baila			7.0	45.0					25.0	50.0			2.0	56.0		
Taki			10.0	30.0	10.0	30.0	7.0	30.0	15.0	25.0	26.0	25.0	40.0	45.0	20.0	45.0
Bheda	4.0	50.0	5.0	50.0	45.0	55.0	5.0	55.0	30.0	55.0						
Chewa/Chering	6.0	40.0	15.0	55.0	15.0	70.0	10.0	50.0	10.0	50.0			14.0	55.0	8.0	60.0
Coral	10.0	56.0									25.0	25.0	8.0	65.0	10.0	75.0
Kakra											34.0	55.0				
Silver carp	5.0	55.0	50.0	45.0	30.0	50.0	25.0	40.0	20.0	40.0	36.0	45.0	45.0	55.0	75.0	65.0
Carpio	55.0	45.0			2.0	60.0	35.0	50.0	25.0	50.0	5.0	45.0	2.5	60.0	16.0	60.0
Talapia					3.0	55.0	12.0	45.0	15.0	45.0	48.0	60.0	18.0	50.0	12.0	62.0
Mola	45.0	25.0	70.0	30.0	55.0	35.0	5.0	20.0					4.0	45.0	15.0	38.0
Bighead			8.0	25.0			60.0	40.0	45.0	40.0			58.0	60.0	85.0	65.0
Gutum													10.0	75.0		
Colisha							3.0	30.0			3.0	40.0				
Baicha	4.0	14.0	15.0	20.0												
Keski			25.0	15.0	6.0	35.0			5.0	20.0	14.0	30.0			15.0	60.0
Chapila	15.0	15.0	18.0	35.0			5.0	20.0					4.0	56.0		
Chanda																
Rup-chanda											10.0	150.0				
Loitta											35.0	30.0				
Poa					35.0	30.0			35.0	30.0					60.0	
Batta									25.0	40.0						

AVERAGE PRICE AND WEIGHT (KG) OF SPECIES BY ZONE

ZONE : C

SPECIES	W1 KG	W1 (TK/KG)	W2 KG	W2 (TK/KG)	W3 KG	W3 (TK/KG)	W4 KG	W4 (TK/KG)	W5 KG	W5 (TK/KG)	W6 KG	W6 (TK/KG)	W7 KG	W7 (TK/KG)	W8 KG	W8 (TK/KG)
Ruhi	10.0	35.0											10.0	55.0	60.0	65.0
Catla							20.0	45.0					20.0	50.0	60.0	55.0
Mrigal													2.0	40.0	30.0	60.0
Kalbasu																
Ghainna																
Boal	20.0	60.0					1.0	50.0							10.0	50.0
Air															5.0	60.0
Pangas																
Shol/Gazar	20.0	40.0					27.0	30.0					20.0	30.0	30.0	45.0
Chital/Phali																
Koi	80.0	60.0					21.5	50.0					20.0	60.0	40.0	65.0
Singi/Magur	22.0	65.0					13.0	70.0					12.0	70.0	35.0	70.0
Sar Punti																
Big Shrimps																
Small Srimps	2.0	20.0					13.5	18.0					12.0	20.0	8.0	20.0
Tengra	.5	40.0													10.0	40.0
Pabda	.5	35.0					1.5	60.0					2.0	50.0		
Punti	102.5	22.0					83.0	22.0					75.0	25.0	12.0	25.0
Miscellaneous																
Chela																
Kakila																
Hilsha	230.0	55.0					240.0	50.0					120.0	55.0		
Baim	1.0	22.0					2.5						2.0	30.0	6.0	35.0
Baila																
Taki	17.0	40.0					14.0	20.0					10.0	25.0	20.0	35.0
Bheda																
Chewa/Chering																
Coral																
Taposi																
Kakra																
Silver carp																
Carpio							20.0								25.0	60.0
Talapia																
Mola	2.0	25.0					7.0	25.0					10.0	30.0	35.0	45.0
Bighead	33.5	30.0					40.0	45.0					40.0	40.0	3.0	30.0
Gutum	2.0	25.0													5.0	40.0
Colisha	2.0	30.0					4.0	25.0					5.0	40.0	4.0	25.0
Baicha																
Chanda																
Surma							8.0	35.0								

