INTERIM REPORT

FAP 17
FISHERIES STUDIES AND PILOT PROJECT

JULY 1993

Prepared for the Government of Bangladesh

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CONTENTS

ACRONYMS/GLOSSARY

ADAB	Association of Development Agencies of Bangladesh.
AEU	Agro-Ecological Unit.
BBS	Bangladesh Bureau of Statistics.
BRAC	Bangladesh Rural Advancement Committee
BRE	Brahmaputra Righ Embankment
BWDB	Bangladesh Water Development Board.
CAS	Catch Assessment Survey
CFP	Chatla-Fukuhati Project
CPP	Compartmentalisation Pilot Project
CPUE	Catch per Unit Effort.
DAM	Directorate of Agricultural Marketing
ELEFAN	Electronic Length Frequency Analysis
EPI	Expanded Programme for Immunization
EUS	Epizootic Ulcerative Syndrome
FAO	Food & Agriculture Organisation.
FAP	Flood Action Plan.
FCD/I	Flood Control Drainage/ Irrigation.
FES	Fishing Effort Survey
FRSS	Fisheries Resource Survey System.
GMM	Gross Marketing Margin
I&M	Institution and Marketing
ICLARM	International Center for Living Aquatic Resource Management
ITDG	Intermediate Technology Development Group
IVS	International Volunteer Services
JC	Jagorani Chakra
LFA	Length Frequency Analysis
LV	Livestock
MIKE 11	A microcomputer based modelling system for rivers and channels
MIP	Manu Irrigation Project
NA	Not Available
NCR	North Central Region
NER	North East Region
NGO	Non-Government Organisation
NL	Non-Agricultural Labour
NMM	Net Marketing Margin
NWR	North West Region
ODA	Overseas Development Administration.
PIS	Pabna Irrigation Scheme
PROSHIKA	Proshika Manobik Unnayan Kendra
PUK	Palli Ynnayan Kendra
RRA	Rapid Rural Appraisal
SBP	Satla-Bagda Project Polder 1
SE	Standard Error
SHP	Shanghair Hoar Project
SWMC	Surface Water Modelling Center
SWR	South West Region
TDS	Total Dissolved Soils
TGA	Target Group Approach
UNDP	United National Development Project
WB	World Bank

1 INTRODUCTION

Purpose of the Report

1.1 The main purpose of this report is to demonstrate the extent of progress in the implementation of the project FAP 17, Fisheries Studies and Pilot Project. In accordance with FAP reporting procedures, this is an intermediate report between the Inception Report, submitted in April 1993, and the Final Report, due for submission at the end of the project in 1994.

1.2 This report also details plans for the activities necessary to achieve project outputs (Appendix I), provides schedules for these outputs, describes the survey methodologies, and details of field procedures and procedures for the analysis of data being collected. The report demonstrates, following analysis of data collected from field programmes, the type and potential utility of the information which the project expects to be able to provide. It should be noted that **all analysis contained in this report is of a preliminary nature and intended for demonstration or illustrative purposes only**. Final conclusions cannot be drawn at this stage.

Planned Activities, Outputs and Objectives

1.3 The plans, schedules and procedures are now fully field tested and the results which they are designed to generate can be considered attainable with a higher degree of confidence than was possible at the inception phase of the project. An early and general finding of FAP 17 has been that the complexities of the physical, environmental, economic and social systems being studied and the logistical demands of gathering reliable, authoritative information about these systems have been underestimated.

1.4 In planning and implementing activities to achieve the required project outputs, it is necessary to keep in view the immediate project objectives. For this reason, and for ease of reference, the important immediate objectives are re-stated here. They are:

a) development of guidelines for the assessment of impacts of future flood control measures on communities and the fisheries resources they use. This will include indicators for technical assessment.

b) assessments of those changes in the economic and nutritional status of different groups which are due to the impact of flood control on fish production.

c) assessment of the factors affecting the flow and distribution of benefits from fisheries production.

d) evaluation of the effects of different flood control measures on the production of fisheries.

e) evaluation of the effects of different flood control measures on the movement and population of fishes.

f) assessment of the feasibility of technical and developmental measures to compensate for or reduce potential losses to fisheries due to flood control.

g) increased local expertise in the assessment of fisheries.

1.5 The development of guidelines for the assessment of impacts of future flood control measures is clearly a major objective which will draw on all the studies being conducted by FAP 17. It is also the objective with the greatest and most direct relevance to the FAP and any other future flood control programmes. It is important to note that it is a set of planning guidelines which this project is designed to achieve rather than a formula, model or simplistic indicator or set of indicators which can be automatically applied to any location in Bangladesh. The project will provide data upon which improved guidelines, and therefore improved approaches to flood control planning, can be based.

Main Constraints

1.6 The major constraint affecting any attempt to produce widely applicable rules, models, formulae or indicators of future impact is the difficulty in establishing acceptable bases for extrapolation from sites or communities which are studied by the project. Interpretation of the data from the core fisheries and socioeconomic programmes will be constrained by such difficulties and these are documented in the following sections of the report.

1.7 In the case of fisheries, it is the lack of reliable information on the depth and area of flooding which will constrain extrapolation of results. In the case of the socioeconomic data, complexity of the systems and the influence of factors, such as varying fisheries

management regimes, which are extraneous to flood control, will constrain wider extrapolation.

Integration of Project Outputs

1.8 The following sections of the report and the attached Appendices give detailed descriptions and illustrative examples which, it is hoped, will adequately serve the purposes outlined in paragraphs 1.1 and 1.2 above.

1.9 The number and range of studies contained within the FAP 17 programme gives rise to a highly complex picture. They are however designed to address a highly complex set of phenomena and it will only be when studies are completed that the integrated picture will properly emerge.

1.10 A key study for obtaining this integrated picture will be the study of the distribution of benefits from fisheries. This study will, by applying economic values to the catches of fish and by tracing these through the social systems which operate and influence the flow of benefits to different groups of people, understanding of which will have been enhanced by the other FAP 17 studies, bring the complex sets of information gathered into an integrated picture of the nature of impact of flood control measures.

1.11 From this, it will be possible to develop more informed advice - guidelines - on how to plan future flood control structures in ways which will avoid or at least reduce negative impacts on the quality of life of people dependent on the aquatic resources which are influenced by flood control measures.

2 IMPACTS ON FISH

OVERVIEW

2.1 A description of the complex nature of the inland fisheries of Bangladesh has been given previously in the Inception Report of FAP 17. This report described the close interrelationships between changes in fish populations and the seasonal hydrological cycles occurring in river and floodplain ecosystems. Much of this information had to be inferred from studies carried out elsewhere in the world, since in Bangladesh historically very little effort has been focused on inland capture fisheries, especially on systematic, long-term,

large-scale research programmes. These are required to generate accurate and detailed background information upon which rational fisheries development and management policies can be based.

2.2 They are also required to provide baseline data for the assessment of the impact of various engineering interventions. The Flood Action Plan (FAP) is preparing proposals for major engineering works, some of which may have significant impacts on the fisheries resources of Bangladesh. A characteristic feature of previous FCD/I developments has been the almost total disregard for their effects on fish resources and fishing communities. It is only very recently, particularly as a result of the Flood Action Plan, that the potential impact of FCD/I schemes on the fisheries sector has been considered at the pre-feasibility stage of the planning process.

2.3 It is in this context that FAP 17 was established as the main fisheries assessment component of the FAP. During the course of the FAP the major potential impacts of FCD/I schemes were identified (Table 2.1). These have been taken into account in immediate objectives, (a), (d), (e),(f) and (g) (paragraph 1.4). Project field activities established to address the immediate objectives, (d) and (e) are detailed below.

Fish Production Study

2.4 This study is designed to provide quantitative information on fish catch, catch composition and fishing effort in spatially paired comparisons of areas inside and outside FCD/I schemes for the purpose of impact assessment.

Fish Breeding Study

2.5 To identify breeding grounds and breeding seasons of important fish species and thereby obtain a greater understanding of the mechanisms by which flood control may disrupt life cycles, resulting in a loss of fish production.

Fish Movement Study

2.6 Seasonal movements of fish identified through temporal changes in catch composition in spatially linked sites will provide a clearer understanding in the ways FCD/I schemes may affect both the structure and magnitude of fish populations.

2.7 In addition, the fish movement study will provide information on the impact of embankments and regulators on the dispersal and survival of fish hatchlings and their recruitment into floodplain fisheries.

Fish Population Study

2.8 This study is designed to explain the effect of FCD/I schemes in terms of changes in population parameters such as growth, mortality, the rate of exploitation and recruitment.

Water Quality and Hydrology Study

2.9 This study provides a simple description of the aquatic environment important for fish production. It also provides information about the origin of floodwaters. The hydrological component of the study will describe the flooding patterns inside and outside FCD/I schemes.

2.10 These studies, once completed, will form the basis for the development of guidelines for the assessments of impacts of FCD/I schemes on fish production (objective (a)).

2.11 Objective (f) has been addressed through the completion of a desk study included as an Annex of this report.

2.12 Objective (g) has been addressed in establishing the field studies and in the analysis of the data by providing training for more than 70 local staff.

Table 2.1 Possible Impacts of Controlled Flooding on Fish Production

Aspects affected	Hydrological Changes					
	Reduction of flood extent.	**Reduction of flood depth.**	**Restriction of river bank overspill.**	**Reduction of area of dry season wet bodies**	**Reduction of water throughput.**	**Drainage congestion.**
Environmental capacity.	Reduction of floodplain environment.		Delay of inundation of floodplain.	Reduction of floodplain environment.		Uncertain.
Water quality.				Decrease in water quality.	Increased risk of pollution; eutrophication and deoxygenation.	Possible stagnation.
Ecosystem production.	Decrease in aquatic productivity. Loss of nutrient input for terrestrial production.	Increase in aquatic productivity.		Decrease in fish production.	Reduction of environmental production.	Uncertain.
Biodiversity.	Possible decrease in species diversity.		Decrease in fish species diversity; depletion of migratory species.	Possible reduction in species diversity.	Loss of fish species.	Uncertain.
Fish migration.			Loss of migration routes and decrease in distribution of fish hatchlings over the floodplains.		Degraded environment.	Possible reduction in the movement from floodplain to river during the flood recession.
Fish reproduction.		Possible increase for breeding grounds.	Disruption of breeding cycle.	Possible reduction in brood stock.	Increase in natural mortality.	Uncertain.
Fish growth.	Decrease in feeding grounds for fish.	Uncertain.	Loss of access to floodplains; reduced feeding opportunities.		Degraded environment, loss of feeding opportunities.	Uncertain.
Fish production.	Decrease in production.	Increased production potential for resident floodplain fish. Outcome for fisheries production uncertain.	Increased susceptibility to capture due to restricted entry to the floodplains through regulators and channels. Long-term reduction of fisheries production.	Reduced fish production due to increased fishing pressure and loss of habitat.	Reduction in fisheries production.	Uncertain.
Capture fisheries sustainability.	Decrease in sustainability.	Uncertain	Increased susceptibility to overfishing.	Decrease in sustainability.	Increased susceptibility to overfishing.	Uncertain.
Aquaculture and culture based fisheries.	Increased availability of land for pond and boro rice/fish culture.	Increased potential for T-Aman rice/fish culture.	Reduced risk to aquaculture investment.	Increased availability of land for boro rice/fish culture.	Uncertain.	Increased potential for aquaculture development and beel stocking.

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2.13 Methodologies used in the fisheries surveys, the results of which will fulfil Objectives (a), (d), (e), (f) and (g), are explained in detail below.

Selection of sampling sites

2.14 The choice of flood control schemes was determined by criteria set out in the Inception Report (April 1993). The selected schemes fulfil the need to assess different types of flood control and have affected the hydrology of the impacted area in different ways. The schemes are listed in Table 2.2.

2.15 The establishment of the most suitable sites for fisheries assessment in four regions of Bangladesh involved a considerable amount of preparatory work. The criteria for selection of sites and methodology used for the selection has been documented in the Inception Report.

2.16 The sampling sites in the North Central (NC), North West (NW), North East (NE) and the South West (SW) regions are given in Appendix VII of the Inception Report.