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AVERAGE PRICE AND WEIGHT (KG) OF SPECIES BY ZONE

ZONE : D

SPECIES	W1		W2		W3		W4		W5		W6		W7		W8	
	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)	KG	(TK/KG)
Ruhi		90.0			15.0	57.5					12.0	80.0	8.0	80.0		
Catla		70.0			23.0	52.5					25.0	60.0	7.0	70.0		
Mrigal		65.0									14.0	60.0				
Kalbasu		70.0														
Ghainna							20.0	45.0	2.0	50.0						
Boal		80.0	6.0	70.0	15.0	80.0	1.0	40.0	7.0	42.5	10.0	45.0	5.0	60.0	40.0	80.0
Air					20.0	70.0			5.0	50.0	12.0	45.0	6.0	65.0	160.0	95.0
Pangas																
Shol/Gazar		30.0	8.0	35.0	9.5	35.0	2.0	30.0	10.0	35.0	28.0	32.5	5.0	45.0		
Chital/Phali					2.0	35.0			5.0	37.5						
Koi		60.0	4.0	75.0	11.5	60.0	4.0	55.0	17.5	55.0	40.0	67.5	6.0	75.0		
Singi/Magur			2.0	60.0	4.0	60.0	4.0	60.0	7.5	60.0	30.0	67.5	3.0	90.0		
Sar Punti																
Big Shrimps		150.0	5.0	150.0	6.5	47.5			16.5	140.0	15.0	150.0			25.0	315.0
Small Srimps		40.0	2.0	30.0							16.0	17.5	5.0	20.0		
Tengra		70.0							24.5	40.0	32.0	27.5	3.0	40.0		
Pabda									1.0	50.0						
Punti			6.0	40.0	10.0	30.0	8.0	35.0	72.0	25.0	63.0	25.0	4.0	25.0		
Miscellaneous			8.0	35.0	4.0	20.0	5.0	20.0			4.0	15.0	2.0	15.0		
Chela					4.0	20.0					3.0	25.0				
Kakila																
Hilsha			13.0	70.0	20.0	45.0	60.0	50.0	6.0	35.0	21.0	32.5	40.0	50.0	200.0	30.0
Baim			2.0	60.0	6.5	32.5	2.0	40.0	3.0	25.0			4.0	40.0		
Baila																
Taki			2.0	35.0	4.5	35.0			19.5	27.5	20.0	25.0	3.0	20.0		
Bheda									.5	45.0	8.0	35.0				
Chewa/Chering																
Coral					25.0	90.0	40.0	45.0					8.0	45.0		
Silver carp					25.0	37.5							6.0	45.0		
Carpio					5.0	35.0										
Talapia							3.0	45.0								
Mola					1.0	30.0	4.0	25.0			8.0	27.5				
Bighead					12.0	40.0					10.0	40.0				
Gutum					.5	30.0					5.0	25.0				
Colisha					.5	35.0					8.0	35.0				
Baicha					.5	30.0	3.0	30.0								
Chanda																
Batta																
Rita					6.0	45.0			2.0	25.0	4.0	20.0	3.0	20.0		
Cutcutia					12.0	80.0					4.0	15.0				

TYPE OF MARKETS AND DEALERS

Zone	Type of Markets			Total	Arotdar	Wholesaler	Ratailer	Part Time Dealer	TOTAL
	Wholesaler #	Retailer #	Both #	#					
A		8		8			294		294
B			8	8	102	131	623	97	953
C		2	2	4		2	93	42	137
D	1	1	8	10	25	110	341	81	557
Total	1	11	18	30	127	243	1351	220	1941

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APPENDIX F.III

CALENDAR OF FISH ACTIVITIES

Calendar of Fish Activities

			Water level					Flood period							
		Month	J	F	M	A	M	J	J	A	S	O	N	D
Crop Calender	F 3	B aman			▓	▓	▓	▓	▓	▓	▓	▓	▓	
		L boro	▓	▓	▓								▓	▓
		HYV boro		▓	▓	▓								
		Pulses	▓	▓									▓	▓
		Oil seed	▓	▓									▓	▓
	F 4	L boro	▓	▓	▓	▓								▓
Major carps eg Catla catla Labeo rohita Cirrhinus mrigala		Spawning migration				▓	▓	▓						
		Breeding					▓	▓	▓					
		Spawning					▓	▓	▓					
		Dispersal of young over floodplain and growth						▓	▓	▓	▓	▓		
		Return of young to beel and river										▓	▓	
		Harvest in beel and river	▓	▓	▓									
		Harvest during spawning migration					▓	▓	▓					
Minor carps eg Cirrhinus reba Labeo gonius puntius sophore		Spawning migration (lateral migration to floodplain)				▓	▓	▓						
		Breeding					▓	▓	▓	▓	▓			
		Spawning					▓	▓	▓	▓	▓	▓		
		Dispersal of young over floodplain and growth						▓	▓	▓	▓	▓		
		Return of young to beel, river and standing water										▓	▓	
		Harvest in beel and river												
		Harvest during spawning migration												
Catfish eg Wallago attu Mystus aor		Spawning migration *(eg Wallago attu)*			▓	▓	▓	▓						
		Breeding			▓	▓	▓	▓	▓					
		Spawning			▓	▓	▓	▓	▓					
		Dispersal of young over floodplain and growth												
		Return of young to beel, river and standing water										▓	▓	
		Harvest in beel and river												
		Harvest during spawning migration												

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	Month	J	F	M	A	M	J	J	A	S	O	N	D
						Water level		Flood period					
Small catfish	Spawning migration						■						
	Breeding			■	■	■	■	■	■				
eg Heteropneustes fossilis	Spawning				■	■	■	■	■	■			
Mystus vittatus	Dispersal of young over floodplain and growth												
Ompok spp	Return of young to beel, river and standing water										■	■	
Pangasius sp	Harvest in beel and river												
	Harvest during spawning migration												
Snakeheads	Spawning migration												
	Breeding	■	■		■	■	■	■	■	■	■	■	
Channa sp	Spawning	■	■		■	■	■	■	■	■	■	■	
	Dispersal of young over floodplain and growth												
	Return of young to beel, river and standing water										■	■	
	Harvest in beel and river												
	Harvest during spawning migration												
Floodplain	Spawning migration (lateral migration to floodplain)					■	■	■					
	Breeding (Reproduction)					■	■	■	■				
resident species	Spawning					■	■	■	■				
	Dispersal and growth						■	■	■	■			
	Return to standing water									■	■		
	Harvest					■	■	■	■	■	■		
	Dry season residence in standing water	■	■	■	■							■	■
Giant freshwater	Mogration to eatuary		■	■	■								
	Spawning in estuary					■	■	■					
prawn	Juvenile migration to freshwater							■	■	■			
	Feeding dispersal into floodplain								■	■	■		
	Harvest	■	■							■	■	■	

Overland migration by H. fossilis and C. batrachus at beginning of monsoon

Peak breeding (breeds almost throughout the year)

APPENDIX F.IV

PRELIMINARY LIST OF FISH AND PRAWNS
IN THE NOAKHALI NORTH AREA

PRELIMINARY LIST OF FISH AND PRAWN SPECIES OCCURRING IN THE NOAKHALI NORTH PROJECT AREA

Habitat code: B = Beel, F = Floodplain, R = Main River, K = Khal, Minor River, P = Pond, IF = Inundated Field, E = Estuary, M = Marine