Table 2.2 Flood Control Schemes studied by FAP 17

Name of flood control scheme	Type of scheme	Functioning
Compartmentalisation Pilot Project (CPP) in Tangail (NC)	FCD	Not yet completed as a compartmentalisation project, some flood protection, but no regulation of flooding or drainage.
Pabna Irrigation Scheme (PIS) (NW)	FCDI	Successful flood control and drainage. Until 1993, pumped drainage and irrigation through Bera was not available. Pumped drainage through Katiola was sporadic.
Brahmaputra Right Embankment (BRE) (NW)	Full river embankment	Successful flood control in the study area.
Chalan Beel Polder B (NW)	FCD	Successful flood control and drainage.
Manu Irrigation Project (MIP) (NE)	FCDI	Irrigation resulting from closure of the barrage in winter. Several breaches since completion have effected the success.
Shanghair Hoar Project (SHP) (NE)	FCD - with submersible embankments	Variable reports of the success of submersible embankment delaying flooding until after 15 May.
Chatla-Fukuhati Project (CFP) (SW)	FCD	All regulators not working well, but some control of flooding and drainage.
Satla-Bagda Project Polder 1 (SBP) (SW)	FCD	Successful flood control and drainage.

Field Surveys

Fish Production Study

2.17 A number of surveys have been established at sites inside and outside the flood control schemes described above. To assess the effect of FCD/I schemes on the total production from an area (**Objective (d)**), two core surveys were established: a catch assessment survey (CAS) and a fishing effort survey (FES).

2.18 The choice of questions for the CAS and observations made during the FES were developed during the training period for the fisheries biologists, who tested responses to various questions and together with senior personnel checked the feasibility and timing of different tasks.

2.19 A summary of the use of each survey form is given in Table 2.3.

Table 2.3 Summary of the purpose of survey forms for each survey

Reference number	Survey	Purpose of information on form
CA01	CAS	Questionnaire to establish: times of fishing by gear (day & night); characteristics of gear; age, sex & status of fisherman/fishermen. CA01 OR CA01a OR CA01b are completed.
CA01a	CAS	Questionnaire to establish: frequency katha fishing; characteristics of gear surrounding katha; age, sex & status of fisherman/fishermen; marketing of catch and leasing system.
CA01b	CAS	Questionnaire to establish: frequency harvesting the kua; characteristics of gear used for harvesting; age, sex & status of fisherman/fishermen; marketing of catch, leasing system & kua owner.
CA02	CAS	Weight and number of species in the catch. CA02 OR CA03 filled in together with CA01, CA01a and CA01b.
CA03	CAS	Subsample details of large catches. Weight and number of species in the subsample. CA03 OR CA02 filled in together with CA01, CA01a and CA01b.
CA04	GME (LFA) & repro & fish movement	Lengths and reproductive condition of "key" species of fish subsampled for these studies.
FE01	FES	Numbers of different gears fishing during 2 hour periods throughout the day.

Reference number	Survey	Purpose of information on form
FE01(A)	FES	For main river surveys only. Number of different gears fishing throughout the day. Coverage of site not time bound.
FE02	FES	Brief gear usage in days or nights and hours.
FE03	CAS	Gear positions and counts recorded during CAS as cross-check for missed gears by FES and for geographical distribution of fishing activity.
SD01	FES	Water quality measurements.
SD02	FES	Weather conditions that effect fishing activity.
GE01	CAS or FES	Gear description and usage for updating databases & documenting gear types by region.
DE01	CAS	Details of diseased fish in the catch. Completed when diseased fish are observed during CAS.
FR01	site selection	Completed during site identification to assess the suitability of sites to be monitored.
FR02	site selection	Completed during site identification to assess the fishing activity at sites to be monitored.
SA01	Hatchling studies	Times of fishing (for estimation of fishing effort) for setting savar nets & identification of hatchlings from catches.
SA02	Hatchling studies	Times of fishing for setting savar nets & records of current speed & depth during fishing.
SA04	Hatchling studies for NE region	Times of fishing (for estimation of fishing effort) for setting savar nets & identification of hatchlings from catches.
SA05	Hatchling studies for NE region	Receipt for the hatchling samples dispatched from NE region to the laboratory at Tangail.
MF01	Admin	Records all forms of different types completed by site by date.
CAS/FES10a	Admin	Records gears counted and number surveyed during CAS in each survey at each site. Checks for any gears counted but not surveyed in CAS or any gears for which CAS was completed but were not observed during FES. This information enables missed gears to be surveyed in survey 2 for that month.
CAS/FES10b	Admin	Summarises months matches of FES and CAS by gear and by site

NB:G = growth
M = mortality
E = exploitation rate
Repro = studies of the cycles of reproduction.

2.20 The FES and CAS are carried out on the same day so that for gear types that are counted catch rates can be obtained. Initially the surveys were conducted on different days (as this was a more efficient use of manpower). This led to some problems in the calculation of production as gears were not always operating on both days. By carrying out CAS and FES Surveys on the same day, closer matching is achieved.

2.21 All sites are surveyed for two days per month enabling gears not monitored on the first survey day to be recorded on the second survey day. Use of the CAS/CAS10a allows the Senior Fisheries Supervisors to keep stock of the missing gears from the first survey day and attempt to get catch rates for them on the second survey day.

2.22 Both surveys are carried out in the demarcated area of the site. Site boundary markers such as mosques, village boundaries, distinctive trees, electric pylons, roads and bridges are known to all field staff and documented on sketch maps of each site.

2.23 The Fisheries Biologist carrying out the FES counts and records the number of fishing gears operating during six two hour periods from 0600 hours to 1800 hours. Fishing gears were pre-coded at the start of the sampling programme and adjusted as more information about fishing gears and usage was gathered. The gear list updated in April 1993 is shown in Appendix III. In addition, information concerning the number of hours fished in the day and night is collected on form FE02. One Fisheries Biologist is required to complete the FES.

2.24 The CAS requires two Fisheries Biologists, one to sort and identify fish (in excess of 120 species of fish have been recorded so far and these are listed in Appendix IV) and the other to interview the fisherman. The monitoring of one catch takes approximately 15 minutes, as any longer would disturb relationships with fishermen, who take time out of their fishing activities to talk to the field officers. The Fisheries Biologists can carry out about 15 interviews per day. Where a large number of fishing gears are operating at a site, the catches of at least three gears of each type are monitored. On occasions when the fishing activity is high, less common gears are favoured for CAS, the catch rates of more common gears like thella jal (push net) can be obtained if time is available or this can be accomplished on the second survey day of the month. This allows catch rates to be obtained for most of the gears operating in Bangladesh. If catch rates are not obtained during one month, then they may be estimated from data collected during the surveys a month before or a month after.

2.25 During FES and CAS weather conditions are observed. Heavy rain, strong winds and high waves on the rivers and beels tend to make all but the hardiest of fishermen give up. In this way the adverse weather conditions may explain the lack of fishing at a particular site. High fishing activity after rain may also be related to the weather. These relationships will be investigated.

2.26 During CAS the fish are examined for signs of Epizootic Ulcerative Syndrome (EUS) and the number and species affected are recorded (form DE01). The incidence of the disease may be affected by flood control. This information is also of general interest for Bangladesh and other countries in the region.

2.27 Figure 2.1 shows the relationship between the CAS and FES data and a summary of the steps for calculations of total annual catch per unit area for all gears combined, for individual gears and the species composition by month and by gear. Details of the procedures for obtaining these results are given in Appendix V.

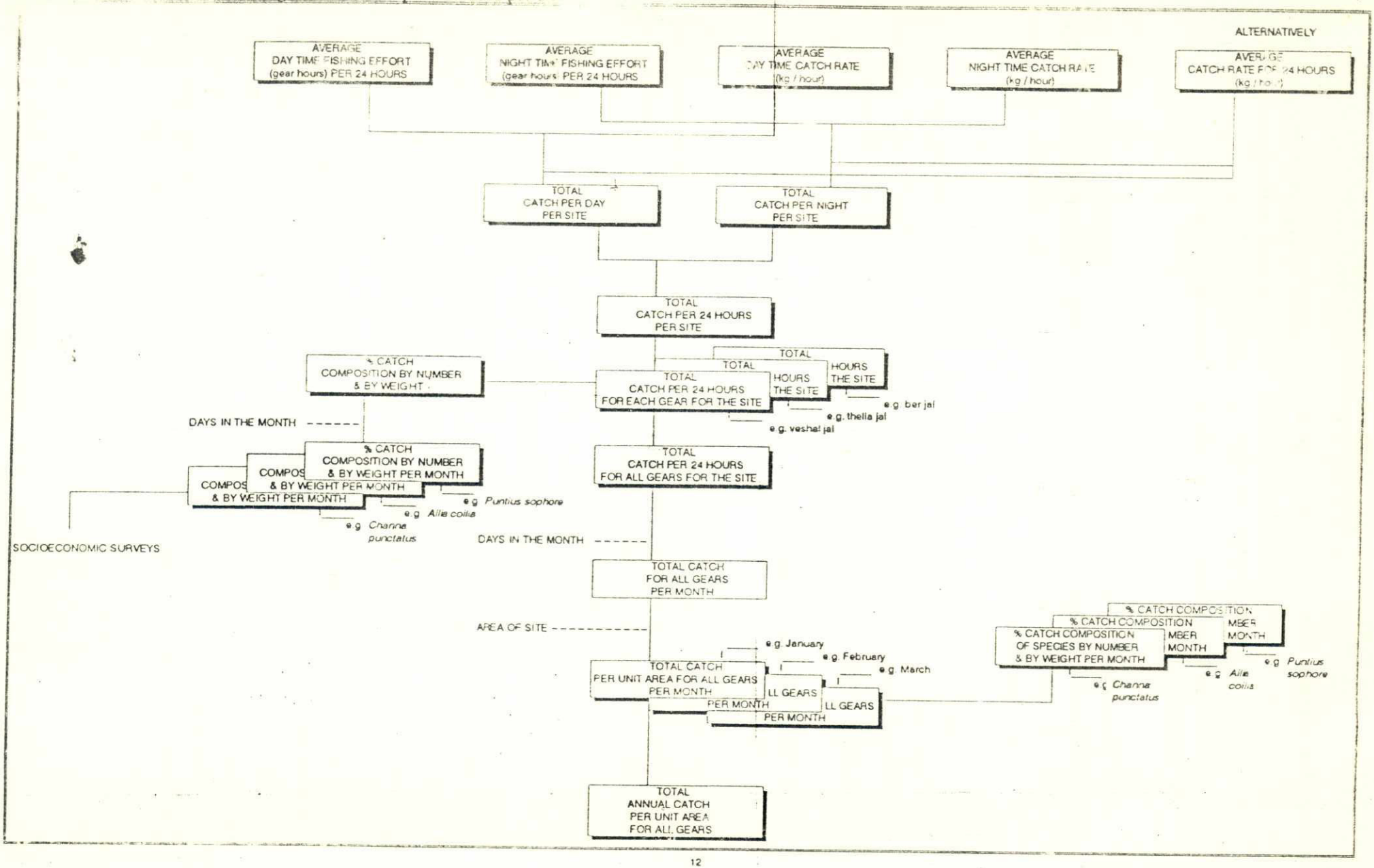
Fish Population and Breeding Studies

2.28 In addition to the core surveys, CAS and FES, collection of length frequency data has also been established. The length frequency distributions when analysed with modal progression analysis give estimations of growth, mortality and exploitation and thus attempt to explain any observed differences in the production of fish from sites inside and outside flood control schemes (**Objective (e)**).

2.29 Length frequency data also reveal the timing of recruitment for species that breed once or twice in the season. When this is the case, estimation of recruitment will be attempted by assessing the number of recruits, i.e. the smallest size fish caught over the season, given the fishing effort for that catch and multiplying by the total effort for the season using the same gear. Effort is being assessed from the FES.

2.30 Length frequency data in conjunction with observation of reproductive condition enables some assessment of the movement of fishes from one habitat to another and shows whether the movement is related to spawning or feeding. There have been many generalisations about the movement of fish from the rivers to the floodplains for breeding, but little evidence is available to support these. FAP 17 aims to clarify the cause and direction of the movement of fishes at different times of year and assess the impact of flood control measures on that movement (**Objective (e)**).