Ecological code: O = Omnivorous, C = Carnivorous, P = Piscivorous, Mo = Mollusc–eater, I = Insectivorous, Pl = Plancton–feeder, Pr = Predator, H = Herbivorous, D = Detritus–feeder, M = Mud–eater
DM = Decaying matter–eater

Distribution code: R = Resident, M = Migratory, I = Introduced

Occurrence code: 1 = Widespread, 2 = Common, 3 = Rare, 4 = Decreasing, 5 = At risk, 6 = Extinct

Scientific Name	Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	N1	N2	N3	N4
Class – Osteichthyes										
Order – Osteoglossiformes										
Family – Notopteridae (Featherbacks)										
Notopterus chitala	Chital	R,K,F,P	2	5	R	C,Pr				
Notopterus notopterus	Foli	R,F,P,K	1	2	R	C			1	
Order – Anguilliformes										
Family – Ophichthidae (Worm Eels, Snake Eels)										
Pisodonophis boro	Kharu, Hijra	R,IF,E			R,M					
Order – Clupeiformes										
Family – Clupeidae (Herrings, Shads)										
Corica soborna	Kachki	R	2	3	R					
Gudusia chapra	Chapila	R,B,P,IF	2	4	R	Pl				
Hilsa ilisha	Hilsa, Ilish	R,E			R,M			1		
Family – Engraulididae										
Coilia dussumieri	Olua	E,R			R,M					
Setipinna phasa	Phasa	R,E			R					
Stolephorus spp.		R,E			R					
Order – Cypriniformes										
Family – Cyprinidae (Carps, Barbs, Minnows)										
Amblypharyngodon mola	Mola	R,K,B,F,P,IF	2	3	R					
Barilius vagra	Khoksa,Koksa	R,K			R					
Brachydanio (Danio) rerio	Anju	R,K,F,IF			R					
Catla catla	Catla	P,R,B,K,F	1	2	R,M	O				1

Scientific Name		Common Name	Habitat	Occurrence Past	Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Chela	cachius	Chep Chela, Pata Chela	K,R,B,P	2	3	R					
Chela	laubuca	Laubuca	K,R,B,P	2	5	R					
Cirrhinus	mrigala	Mrigal	R,B,K,F,P	2	2	R	H				
Ctenopharyngodon	idellus	Grass Carp	P		2	I	H				
Cyprinus	carpio	Carp	P		2	I					
Danio	acquipinnatus	Septi, Chebli	F,R,IF			R					
Hypophthalmichthys	molitrix	Silver Carp	P		2	I	Pl				
Hypophthalmichthys	nobilis	Bighead	P			I	Pl				
Labeo	calbasu	Kalbasu, Kalibaus	R,K,B,F,P	2	5	R	H				
Labeo	gonius	Ghonia	R,K,P	2	5	R	H		1		
Labeo	rohita	Rui, Rohit	R,K,B,F,P	2	2	R	H			1	
Osteobrama (Rohtee)	cotio	Keti, Chela, Dhipali	R,K,B,F,P,IF		2	R	H		1		
Puntius	chola	Chala Punti	R,K,F,P	1	2	R					
Puntius	sarana	Sar Punti	R,K,B,F	2	5	R					
Puntius	sophore	Punti	R,B,K,F,P	2	2	R				1	
Puntius	ticto	Tit Punti	K,B,F,P,IF	1	2	R	O				
Rashora	daniconius	Darkina	R,B,K,F,IF	2	3	R	Pl				
Salmostoma	acinaces	Chela	R,K,			?					
Family – Cobitidae (Loaches)											
Botia	dario	Rani, Batia	R,B,F	2	3	R					
Lepidocephalus	guntea	Gutum, Puiya	R,K,B,F,P	2	2	R					
Order – Siluriformes											
Family – Bagridae (Long Barbeled Catfishes)											
Aorichthys (Mystus)	aor	Ayre, Guji Air	R,B,K,P,IF,F	2	4	R		1			
Mystus	armatus	Tengra	R,K		4	R					
Mystus	cavasius	Golsha	R,B,K,F,IF	2	2	R					
Mystus	tengara	Kalo Bujuri, Bajari tengra	K,R,P,F,B	2	2	R					
Mystus	vittatus	Tengra	R,K,B,F,P	2	2	R			1		
Rita	rita	Rita	R,F,E		3	C					
Family – Siluridae (Butter Catfishes, Freshwater Sharks)											
Ompok	bimaculatus	Kani Pabda, Boali Pabda	R,K,B,IF	2	4	R					
Ompok	pabda	Madhu Pabda	R,K,B,IF,P	2	4	R					
Wallago	attu	Boal	R,K,F,B,P		4	R	P,Pr	1	1	1	