Calculation of average annual catch per unit area per s



2.31 After CAS has been carried out, a sample of fish is collected, stored on ice and then taken to the laboratories at regional field stations. Measurements of standard lengths of the "model" species are carried out in the laboratory in order not to delay fishermen unnecessarily.

2.32 The lengths (total length[1] and standard length[2] for the first 100 fish and thereafter just standard length) are measured and the larger (at least 20 from each site per month) are dissected to establish the reproductive condition of the fish. The least selective gears, such as seine nets, have been chosen for the collection of samples for length. Fish are also collected from a number of other gears like cast nets, push nets and lift nets, which are very common, because seasonally employed gears such as seine nets will not give data over a sufficient time period.

2.33 The species chosen for both length frequency work and reproduction studies are representative of trophic levels and of different spawning behaviour. The species originally chosen for the length frequency analysis are given in Table 2.4.

Table 2.4 "Model" species for studies of population dynamics

Species	Common name	Habitat	Feeding	Other details
Gudusia chapra	Chapila	Rivers; baors; beels; khals; floodplains during rains.	Not known	Prefers clearwater and surface water. Max. caught Jul-Sept.
Oxygaster bacaila	Chela	Beels; baors; river; floodplain; paddy fields.	Larvivorous; feeding upper layers of water, active during monsoon.	Prefers clearwater, max length 175 mm.
Chanda nama	Chanda	Rivers; haors; beels; baors; floodplain; paddy.	Larvivorous.	During monsoon comes into paddy fields.
Corica soborna	Kachki	Rivers; beels.	Not known.	Swims in schools in the surface water. Max. length 40-60 mm.

[1] Total length is the length of the fish from the tip of the snout to the end of the tail.

[2] Standard length is the length of the fish from the tip of the snout to the end of the caudal peduncle (where the tail fin starts).

Species	Common name	Habitat	Feeding	Other details
Colisa fasciatus	Kallisa	Rivers; beels; baors; paddy and ponds, most common in beels.	Omnivorous; larvae; pupae; algae, phytoplankton; protozoa and mud.	Males build nests of bubbles and guard the nest. Females lay in the nest. Max length 127 mm.
Puntius sophore	Jat Putti	Rivers; beels; baors; paddy and ponds, most common in beels.	Larvivorous OR herbivorous (40% algae; 15% plants; 30% protozoa; diatoms; crustacea; rotifers); 15% insect larvae; fish remains; sand.	Max. length 125 mm
Mastacembellus pancalus	Guchi Baim	Rivers; beels; baors; khals; bottoms, prefers muddy holes, open water under decaying organic matter.	Mud & debris; chironimid larvae; Limnophila; Culex; Eristalis.	Spawning May-Nov on plants. Max. length 175 mm.
Channa punctatus	Taki	River; beels; baors. Prefers muddy bottom, shallow water.	Predator: fish fry; small fish; molluscs; insect larvae; pupae; cannibalism common.	Spawning Apr-Jul: lays eggs in receptacle made of floating vegetation in the banks, guards until hatched, males & females guard the school of fingerlings until 30-35 cm; females show more care. Tolerates extremely low O2. Also severely affected by US disease. Max. length 300 mm.
Lepidocephalus guntea	Gutum	Rivers; beels; baors; khals. Prefers bottom living & among the roots of water hyacinth.	Not known.	Max. length 150 mm.
Glossogobius giurius	Bila	All habitats, including estuaries.	Adults: Predator; piscivorous & mollusc eater; cannibalism is common; cladocera; copepods; decapods; ostracods eaten by all sizes. Juv: also carnivorous, prefer cyclops. Also Hemiptera; Odontera; Orthoptera.	Catadromous:probably breeds in estuaries during the dry season. Opinion is divided on this. Max. length 500 mm.

Species	Common name	Habitat	Feeding	Other details
Mystus vittatus	Tengra	Rivers; haors; baors; beels; khals; floodplain; paddy and jute fields.	Benthic organisms; algae; aquatic plants; protozoa; chironimids; other insect larvae & pupae; molluscs; some fish remains.	Spawning in the rainy season.
Wallagonia attu	Boal, fresh water shark	All habitats, even brackish water. Adults prefer large, open water. Juv: confined water.	Voracious predator, nocturnal feeder, hunts in surface water: carp fry & fingerlings; terrestrial insects & rodents.	Spawns Jul-Aug, lays eggs in shallow water.
Heteropneustes fossilis	Shingi, stinging catfish	All lotic & lentic waters, prefers clean water, tolerant of warm, shallow water, seen amongst rotting organic matter & with water hyacinth, also in holes during dry season.	Predatory, omnivorous: algae; aquatic plants; protozoa; small aquatic insects; crustacea; snails; crabs; sand & mud. Cannibalism has been noted.	Spawning during rainy season. ** Highest quantity of protein of all freshwater fishes.

2.34 A number of seasonally common fish species have been added to the above list. These include :

Scientific name	Local name
Aspidoparia morar (NC & main rivers)	Piali
Puntius conchonius (NC & main rivers)	Canchan punti
Puntius ticto (NC)	Tet punti
Salmostoma phulo (NC & NW)	Chella
Cluposoma garua (NE)	Laria
Cluposoma murius (NE)	Kedar
Eutropichthys vacha (NE)	Bacha
Mastecembellus armatus (NC)	Boral baim
Nemacheilus botia (NC)	Balichata
Botia dario (NC)	Rani
Gagata youssoufi (main rivers)	Kaokata
Mystus bleekeri (NC & NW)	Golsa(NC),Tengra(NW)
Mystus cavasius (NC)	Capasi tengra
Mystus tengara (NC)	Bajari tengra
Amblypharynogodon mola (NC)	Mola
Chanda ranga (NC)	Lal chanda
Xenentodon cancila (NC)	Kaika
Anabas testudineus (NC)	Koi

Although the list of species considered is relatively extensive it is doubtful whether sufficient data will be available from sites inside and outside flood control schemes and from a range of gears to enable sampling to be unselective for all of these species.

2.35 Length data from fish caught in different gears will be kept separate until the selectivity of each can be considered. Selectivity will be assessed for the most common gears such as lift nets and push nets.

2.36 The time period per month over which length frequency data is collected on the "model" species has been minimised to ensure a distinct sampling period. However, if the growth of fish at a particular time of year is very low, such that there would be little progression in the modal length class due to growth, then samples from two separate months can be pooled.

2.37 It is possible to collect samples for length frequency analysis from all the sites in a region over a period of eleven days. Since many of the fish measured may be young or even fry and have rapid growth rates, it was considered advisable to reduce this period as much as possible.

2.38 Reducing the time of data collection to about four days meant that key sites had to be selected in each region. This has the consequence of increasing the number of individuals needed from each catch. The sites from which fish are collected for length frequency analysis are given in Table 2.5.

2.39 The analysis of length frequency data is not dependent upon having large monthly samples throughout the sampling period, but can be used with samples more than one month apart, as long as each reflects the status of the population at that time. This means that where data are poor these can be discounted.

2.40 The collection of length data through the dry season has been sporadic, in that fishing activity was reduced and a number of sites previously sampled were dry. The collection of data from katha and kuas however will be very important. The catches from katha and kuas are much greater, thus there is an opportunity to collect substantial data. The majority of kuas were observed in the SW region, but the main harvest had already occurred before the start of the monitoring programme in February.

Table 2.5 Sites considered for length frequency and reproduction studies

Region	North West		North Central		North East			
Scheme	PIS		CPP		MIP		SHP	
Position	In	Out	In	Out	In	Out	In	Out
Grouping of Sites for comparison of data	NW03 NW04 NW05 NW06 NW07	NW02 NW14 NW15 NW16 NW17 NW18	NC10 NC11	NC02 NC03 NC04 NC05	NE01 NE02 NE03 NE04 NE05	NE06 NE07 NE08 NE09 NE10	NE12 NE13 NE14 NE15	NE16 NE11 NE17 NE18 NE19 NE20
Grouping of Sites for comparison of data	NW08 NW09 NW10	NW01 NW19 NW20 NW21	NC12 NC13 NC14 NC15	NC06 NC07 NC08 NC09				
Grouping of Sites for comparison of data	NW11 NW12 NW13	NW24 NW25 NW26		NC16 NC17 NC18 NC19				

NB:PIS - Pabna Irrigation Scheme
CB(Pol B) - Chalan Beel (Polder B)
CPP - Compartmentalisation Pilot Project (Tangail)
MIP - Manu Irrigation Project
SHP - Shanghair Haor Project

2.41 The seasonal pattern of sampling can be built into the analysis of growth and mortality, provided the biology of the species is understood. Particularly important is the determination of spawning seasons.

2.42 ELEFAN and other length frequency based programs will be used to calculate coefficients of mortality (both fishing and natural). The programs encompass standard fisheries equations for this. The rates of exploitation are calculated as fishing mortality divided by total mortality i.e. fishing and natural mortality combined.

Fish Movement Study

2.43 Special surveys were established to monitor the drift of hatchlings from rivers to floodplains and to investigate the effects of regulators on hatchling numbers and densities, to assess, in both quantitative and qualitative terms, the effects of flood control on recruitment of fish. The results of these studies will assist in mitigation by improving regulator design by allowing the passage of hatchlings onto the floodplains.

2.44 Hatchling drift studies were carried out in the NC and NW regions during the 1992 wet season.

2.45 In the NC, the hatchling drift down the Dhaleswari River is exploited from June until August by fishermen who mostly collect carp hatchlings to supply "seed" for aquaculture. A continuous survey of numbers and species of hatchlings was established in June, sampling the drift both day and night and has continued to date, although less intensively.

2.46 In the NW, drift of hatchlings was monitored through the Charghat Regulator across the Baral River (part of the Pabna Irrigation Scheme). Collections of hatchlings were made throughout the day and night, at four positions upstream and downstream of the regulator from August to November 1992. Sampling was by a fisheries biologist staying permanently on site and was made possible with the help of local fishermen.

2.47 Hatchlings were preserved in 5% formalin and transported to Tangail field station, where fisheries biologists sorted and identified them. It was not possible to identify all species of hatchlings, but each type was separated and coded. By collecting live hatchlings of these types in 1993, it may be possible to grow them on in aquaria and so discern the species.

2.48 At the time the hatchlings were collected, current speed measurements were made ~~in order to~~ calculate the hatchling densities from the hatchling numbers. Daily water level readings inside and outside the regulator were also taken to investigate the effect of variations in head difference and hydrostatic pressure on hatchling survival. Discharge data have also been collected from Bangladesh Water Development Board (BWDB) to correlate hatchling numbers and density with flow.

Water Quality and Hydrology Study

2.49 In order to carry out an assessment of the impact of flood control on fisheries, it is essential to relate the information on fish stocks collected by the methods described in the previous paragraphs to changes in the timing, extent, duration and magnitude of flooding. Unfortunately, it is precisely this type of detailed hydrological information which is lacking for Bangladesh. Therefore, to provide baseline data on flooding patterns at floodplain sampling sites, biologists undertaking fortnightly FES surveys also collect data on the flood extent using sketch maps and measure water depths at fixed points on the floodplain covering a range of land heights.

2.50 During the FES water quality measurements are taken. These consist of depth, water temperature, pH, conductivity (in μS), total dissolved solids (TDS) and oxygen concentration in mg l^{-1} and % saturation. These are the aspects of water quality that are important for fish.

PROPOSED ANALYSES

2.51 As an illustration of the type of monthly results generated by CAS and FES surveys, data collected in the North Central Region between January and April 1993 have been analysed to produce examples of estimates of catch rates, fishing effort, total monthly catch of individual gears and total monthly catch of all gears by site.

2.52 Catch rates provide a measure of Catch Per Unit Effort(CPUE) of individual gears. These data will be used in the following ways:

a) When combined with fishing effort data, estimates of total catch per gear can be made.

b) CPUE values can provide contemporaneous spatial comparisons of the relative abundance of fish in carefully selected aquatic habitats e.g.rivers, canals and dry season beels.

c) CPUE values can provide important data used in various economic analyses.

2.53 An example of how catch rate data will be used to estimate total catch (objective a) is provided in Figure 2.1 and Appendix V. An example of the monthly results which will be produced for each site is presented in Table 2.6.

2.54 An example of how catch rates are used to make spatial comparisons of the relative abundance of fish (objective b) is shown in Table 2.7. Comparisons are made between catch rates of push nets (thella jal) and cast nets (jhaki jal) used in beels and floodplain sites inside and outside the Tangail CPP scheme. By applying statistical analyses, e.g. *t* test, to data such as these, the first level of impact assessment of FCD/I schemes on fish stocks will be obtained.

Table 2.6 Summary of catch rates, fishing effort and total catch of all gears observed in selected sites in the NCR during January 1993.

Site Code	Habitat	Gear Code	Name	Catch rate (kg/hr.)	Mean Daily Fishing Effort (gear hours)		Total Monthly Catch (kg)
					Day (05.00-18.00)	Night (18.00-05.00)	
NC02	River	88	Current net	0.002	33.6	85.3	0.3
Total NC02					33.6	85.3	0.3
NC03	Canal	164	Cast net	0.383	33.6	0.0	12.9
		255	Push net	0.081	100.8	0.0	8.2
		307	Hand picking	0.266	67.2	0.0	17.9
Total NC03					201.5	0.0	38.9
NC05	Beel	164	Cast net	0.101	335.8	0.0	34.2
Total NC05					335.8	0.0	34.2
NC06	River	89	Seine net	0.376	33.6	0.0	12.6
		105	Lift net	0.045	67.2	0.0	3.0
		164	Cast net	0.213	100.8	0.0	21.5
		255	Push net	0.254	100.8	0.0	25.7
Total NC06					302.3	0.0	62.9
NC07	Canal	30	Hook + Line	0.006	235.1	0.0	1.5
		105	Lift net	0.040	167.9	0.0	6.8
		164	Cast net	0.152	33.6	0.0	5.1
Total NC05					436.6	0.0	13.4
NC11	Floodplain	164	Cast net	0.267	235.1	0.0	62.9
		255	Push net	0.152	67.2	0.0	10.2
Total NC11					302.3	0.0	73.2
NC12(A)	River	95	Traps	0.003	6851.0	5797.0	42.9
NC12(C)		105	Lift net	0.041	335.8	0.0	14.0
Total NC12 (A+C)					7186.8	5797.0	56.9
NC14(A)	Floodplain	88	Current net	0.015	806.0	1023.0	29.1
		95	Traps	0.002	1645.6	1108.3	6.9
		105	Lift net	0.079	167.9	0.0	13.4
		123	Gill net	0.013	772.4	937.8	22.8
		164	Cast net	0.318	705.3	0.0	224.5
		255	Push net	0.287	839.6	0.0	241.8
NC14(B)		255	Push net	0.137	369.4	0.0	50.6
Total NC14 (A+B)					5306.2	3069.0	589.2
NC15	Beel	88	Current net	0.007	2250.1	2642.8	36.8
		255	Push net	0.219	1141.8	0.0	250.9
Total NC15					3391.9	2642.8	287.6

Table 2.7 Mean and standard error (SE) of Catch rates (CPUE) of Push nets and Cast nets used on floodplain and beels inside and outside the Tangail CPP

Habitat	Gear	Inside		Outside	
		CPUE (kg/hr)	SE	CPUE (kg/hr)	SE
Beels	Push Net	0.266	0.0209	0.318	0.1077
Floodplain	Push Net	0.152	0.0358	0.243	0.0323
River	Cast Net	0.123	0.0388	0.124	0.0196

2.55 Data on fishing effort will be used in the following ways:

i) to provide estimates of total catch when combined with catch rates.

ii) to provide a description of the structure of the fishery in terms of gear composition.

iii) to enable impact assessments of FCD/I to be carried out in terms of changes in the types of fishing activities and fishing intensities inside and outside schemes.

2.56 Details of how fishing effort data will be used together with catch rates to generate estimates of total catch at each site (objective i) are given in Figure 2.1 and Appendix V. An example of the monthly results which will be produced for each site is presented in Table 2.6.

2.57 Fishing effort measured in total gear hours fished per month by each type of gear will be analysed to obtain a description of the structure of the fishery in terms of gear composition at each site or in groups of related sites (objective ii). Examples of typical sets of results are shown in Tables 2.8 and 2.9. In these examples, for the sake of simplicity, monthly results for a four month period (January - April 1993) have been summed and the average total monthly fishing effort per gear calculated. Both night and day fishing have been taken into account in these examples.

2.58 Such information will provide a greater understanding of the temporal and spatial changes in the nature of fisheries which will be linked with changes in the abundance of different fish stocks using information on catch rates and species composition of the catch. In addition, data on structural differences in fisheries will be related to socio-economic aspects such as variations in the proportions of subsistence, part-time and professional fishermen.

Table 2.8 Monthly Effort by Gear Type in the Atia Beel (NC15), January-April 1993 (Inside the Tangail CPP Scheme)

Gear Type	Gear code	Day(05.00-18.00)		Night(18.00-05.00)		24 Hours	
		Average Gear hour	%	Average Gear hour	%	Average Gear hour	%
Gill net (Monof.)	88	845.3	34.9	1260.0	62.1	2105.3	47.3
Hook & line	278	280.0	11.6	770.0	37.9	1050.0	23.6
Push net	255	967.4	39.9	0.0	0.0	967.4	21.7
Rod+line	30	120.0	5.0	0.0	0.0	120.0	2.7
Hand picking	307	75.0	3.1	0.0	0.0	75.0	1.7
Cast net	164	58.4	2.4	0.0	0.0	58.4	1.3
Gill net (Multifil.)	123	38.8	1.6	0.0	0.0	38.8	0.9
Basket Scoop	296	31.0	1.3	0.0	0.0	31.0	0.7
Lift net	105	7.5	0.3	0.0	0.0	7.5	0.2
Total		2423.3	100.0	2030.0	100.0	4453.3	100.0

Table 2.9 Monthly Fishing Effort by Gear Type in the Mailjani Beel (NC19), January-April 1993 (Outside the Tangail CPP Scheme)

Gear Type	Gear code	Day(05.00-18.00), 24hr	
		Average Gear hour	%
Gill net (Monofil.)	88	62.0	8.4
Push net	255	402.4	54.6
Rod+line	30	23.3	3.1
Cast net	164	138.1	18.7
Basket Scoop	296	54.3	7.4
Drag net	202	57.4	7.8
Total		737.4	100.0

Note: There is no night fishing effort in this case.

2.59 A knowledge of the structure of the fishery in terms of gear composition and fishing effort will provide a basis for the assessment of the impact of FCD/I schemes on fisheries (objective iii). The examples presented in Tables 2.8 and 2.9 demonstrate how paired spatial comparisons of fishing activities will be made between sites inside and outside FCD/I schemes. Similar spatial comparisons will be made in terms of fishing intensity

using data on total fishing effort (gear hours) for individual gears or all gears combined together with data on the area fished, i.e. the size of the sampling site.

Catch

2.60 Data on the total catch (=production) from aquatic ecosystems are essential for quantitative assessment of the impacts of different types of FCD/I on fisheries. Estimates of total monthly catch at each site will be derived from catch rate and fishing effort data. An illustration of results which will be generated each month is presented in Table 2.10. In this example monthly catch data estimated at each site have been averaged over a four month period (January - April 1993). At this time of year gears such as katha (submerged brush shelters) and kua (man-made pits excavated on the floodplain) make a significant contribution to the total catch at some sites. Since these gears are fished infrequently, only once per month or less, then different sampling methods and data processing methods are applied to obtain monthly catch estimates.

2.61 Total catch estimates at each site will be adjusted by site area to provide estimates of catch per unit area. These form the basis of various impact assessments which will be undertaken at different levels both spatially and temporally. Table 2.11 shows total catch per site inside and outside an FCD/I scheme. Since these data have not yet been adjusted by area, accurate comparisons cannot be made at this stage. The example merely demonstrates how spatial comparisons can be made using monthly, seasonal and annual catch data. Data from clusters of sites inside and outside FCD/I schemes will also be analysed in the same way to provide larger scale comparisons.

Catch Composition

2.62 Data on species composition of the catch will be used in the following ways:

i) to provide information on the differential impact of FCD/I on different species and species groups.

ii) to provide information on the community structure and diversity of fish populations inside and outside FCD/I schemes.

iii) to provide information on the seasonal movement of fish between aquatic habitats inside and outside FCD/I schemes.

Table 2.10 Mean Monthly Fish Production (kg) in the North Central Region, January-April 1993

Site	Habitat	Total Daily Gears (A)	Katha (B)	Kua (C)	Total Catch of All Gears (A+B+C)
02	River	75	NA (40)	0	(115)
03	Canal	20	17	0	37
04	Floodplain	0	0	0	0
05	Beel	11	NA	0	11
06	River	44	NA (90)	0	(134)
07	Canal	29	NA	0	29
08	Floodplain	0	0	0	0
09	Beel	0	0	0	0
10	Canal	40	56	0	96
11	Floodplain	141	0	0	141
12	River	120	45	0	165
13	Canal	0	0	0	0
14	Floodplain	165	NA	51	216
15	Beel	258	469	0	727
16	River	1284	175	0	1459
17	Canal	0	0	0	0
18	Floodplain	46	0	360	406
19	Beel	229	438	0	667
21	River	58	23	0	81
22	Canal	1	1	0	2
23	Floodplain	0	0	0	0
24	Beel	142	0	181	323
25	River	264	NA (350)	0	(614)
26	Canal	185	NA	108	293
27	Floodplain	0	0	0	0
28	Beel	455	NA	84	539
29	River	127	1238	0	1365
30	Canal	111	NA	23	134
31	Floodplain	50	0	173	223

Notes:

1. A = Mean monthly catch of all gears operating on a daily basis and observed in CAS/FES surveys.
   B = Mean monthly catch of Katha where fishing frequency is usually once per month per unit.
   C = Mean monthly catch of Kua where fishing frequency is usually once per month or less.
2. Estimates in brackets have been extrapolated for sites where Katha fishing was important but no catch rates were obtained. Extrapolation is based on catch rates from a similar adjacent river.

Table 2.11 **Mean Monthly Fish Production (kg) by Habitat Inside and Outside the Tangail CPP for the Period January-April 1993**

Habitat	Inside		Outside	
Secondary River		165	134	115
Canal	0	96	37	29
Floodplain	141	216	0	406
Beel		727	0	667

Note: Where there are two sites per habitat inside and outside the CPP, both values are given.

iv) to provide information which when combined with fish price data can be used in various economic analyses (Figure 2.1).

2.63 To obtain a more detailed understanding of the mechanisms by which FCD/I projects affect fish stocks and fishing communities, it is necessary to collect information not only on total fish catches but also on the catch of individual species which make up the catch (objective i). Examples of the types of results which will be generated to allow comparisons to be made between fish populations inside and outside FCD/I schemes are presented in Tables 2.12 and 2.13. In these examples, for the sake of simplicity, only the most abundant species are listed but as can be seen by the values of total numbers of species recorded in each habitat, most species comprise less than 5% by weight of the catch.

2.64 Catches from beels and floodplains were dominated by *prawns, Channa, Colisa* and *Puntius sophore* between January and April 1993 while river and canal catches comprised mainly *Glossogobius guiris, Esomus danricus, Channa, Heterpneustes,* and *Puntius conchonius*. In addition to the differences in the relative importance of different species between different habitats there were also notable differences inside and outside the FCD/I which will be investigated further during 1993.

2.65 One of the potential impacts of FCD/I schemes on fish stocks is the reduction in species diversity. Therefore, analyses will be carried out using appropriate species diversity indices e.g. Shannon/Shamon or Margelefs to describe community structure taking into account the relative abundance of each species present and the total number of species inside and outside FCD/I schemes (objective.ii). Tables 2.12 and 2.13 present data on the total number of species recorded in different habitats inside and outside the Tangail CPP.