Scientific Name	Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Schilbeidae (River Catfish)										
Clupisoma garua	Ghaura	R,K	2		R	C,DM				
Eutropiichthys vacha	Bacha	R,K		5	R	O				
Silonia silondia	Shilong	R,E			R,M	Pr				
Family – Pangasiidae										
Pangasius pangasius	Pangas	R,E			R,M	C,Mo	1			
Family – Sisoridae (Hillstream Catfish)										
Bagarius bagarius	Baghair, Acer	R,K,B,F			R	C,Pr				
Family – Clariidae (Air–Breathing Catfish)										
Clarias batrachus	Magur	B,K,P,F,IF	2	4	R					
Family – Heteropneustidae (Stinging Catfish)										
Heteropneustes fossilis	Shingi	K,B,P,F,R	2	4	R					
Family – Chacidae (Square–Head Catfish)										
Chaca chaca	Cheka	R,K,B,F,P								
Order – Cyprinodontiformes										
Family – Belonidae (Gars)										
Xenentodon cancila	Kaikka	K,R,B,IF,P	2	2	R					
Family – Oryziidae (Ricefishes)										
Oryzias melastigma	Bechi, Kanpona	R,K,E,P			R	Pl,I				
Order – Syngnathiformes										
Family – Syngnathidae (Pipefishes)										
Microphis cuncalus	Kumirer Khil	E,R			R					
Order – Synbranchiformes										
Family – Synbranchidae (Swamp Eels, Mud Eels)										
Monopterus cuchia	Kuchia	B,K,F,P,IF	2	3	R					
Order – Perciformes										
Family – Centropomidae (Barramundis)										
Lates calcalifer	Coral, Bhetki	E,R			R,M					

Scientific Name		Common Name	Habitat	Occurrence Past	Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Ambassidae (Glass Perches, Snook)											
Chanda	beculis	Chanda	K,B,P,F	2	2	R					
Chanda	nama	Nama Chanda	K,B,P,F,IF	2	1	R					
Chanda	ranga	Ranga –Chanda, Lal Chanda	K,B,P,F,IF	2	3	R					
Family – Sciaenidae (Drums, Croakers)											
Pama	pama	Poa	R,E			R,M					
Family – Nandidae (Mudperches)											
Badis	badis	Koi Bandi, Napit	K,B,F,P	2	3	R					
Nandus	nandus	Meni, Bheda	K,B,F,P	2	3	R	Pr				
Family – Cichlidae (Cichlids)											
Oreochromis	mossambicus	Tilapia	P			I					
Oreochromis	niloticus	Tilapia	P			I					
Family – Mugilidae (Mullets)											
Rhinomugil	corsula	Khorsula, Bata, Khalla	R,E			R					
Family – Polynemidae (Threadfins)											
Polynemus	paradiseus	Tapasi, Muni, Rishi	R,B,K			R					
Family – Gobiidae (Gobies)											
Apocryptes	bato	Chiring	R,K,E			R					
Glossogobius	guiris	Belle, Bailla	E,R,K	2	2	R	C				
Periophthalmus	koelreuteri	Mudskipper	E			R					
Family – Eleotrididae (Gudgeons, Sleepers)											
Eleotris	fusca	Dora Baila, Kuli	M,I,E,R.	2	3	R					
Family – Gobioididae (Eel like Gobies)											
Odontamblyopus	rubicundus	Lal Chewa	R,K,E			R					
Family – Anabantidae (Climbing Perches)											
Anabas	testudineus	Koi	B,K,F,P	2	3	R			1		

Scientific Name		Common Name	Habitat	Occurrence Past	Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Belontiidae (Gouramies)											
Colisa	fasciatus	Khalisha	B,K,P,F	2	3	R					
Colisa	labiosus	Baicha	R			?					
Colisa	lalius	Lal Khailsha, Boicha	B,K,P			R					
Family – Channidae (Snake Heads, Murrels)											
Channa	marulius	Gajar, Gajal	B,K,R,F	2	3	R	C		1	1	
Channa	orientalis	Cheng, Gachua	R,K,B,F,P	2	4	R	C				
Channa	punctatus	Taki, Lata	B,K,F,P	2	3	R	C,Pr				
Channa	striatus	Shol	B,R,K,F,P,IF	2	2	R	C		1		
Family – Mastacembelidae (Spiny Eels)											
Macrognathus	aculeatus	Tara, Baim	B,K,F,R,IF,P	2	3	R					
Mastacembelus	armatus	Baim, Bam, Sal Baim	R,K,F,B,IF,P	2	4	R					
Mastacembelus	pancalus	Guchi, Baim, Pankal	K,F,B,P,IF	2	2	R					
Order – Tetraodontiformes											
Family – Tetraodontidae (Puffer Fishes)											
Chelonodon	fluviatilis	Potka	R,F,E			R,M					
Tetraodon	cutcutia	Tepa, Kutkuitta	R,K,F,B,P			R					
Class Crustacea											
Order – Decapoda											
Family – Palaemonidae											
Macrobrachium	dalichodactylus	Guda Icha	R,B,F			R					
Macrobrachium	dyanus	Kaira Icha	R,B,F			R					
Macrobrachium	lamarrei	Knunchu Icha	R,B,F,P	2	1	R					
Macrobrachium	malcolmsonii	Chatka Icha	R,B,F			R					
Macrobrachium	mirabilie	Latia Icha	R,B,F,P			R					
Macrobrachium	rosenbergii	Golda Icha, Golda Chingri	R,B,F	1	4	R	1				
Macrobrachium	styliferus	Choto Chingri, Small Shrimps				?		1	1		
Macrobrachium	villosimanus	Katholia Icha	R,B,F			R					

APPENDIX F.V

LIST OF FISHING GEARS

Fishing Gears Used In Inland Waters with Local Names and Modifications

English Names	Local Names	Remarks
Cast Net	Jaki Jal, Kharki Jal, Pak Jal, Khapla Jal, Moya Jal	Operated by individual fisherman casting from banks, knee deep water, boat or floats.
Cast Net	Uther Uter	Large in size, operated by two persons from a boat, covers more areas.
Hand-scoop Net	Thela Jal	Hand operated small net fitted in a rectangular bamboo frame
Lift Net	Vel Jal Khara Jal	Net fitted in a 'V' shaped bamboo frame and pivoted on a bamboo pole gantry
	Nouka Veshal	Lift net operated from mobile boat
Stake Net	Mokh Jal Bedge Jal	Funnel shaped, fixed in stakes or buoys, operated by three or four persons from a boat
Seine Net or Shore Seine Net	Ber Jal Bare Jal Jagat Ber Jal	Large net, 50-57 mm. Mesh size, operated by 12-14 fishermen for encircling a large water area
	Dal Jal Khatha Jal Jagh Jal Bichan Jal	Ordinary seine net rectangular shape operated by 5-20 persons depending on size. Sometimes the net is set by two boats one at each end to enclose the area quickly
	Kona Ber Kal Masher Jal Chara Kal	Rectangular seine net with fine mesh, two-eight persons operate the net
	Tona Jal	A very large seine net operated by nine to twenty persons
	Dharma Jal	Small in size operated from a boat
Gill Net	Fash Jal, Koi Jal Moi Jal, Goar Jal Punti Jal	Trap net, placed in a fixed place over night, rectangular. The mesh size determines what kind of fish will be caught.
	Current Jal Chadi Jal	Trap net with fine mesh & made up of nylon twine operated in flowing waters
Dip Net	Chak Jal	Square shaped net tied loosely to crossed bamboos and operated from a boat or a fixed place close to shore
Traps	Chai Ghuni Polo Bhan	Made of netting on a frame, woven bamboo strips or basket works of several shapes and sizes.