Table 2.12 **Species Composition (% by weight) Inside/Outside the Tangail CPP (Data combined for January-April 1993.**

Floodplains			
Species Code	Species Name	Inside	Outside
6	*Anabas testudineus*	6.4	0.6
41	*Channa punctatus*	16.2	13.4
55	*Colisa fasciatus*	9.1	27.5
56	*Colisa lalius*	6.8	0.0
110	*Lepidocephalus guntea*	6.1	5.4
123	*Mastacembelus pancalus*	5.9	1.8
180	*Puntius sophore*	8.0	1.7
931	*Prawn spp.*	16.3	38.4
	Total number of species	45	17
Beels			
Species Code	Species Name	Inside	Outside
6	*Anabas testudineus*	8.0	0.5
41	*Channa punctatus*	16.4	4.4
55	*Colisa fasciatus*	13.2	9.8
110	*Lepidocephalus guntea*	7.4	7.1
123	*Mastacembelus pancalus*	5.1	3.8
180	*Puntius sophore*	11.9	7.0
212	*Puntius ticto*	<0.1	6.7
931	*Prawn spp.*	21.3	28.4
	Total number of species (excluding unidentified prawn	39	43

Note: Only those species comprising 5% or more of the total catch weight have been included in the list above.

Table 2.13 Species Composition (% by weight) Inside/Outside the Tangail CPP (Data combined for January-April 1993)

Rivers			
Species Code	Species Name	Inside	Outside
13	*Aspidoparia morar*	0.0	8.7
41	*Channa punctatus*	26.3	2.3
83	*Glossogobius giurus*	13.7	24.9
175	*Puntius conchonius*	14.0	40.5
180	*Puntius sophore*	6.9	1.1
931	*Prawn spp.*	6.4	3.3
	Total number species (excluding unidentified prawn)	37	43
Canals			
Species Code	Species Name	Inside	Outside
41	*Channa punctatus*	24.5	21.7
55	*Colisa fasciatus*	5.7	6.8
75	*Esomus danricus*	0.5	24.4
88	*Heteropneustes fossilis*	20.1	3.0
110	*Lepidocephalus guntea*	10.2	7.9
123	*Mastacembelus pancalus*	11.6	9.5
137	*Mystus vittatus*	9.4	2.7
180	*Puntius sophore*	4.3	16.3
	Total number species (excluding unidentified prawn)	25	19

Note: Only those species comprising 5% or more of the total catch weight have been included in the list above.

These data do not take into account the variation in number of sampling sites within each habitat and therefore should be treated with caution since increases in sample size will probably result in increases in the number of species recorded. However, as the amount of information from each site increases during the year, future analyses using annual data sets will provide accurate descriptions of species diversity. It will then be possible to explore the potential relationships between changes in species diversity and increased fishing pressure by using fishing effort data per unit area or, alternatively, by using exploitation rates derived from LFA.

2.66 Seasonal and spatial changes in the species composition of the catch will affect not only its economic value but possibly also its nutritional value. These aspects (objective iv) will be investigated by socio-economic studies of FAP 17.

Reproduction Studies

2.67 For each of the selected species listed in Table 2.4 and the additional seasonally abundant species listed in paragraph 2.34 data on their reproductive state will be analysed spatially and temporally to provide information on breeding grounds and breeding seasons. An example of how data will be used to identify breeding seasons is presented in Table 2.14 for three common species recorded inside and outside the Tangail CPP area between August 1992 and May 1993. The data indicate some important differences in the timing of peak breeding seasons inside and outside the FCD/I. Further data are required from the current wet season to establish whether these spatial differences exist or not.

Fish Movements

Movement of Adult Fish

2.68 Studies of seasonal movement of fish will be used in the following ways:

i) to gain a clearer understanding of the mechanisms through which FCD/I schemes may affect the structure of fish communities and the magnitude of fish yield.

ii) to provide data which when linked with information on species distributions,size (LFA data or average individual weight from CAS) and reproductive state, will result in a greater understanding of the life cycles of selected species.

Table 2.14 Breeding Seasons of Selected Floodplain Fish Inside and Outside the Tangail CPP, North Central Region, August 1992 – May 1993

SPECIES	FCD	Aug 1992	Sep	Oct	Nov	Dec 1992	Jan 1993	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec 1993	Jan 1994	Feb	Mar	Apr	May	Jun
Glossogobius giuris	Inside																							
	Outside																							
Mystus vittatus	Inside																							
	Outside																							
Puntius sophore	Inside																							
	Outside																							

LEGEND

Peak season >50% fish ripe, ripe running, spent

20–50% fish ripe, ripe running, spent

<20% fish ripe, ripe running, spent

iii) to provide information on the impact of embankments and regulators on the dispersal and survival of fish hatchlings and their recruitment into floodplain fisheries.

2.69 Analyses relating to (i) and (ii) will involve the identification of temporal changes in species composition at sites comprising a series of spatially linked aquatic habitats. Information from the main rivers Jamuna and Padma will also form an important component of these analyses.

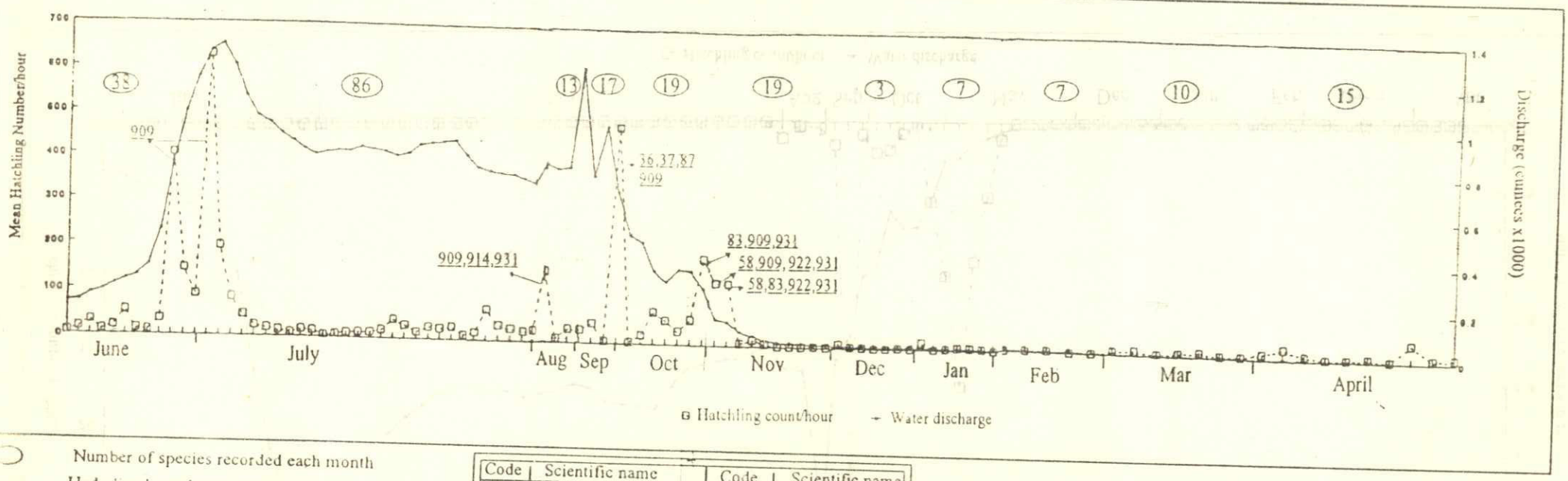
Fry and hatchling Movement

2.70 Studies of hatchling drift in the NC and NW regions have been described briefly in paragraphs 2.44 and following. Temporal variations in the abundance of several species of hatchlings in relation to changes in flow of the Dhaleswari River, NC region, are shown in Figure 2.2. The rising floodwaters brought large numbers of major carp hatchlings in two peak pulses, three days apart in June and July 1992. Numbers then dropped sharply coinciding with decreased flow rates but remained sufficiently high to sustain a commercial hatchling fishery throughout July. Later in the year (August - October) intermittent rises in river flows during the flood recession coincided with substantial pulses of hatchlings of other species. The most important of these were *Chanda spp.*, *Glossogobius spp.*, prawns and an unidentified species which appeared in enormous numbers in September and again in November (Figure 2.3).

2.71 The results confirm the great importance of the early floods in transporting considerable numbers of major carp hatchlings to the floodplains where they feed and grow. Perhaps more importantly, the study revealed the huge number of other hatchling species carried by the early floodwaters - 86 species were recorded in July alone (Figure 2.2) - and the vast densities of species other than major carp in river waters during the flood recession. The fate of these hatchlings remains unclear but further studies to be undertaken this year will provide a greater understanding of the movements of these hatchlings.

2.22 The results from studies of the Charghat regulator on the Baral River, NW Region, also revealed considerable species diversity in hatchlings and fry recorded inside and outside the regulator between August and November 1992 (Figure 2.4). This study started rather late and missed the first floods of July. However, water level differences across the regulator still ranged from 0.4 to 1.9 metres during the early part of the study (August - September). Since water passes through the regulator at its base such head differences

Figure 2.2 Temporal variation in the abundance of fish hatchlings in the Dhaleswari River, NCR between June 1992 and April 1993.