APPENDIX F.VI

FISHERIES DEVELOPMENT AND THE FLOOD ACTION PLAN

APPENDIX F.6

FISHERIES DEVELOPMENTS AND THE FLOOD ACTION PLAN

Impacts of FCD and FCDI Projects on Fisheries - Lessons from Existing Schemes in the South East Region

Two main types of fisheries impact due to FCD and FCDI project interventions have been reported. The first relates to pond fish culture, which is usually benefited from FCD, and the second relates to inland capture fisheries which are almost invariably severely damaged. The pond culture benefits are realised mainly by land owners and farmers who also stand to benefit from the positive agricultural impacts obtained by FCD/FCDI. The impact on capture fishing will be experienced by large numbers of landless fishermen, especially occasional fishermen who depend upon the fishery as a **free common good**. The net impact of FCD/FCDI projects on fisheries is negative in the very large majority of cases (FAP 12, 1992; Thompson, 1990).

In the South East Region, two irrigation projects have been constructed, one in the area of Meghna-Dhonagoda and the other one in Chandpur. Some of the chief impacts caused by the FCD schemes in these areas have been summarised below:

Reduction of the Areas of Open Water Within FCDI Development

This reduction has severely affected subsistence fishing, especially for the poorer section of the rural population who rely on traditionally free fishing rights to provide the bulk of their animal protein food. Immediately affected are those people who cannot afford to purchase fish which previously they where able to catch for themselves. Large numbers of unemployed subsistence fishermen, including women and children, produce food for their families by catching fish in a hidden economy. As well as subsistence fishermen being affected, rural families engaged in part time fishing from floodplains, rivers/Khals and Beels will be effected to a variable extent, depending on the significance of fishing within their household economy.

Loss of Area of Perennial Water Bodies

Negative impacts on capture fisheries arise from FCDI works which reduce the area of perennial Beels and floodplain, resulting in the loss of breeding, nursery and feeding grounds for fish and other aquatic organisms, e.g. high value shrimps and prawns. The obstruction of migration routes from rivers into Beels and the floodplain, will alter and diminish fish stocks and species composition within and outside FCD boundaries. In addition, changes to the ecology of these areas have also resulted in increased aquatic vegetation. All these changes have detrimental effects on fishermen catch rates and earnings. The loss of high value migratory fish such as the major carps (Rui, Catla, Mrigal, etc.) and Hilsa will be felt immediately.

Reduction in Fish Stocks and Catches

Reduced fish stocks and lower catch rates endanger the livelihood of fishermen, many of whom have been forced to migrate from the impacted areas in search of alternative employment. Reduced catches also encourages the use of harmful fishing methods and overfishing of remaining waters in an effort to maintain production and income levels.

Reduction in the Social and Economic Status of Fishermen

Most of the full time fishermen are Hindus and it is unlikely that they will easily find alternative professions, being bound culturally to fishing. As fishermen are displaced they will be forced into unemployment or to find work as day labourers and will also suffer socio-economic difficulties, both at household and community levels.