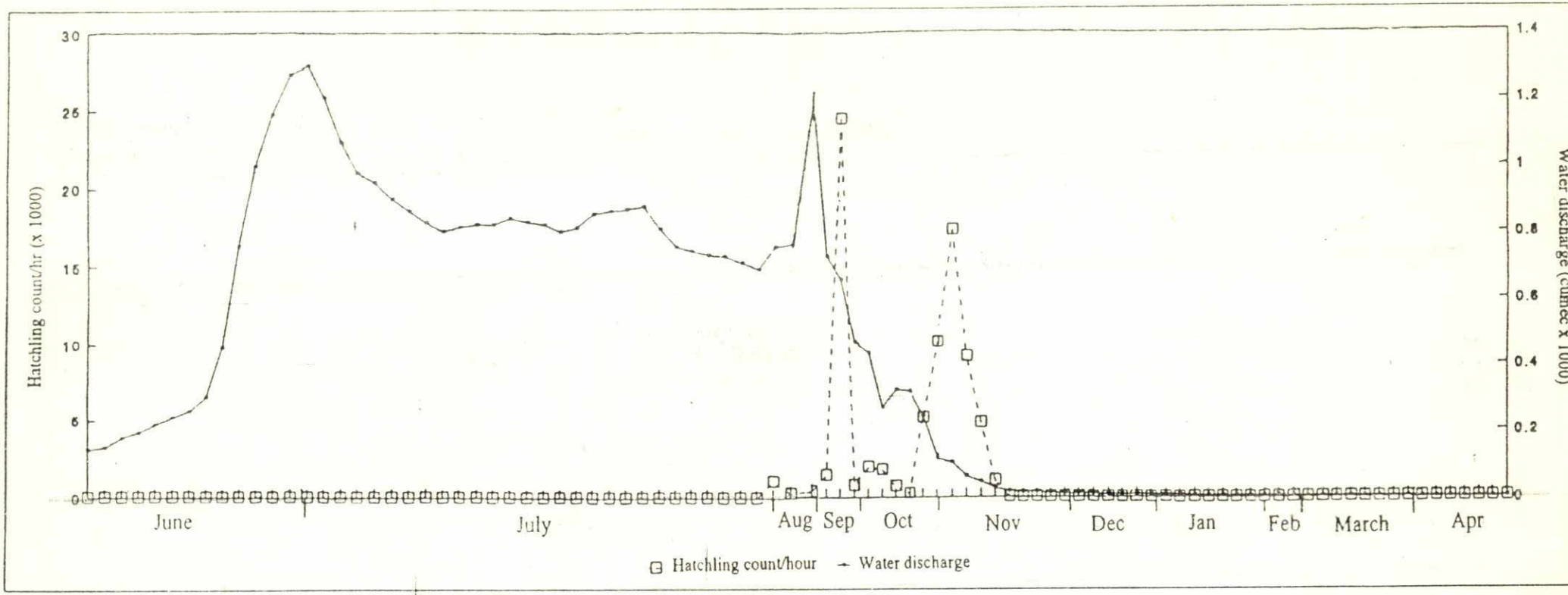
Number of species recorded each month

Underlined number = species codes

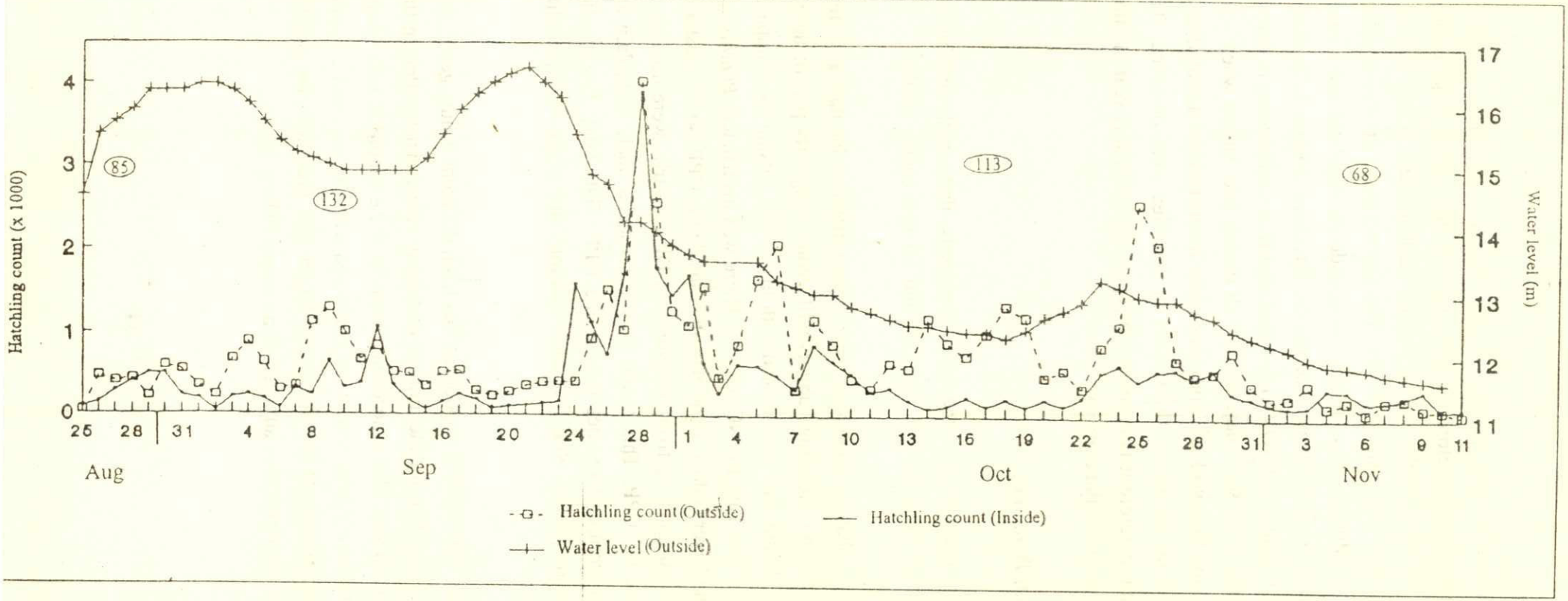
Code	Scientific name	Code	Scientific name
36	Chanda nama	909	Major carp
37	Chanda ranga	914	Unknown
58	Corica soborna	922	Mugil spp.
83	Glossogobius giurus	931	Prawn spp.
87	Hara hara		

98

Figure 2.3 Temporal variation in the catch rate (numbers/hour) of unidentified hatchlings (species 913) in the Dhaleswari River, NCR



igure 2.4 Average hatchling count for all species and water levels inside and outside the Charghat regulator



Total number of species recorded each month

should result in notable increases in hydrostatic pressure which may be sufficient to damage or kill fish hatchlings. Therefore the first stage of the investigation involved the careful monitoring of hatchling catches inside the regulator to identify any fatalities. None were recorded during the whole study period. The second stage of investigation involved the calculation of hatchling densities inside and outside the regulator and a comparison of the results with water level differences across the structure (Figure 2.5). Statistical analysis using analysis of variance (ANOVA) revealed significant differences in densities inside and outside the regulator on some days but not all during late August when water levels rose rapidly. During the first week of September water levels reached a peak then decreased and during this time no significant differences in densities were observed. The results are inconclusive and therefore it is proposed to repeat the study this year starting at the onset of the first flows in the Baral River.

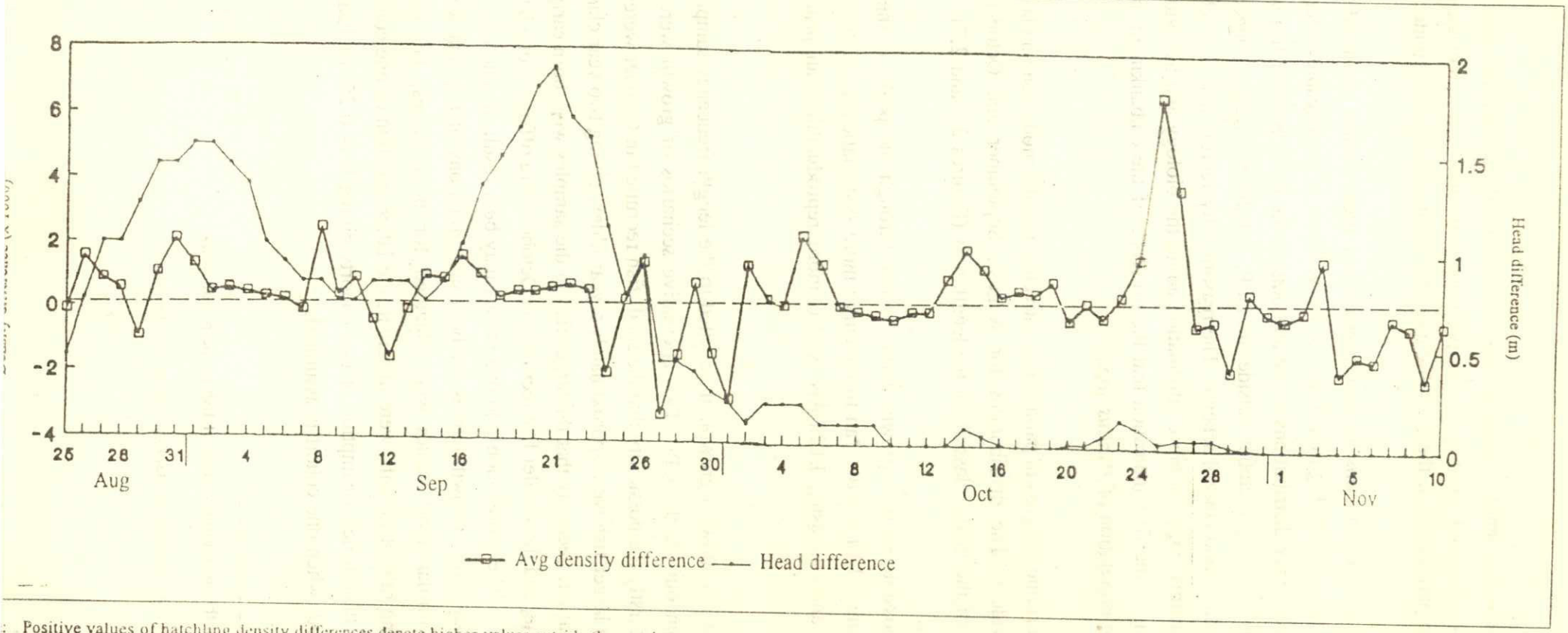
Fish Population Dynamics

2.72 It has been decided, from the initial appraisals, that length distributions from seine nets (katha, kachi jal and ber jal), cast nets and lift nets can be pooled.

2.73 On the basis that the population may inhabit different habitats at different stages of life, pooling between connecting habitats will avoid using only part of the population for growth analysis. Some sites were pooled both inside and outside the Compartmentalisation Pilot Project (CPP) in Tangail (NC region). There was insufficient *Puntius sophore* caught in the Lohuajong River and its connected sites, inside the CPP, so the cluster of sites inside the embankment (originating from the Northern Dhaleswari), were used as representative of catches inside the CPP. This meant only Inderobelta khal, floodplain and beel were considered. The comparative sites outside the CPP, Gala khal, Gazaria floodplain and Gazaria beel were pooled. Site lists and locations are given in Appendix VII of the Inception Report.

2.74 Since it has been decided to pool catches from different fishing gears, the data should be adjusted by proportion for the amount of fishing effort that resulted in the catch from each gear from each site. This is necessary because, for example 36 hours fishing with cast nets, selecting relatively large fish, when combined with catches from 1 hours fishing with a seine net, may exaggerate the number of larger fish present in the population. Hence each catch from each gear was adjusted to an hours fishing effort.

gure 2.5 Mean density differences of fish hatchlings and fry inside and outside the Charghat regulator and the water level (head) differences across the regulator.



: Positive values of hatchling density differences denote higher values outside the regulator.

2.75 Adjusting the length frequency data for fishing effort is not essential for analysing growth using ELEFAN, because it is the positions of the modal length classes that are used to determine parameters of the growth curve and its fit, not the magnitude.

2.76 The length distributions for pooled gears and sites, outside and inside the CPP are shown in Figure 2.6 and Figure 2.7, respectively. There is a noticeable difference between the length frequency distributions inside and outside the CPP. Smaller fish were recruited into the fishery during October outside the CPP, but there is little evidence to show the same inside the flood control scheme. The reasons why recruitment is much reduced are not known at this stage, as more information about the biology and behaviour is needed. However this is the first indication that the presence of the embankment may indeed be effecting the population of *Puntius sophore*.

2.77 To determine the growth parameters, movement of the modal length classes over time must be evident. The distributions for August, September and October do show a progression of the modal class along the length axis (Figures 2.6 and 2.7).

2.78 It is possible to fit a growth curve by eye through the peaks in the length data. However using ELEFAN one can fit the curve more systematically and test the goodness of fit. The analysis using ELEFAN is also more reproducible than pencil and paper methods.

2.79 Figure 2.8 shows a growth curve fitted to the length frequency samples of *Puntius sophore* from outside the CPP. Two alternative scenarios of growth were tested using ELEFAN. Firstly the possibility that the small fish recruited in October were young of the year and the larger fish were approximately a year older, giving two year classes (cohorts) in the population. Secondly that the larger fish in the samples were born early in the year, say May/June, and the smaller fish recruited in October were offspring of a later spawning, say in August. The segregation into two modes may be a result of schooling behaviour of fish of similar sizes. Growth curves for both interpretations of the data were fitted and examined. Similar $L\infty$[3] values were obtained for both curves, but the k[4] values, expressing the rate of growth, were different, the latter situation of one cohort yielding k = 0.45 and the former assumption of two cohorts giving k = 0.25, (indicating a higher rate of growth when one cohort is assumed).

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[3] L_∞ equals the asymptotic length of fish in the population.

[4] k is the rate at which fish attain the asymptotic length.