Reduction in Fish Consumption by the Local Population

It is important to determine which members of the society will be most adversely effected. It is likely that the landless and poor will be affected first as they have less resources to purchase replacement sources with resulting nutritional consequences. Fishing opportunity and nutritional losses for poor people must be calculated and incorporated into the economic equation and the importance of the subsistence fishing should be quantified before costs and benefits are estimated. However, this is notoriously difficult to do and requires specific detailed studies for the recommended interventions

Reduction in the Average Size of Fish inside the Poldered Areas

This situation has been observed in the Chandpur Irrigation Project. It appears to be the result of intensified fishing in the remaining open water bodies within the polders, which are thus subjected to overfishing.

The Meghna-Dhonagoda Irrigation Project

This scheme provides an example of the type of changes that occur due to FCD/FCDI projects. The following is a summary of the findings reported by FAP 12 (FAP 12 Main Report, 1992):

Average fishing days in a year increased from 252 to 276, the average catch per fisherman per day dropped from 4.4 to 2.7 kg. The average catch during 1990-91 decreased from 977 Kg to 680 Kg. The quantity of fish sold by each fisherman dropped from 924 to 639 kg. Net income dropped from 18.266 Tk in the control area to 15,878 Tk inside the project area. Quantity of fish traded per dealer dropped from 29.66 MT to 17.15 MT. All fishermen who responded to the FAP 12 RRA recognised a loss in catch of 25% or greater and attributed this to the project.

The estimated value of lost production was conservatively estimated to be 33 million TK per year. To this must be added losses from internal waters and from river fishes which have lost spawning grounds. In comparison, the total crop output was tentatively estimated at 71 million Tk. Taking into account uncertainties in the data, the impact of lost fishing output may be critical for the economic viability of the project. It is therefore vital that the effect of lost capture fisheries be incorporated in the economic cost benefit analysis as accurately as possible.

In 1985, MPO forecasted a 35% drop in per capita fish consumption by the year 2,005 by relating demand and production. Most of this loss was assumed to be due to a partial loss of the area available to floodplain fisheries. An estimated 3.14 million hectare were proposed to be bought under FCD and FCDI projects by the year 2005, a full 2 million of which will be fully flood-free area and the aquatic environment in 1.4 million hectares will be changed by delaying flooding or reducing the water surface area. According to MPO, if these projects were to happen, one third of Bangladesh's floodplain will vanish over 2 decades (MPO 1985).

Expansion of the areas of irrigated HYV crops within FCD developments has led to increased use of chemical fertilizers and pesticides and resulted in a higher risk of contaminated runoff and potentially residual water bodies. This may lead to higher mortality rates for aquatic species especially in the juvenile stages of all types of resident species and particularly fish which breed in enclosed Beels or adjacent flooded areas.

Culture Fisheries

There is a potential benefit for culture fisheries in closed water bodies such as ponds, borrow pits and canals. The Meghna-Dhonagoda Irrigation Project has improved conditions for culture fisheries by preventing (except in the serious embankment breach such as in the 1987-88 floods) the inundation of ponds and loss of stocked fish. The Inland Fisheries Project of Bangladesh which started in Comilla in 1984 achieved a total production from 1984 to 1987 of 217,856 MT, which was below the predicted production of 375,777 MT. The discrepancy is believed to have been caused by heavy losses suffered due to flooding in 1987 and 1988 (Rotary Club of Comilla, 1988).

Protection against flood overtopping encourages regular restocking, improved culture methods and pond rehabilitation. Moreover, benefits to culture fisheries have not always materialised due to ineffective flood control caused by poor maintenance, the accumulation of water hyacinth, faulty design of FCD infrastructures and lack of credit for fisheries extension programmes.

To conclude, the impact of flood control projects on future fish production should be assessed in the context of rising demand for fish, declining yield, habitat destruction and the obstruction of fish migration routes. Falling fish production trends in areas inside and outside polders suggest that it will be increasingly difficult for the natural processes of replenishment of floodplains to occur.