Figure 2.6

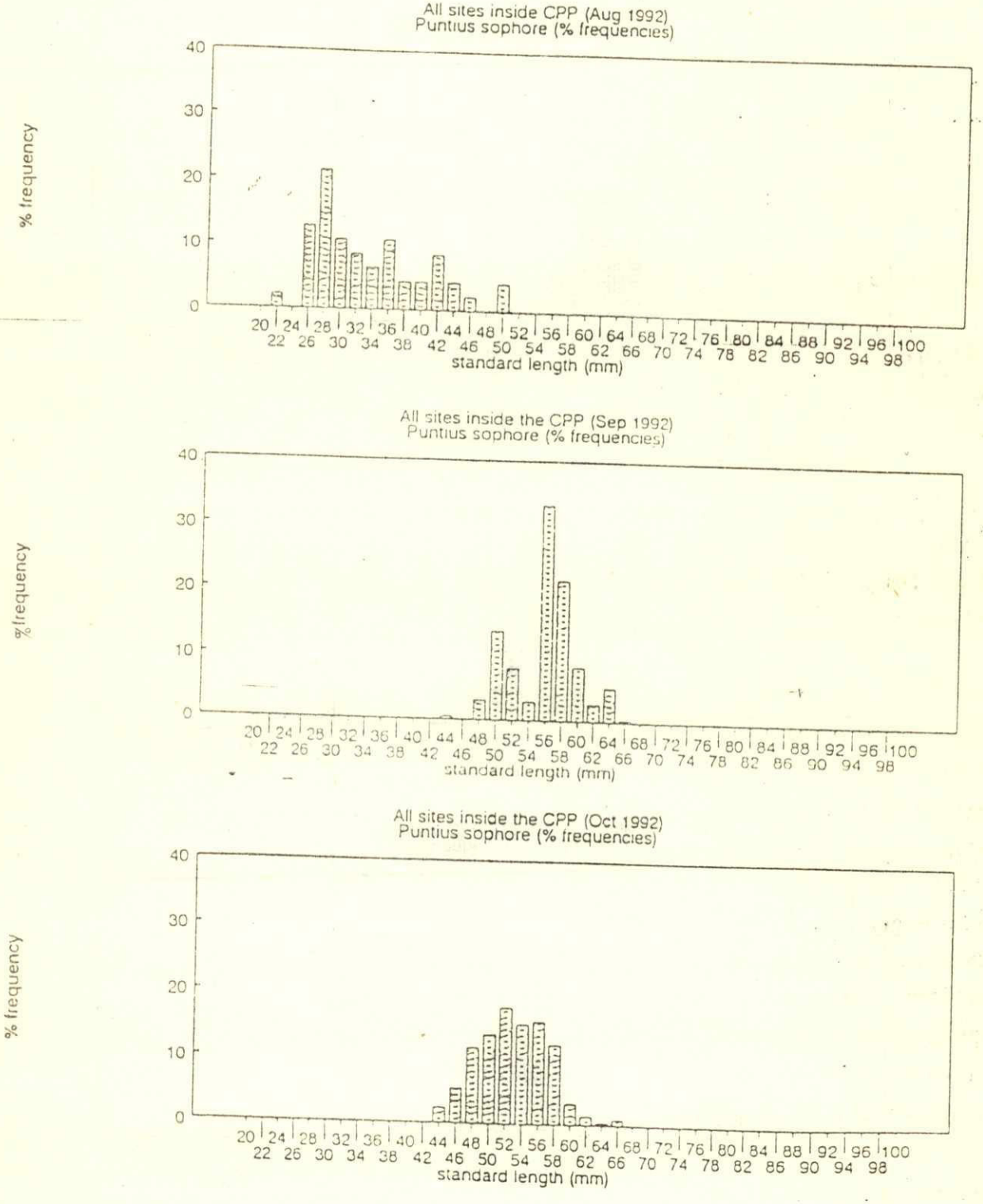

All sites inside CPP (Aug 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)
All sites inside the CPP (Sep 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)
All sites inside the CPP (Oct 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)

Figure 2.7

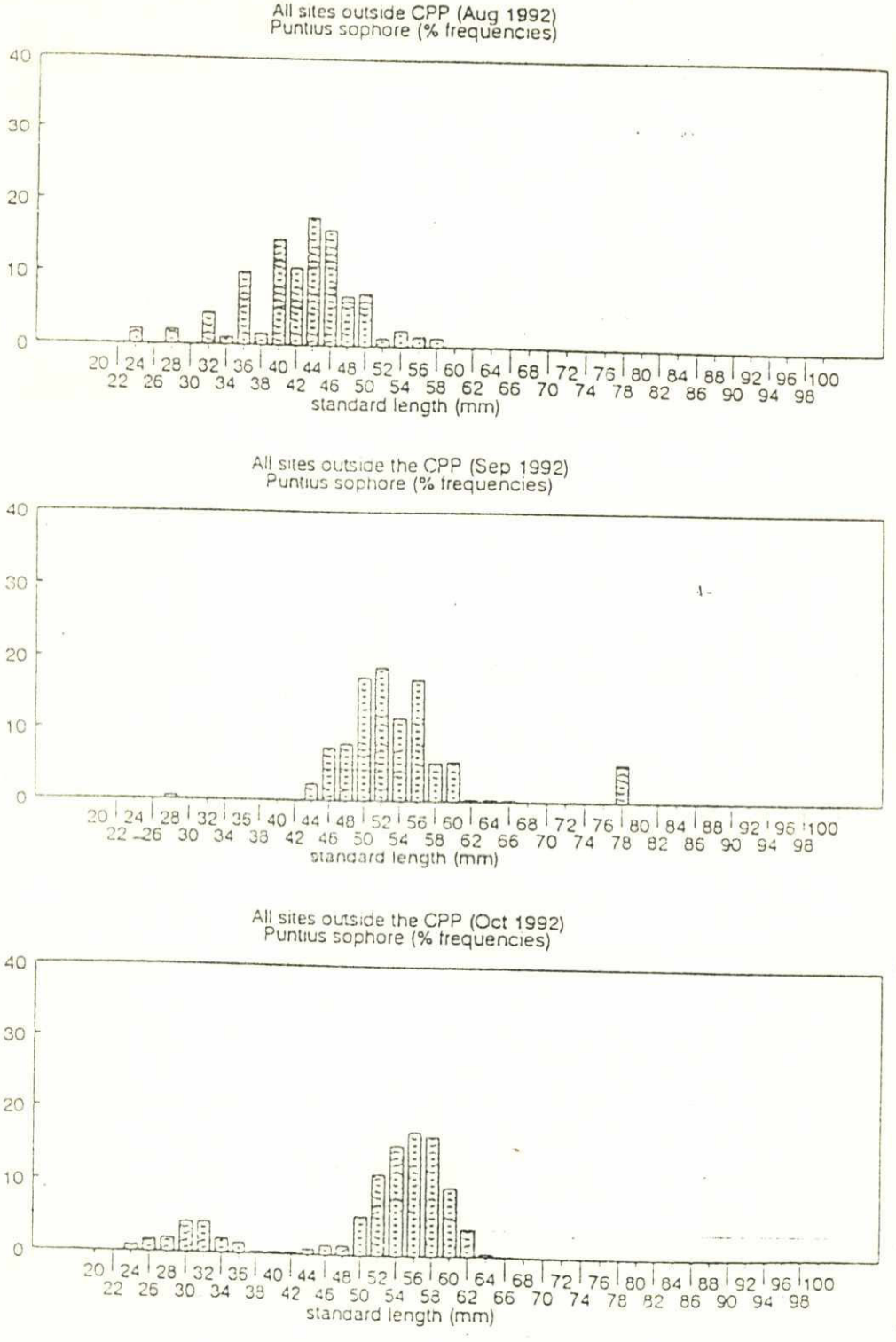
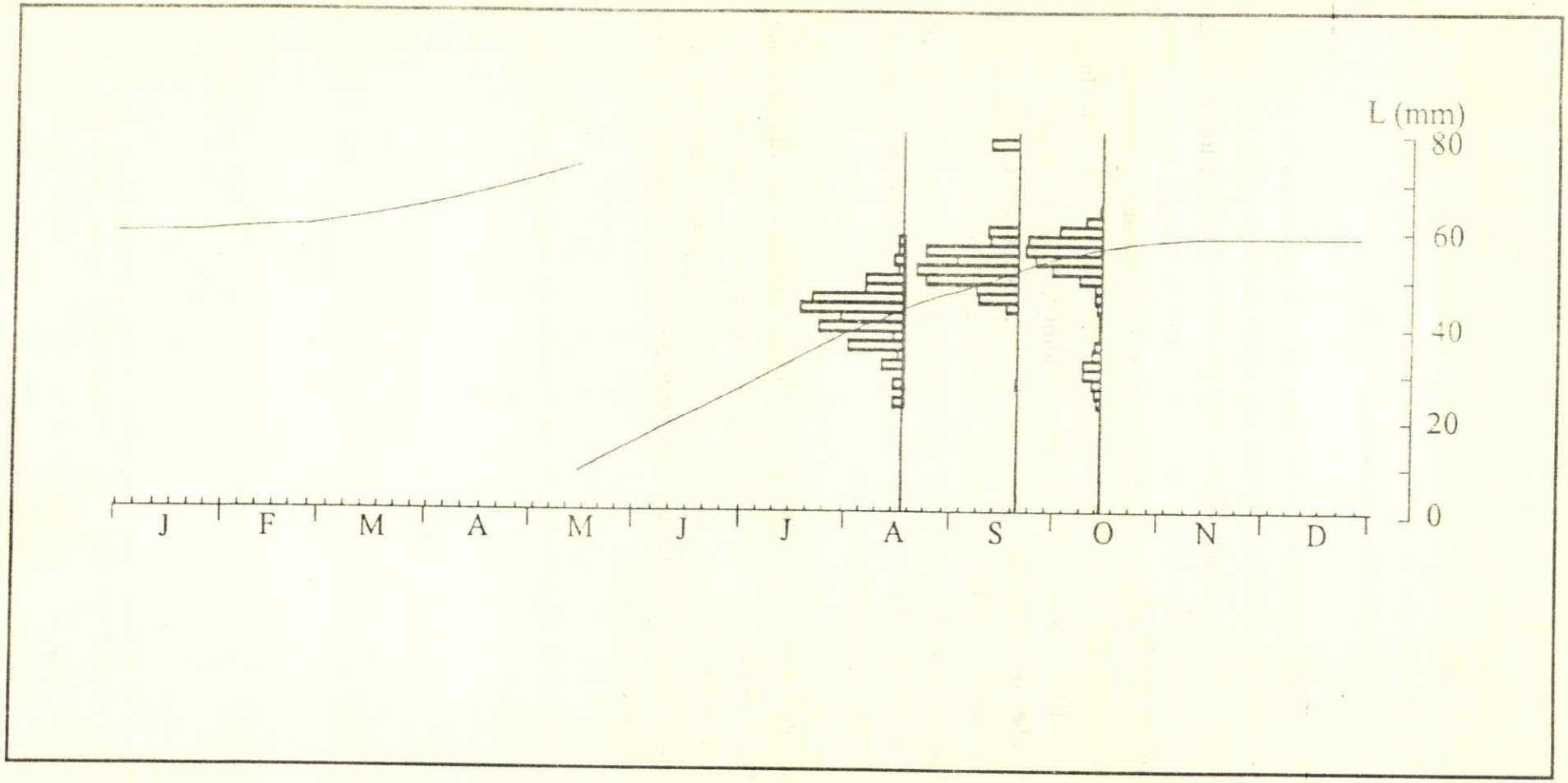

All sites outside CPP (Aug 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)
All sites outside the CPP (Sep 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)
All sites outside the CPP (Oct 1992)
Puntius sophore (% frequencies)
% frequency
standard length (mm)

Figure 2.8 Puntius sophore (outside CPP adjusted)



2.80 The assumption of one cohort (two peaks in spawning) is presented here as the most likely because fish of about 80-100 mm in breeding condition were collected May/June 1992. However the information about the reproductive condition, collected during the sampling programme, has not yet been collated and when this has been carried out evidence to support one or other of the situations may be available.

2.81 The length data of *Puntius sophore* from inside the CPP has shown no additional recruitment of fish in October, indicating that breeding fish in the beels inside may spawn earlier or that the season may be much shorter. The growth curve fitted to the length frequency data (Figure 2.9) reveals a much higher rate of growth than that resulting from fish outside the CPP ($k = 1.6$ inside, compared to $k = 0.45$ outside). Certain length classes appear to be sampled less frequently, resulting in gaps in the distributions (Figure 2.6, August). Since the ELEFAN algorithm tests the suitability of different growth curves by assessing the number of times the curve passes through peaks and troughs in the distributions, any "missing" information resulting in a trough, gives a low test score. Hence subjective and informed interpretation of the fit of the growth curve is necessary in these circumstances. It is hoped that subsequent monthly samples will give greater weight to the assumptions about the biology of the fish.

2.82 In order to establish differences in growth performance between fish caught inside and outside the CPP, a number of equally possible combinations of k and $L\infty$ will be estimated and a growth index calculated. The indices, which are normally distributed, will then be compared using analysis of variance. The justification for this approach is given in Moreau, Bambino and Pauly (1986)[5].

2.83 The calculation of growth performance indices is considered premature at this stage of the analysis.

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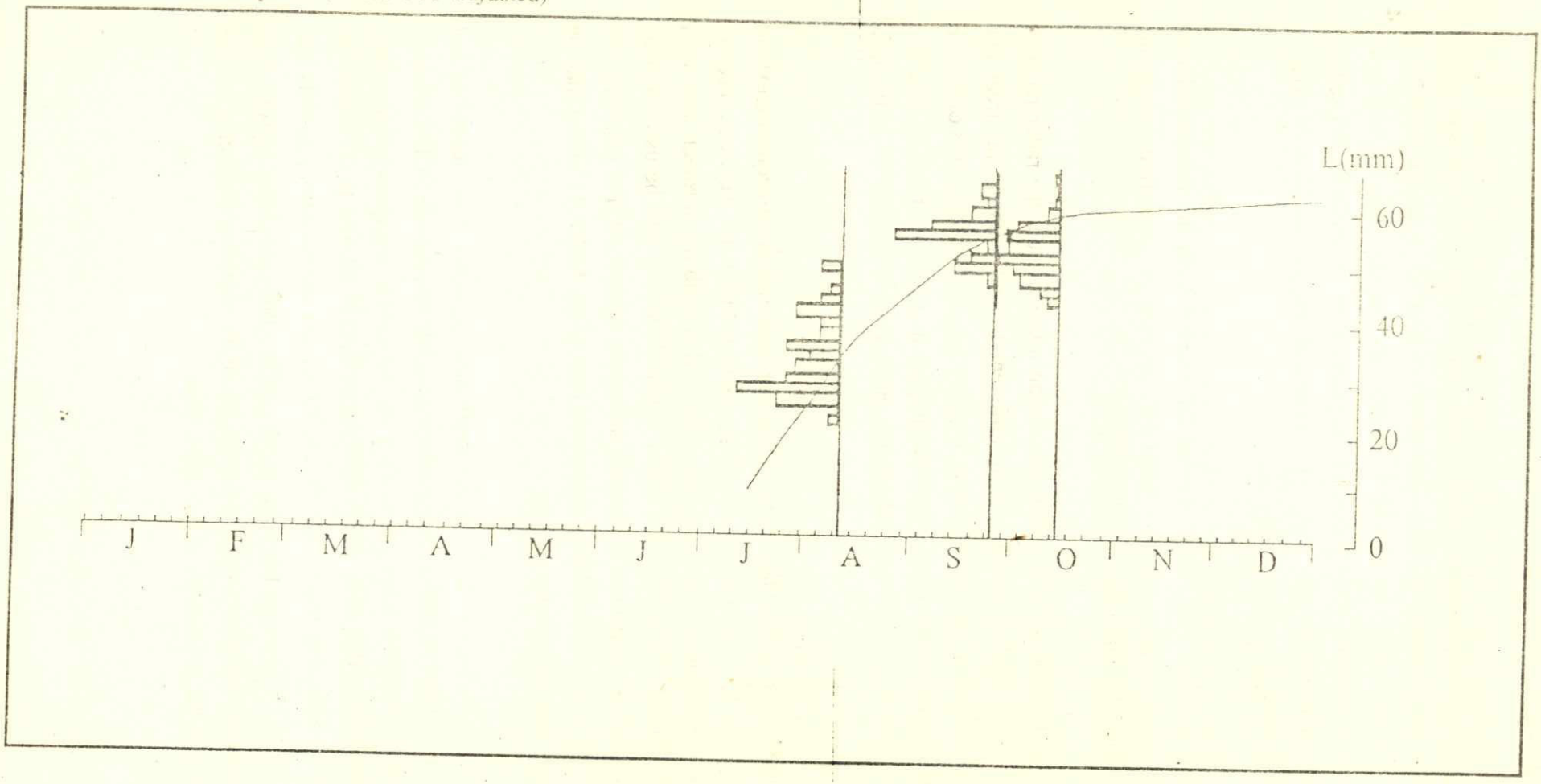
[5] Moreau, J; Bambino, C & D Pauly. 1986 A comparison of four indices of overall fish growth performance, based on 100 tilapia populations (Fam. Cichlidae). Iclarm contribution No. 292.

Figure 2.9 Puntius sophore (inside CPP adjusted)



EXTRAPOLATION OF RESULTS

2.84 The methods for the extrapolation of the fish production estimates to larger areas of Bangladesh is being investigated with the collaboration of FAP 19, FAP 20, FAP 25 and the Surface Water Modelling Center (SWMC). In order to consider extending the results of the fish production estimates from individual habitats (sites) to whole FCD/I schemes or wider catchment areas within each region, the extent, depth, and duration of flooding throughout the seasons needs to be determined.

2.85 During the dry season, the remote sensing information from the interpretation of SPOT and TM satellite imagery can be carried out, so long as cloud-free images are available for the years of sampling (1993 and 1994).

2.86 Recently it has been possible to obtain wet season imagery from the radar receiver obtaining data from the ERS 1 satellite. With sufficient ground-truthing the areas and possibly the depths of flooding can be discerned. Imagery acquired in May 1993 of the NE region was ground-truthed at the time of the satellite pass in a joint exercise by FAP 17, FAP 19 and FAP 25 staff and will be available for interpretation by FAP 19 in the next two months.

2.87 In addition to remote sensing data, the most widely used method of acquiring extent, depth and duration of flooding is from the hydrologic model, MIKE 11. This was recently used in fisheries assessment work by Gumti Phase II Feasibility Project and with collaboration with other projects (FAP 20, FAP 25 and SWMC) it will be used in areas where sufficiently detailed simulations of flooding have been carried out. For example data for the Tangail CPP are already available. Additional runs of the MIKE 11 model may be completed for other areas later in the project.

2.88 FAP 17 fisheries biologists are collecting depth measurements from floodplain and beel sites in order to monitor depths at comparable sites inside and outside FCD/I schemes throughout the 1993 wet season. This information will be used to interpret fisheries data (fish production, population dynamics and breeding activities) in relation to differences in the hydrology. With assistance from FAP 19, digital terrain (or elevation) models can approximate the extent of flooding from the depth profiles throughout the season. This would establish areas of floodplain around the areas where the sampling was being carried out and hence estimate the production of fish from these.

2.89 The extent to which extrapolation of results from the fisheries programme can be achieved is still uncertain. However the choice of methods mentioned above makes some broadening of the results probable.

FUTURE PROGRAMME

2.90 Activities carried out to date by the fisheries programme are summarised schematically in Appendix I(a) together with a schedule of proposed future activities for the remainder of the project. It is proposed that the fisheries surveys continue until the end of February 1994 in all regions. This will provide a sampling period of one year to be completed at all sites and enable accurate catch assessments of important dry season gears such as katha and kua to be undertaken. Several surveys of fish hatchling movements in the North East, North Central and North West regions will be completed during 1993.

2.91 A schedule of outputs resulting from the fisheries programme is given in Appendix I(a). Reports based on a series of desk studies on various topics will be included as Annexes to this Interim Report. The results of the field investigations will be included in the project Final Report.

3 IMPACTS ON PEOPLE

OVERVIEW

Background

3.1 The FAP 17 Inception Report presented a conceptual framework, based on the Entitlements Approach of Amartya Sen, for understanding the possible socio-economic impacts of flood control on fisheries in Bangladesh. In this framework a household's welfare is determined by the resources at its disposal - those which it owns or has customary access to, and by the mechanisms of both technology and exchange that allow it to transform these resources into goods that it needs. This provides a disaggregated perspective of livelihood opportunities and gives due importance to common property resources. The impact of policy interventions on different groups is thus played out through an array of mechanisms that includes, but is not limited to, economic markets.

3.2 The ability to place common property resources and non-marketed outputs on an equal

footing with more conventional components of economic analysis, and to do so from the perspective of the household (or of groups of like households) recommended this approach for FAP 17. The Inception Report argued that this would be the most suitable framework for the analysis of the impact of the FCD/Is on households that rely on fisheries resources. Experience has endorsed this view. But there is a much wider range of factors that mediate access to the fisheries resource and influence its significance to a particular community than was initially anticipated. So wide, indeed, that it has required a review of the methodology for measurement of impact - paired inside/outside comparisons of villages.

3.3 The methodology proposed in the Inception Report was based on comparisons of communities, and of the socio-economic strata that compose them. It was assumed that these communities could be paired with sufficient precision that inside-outside differences between households in the same strata could be attributed to flood control. It is now clear that the genuine socio-economic differences that were due to effects of flood control on fisheries would in many, if not all cases, be swamped by other factors, too numerous and subtle to be allowed for in community selection. The aggregate impact of FCD/Is on fisheries incomes (or imputed catch values) will therefore be inferred from estimates of change in catch derived by the fish catch assessment studies and its significance gauged from the household level data generated by the village studies.

3.4 The purpose of this chapter is to:

- provide a brief overview of the changes to socio-economic studies.
- show how experience in the field made these changes necessary.
- briefly explain the revised components of the socio-economic programme and the newly proposed method for assessing impacts.

3.5 The objectives and methodology of each component of the programme and their linkages are explained in detail in subsequent chapters.

Changes to the Study Structure

3.6 Study components and the changes to them are summarised in Table 3.1 below. It will be noted that a number of changes have been made to the institutions and marketing studies, generally narrowing their scope. The reason for this lay simply in the resources available for the study. When the Inception Report was written, the demands that would be made on the field team by the village studies alone were not fully appreciated. It was

thought that one or more team members would be available in each region to assist with these studies for extended periods. This is not the case. A trade-off was necessary and the institutions and marketing studies, which are less central to the concerns of FAP 17, were cut back.

Table 3.1 Socio-Economic Study Components: Changes of Emphasis

Study Component	Original Functions	Revised Function	Reasons for Change
Village Studies	Estimation of flood control impacts on fisheries dependent households	Provide household data that will allow assessment in the significance of changes in the value of fish production. Field support for aquaculture impact and marketing studies.	Difficulties of using paired comparisons for measuring FCD/I impacts
Aquaculture Impact Study	Assess impact of flood control on aquaculture	No change	N/A
Marketing Study	Evaluation of fish marketing in floodplains	Estimation of costs and returns; evaluation of significance of fish marketing in livelihood strategies; collection and analysis of price data.	Resource constraints
Institutional Study	Assessment of institutions involved in floodplain fisheries	Secondary data collection on major institutions. Primary investigation of *jalmohals* and access restrictions at catch assessment sites and study villages	Resource constraints Critical importance of *jalmohals*
Target Group Approaches	Identify successful NGO approaches to the promotion of aquaculture for target groups of the adversely affected	No change	N/A
Value Distribution	Not previously included	Integration of catch and socio-economic data to provide an assessment of fisheries impacts and their significance	Difficulties of using paired comparisons for measuring FCD/I impacts

3.7 But the most important changes are:

- to the role of the village studies, the core component of the socio-economic studies, and
- the introduction of the value distribution study.

3.8 Both are due to the difficulties of attributing differences between villages to flood control when performing paired comparisons. The reasons for this are given below.

Difficulties in Using Paired Comparisons

3.9 Variation between and within regions was expected, given the effect of differences in physical and environmental factors on the range of livelihood strategies open to any group. But the degree of variation, especially with regard to fisheries, between communities with apparently similar resource bases has been more surprising. Once in the field, it is apparent that the range of factors shaping livelihood choices in a particular village is extremely diverse.

Access

3.10 The most important source of variability in the significance of fisheries between communities is the existence and level of enforcement of access restrictions. Particularly in the NE and the NW, the control of access to the most productive waterbodies largely determines the degree of dependence on fishing among local people. Moreover, though there would be an effect on impacts measured through paired comparisons, this can not be estimated without detailed study.

3.11 Take, for example, the paired comparison between communities inside the Manu Irrigation Project and outside in Hakaluki Haor area. It was initially assumed that since both communities are located on similar argo-ecological units close to large waterbodies, both would depend to a large degree upon fishing and that differences in livelihoods could be attributed to the effects of the embankment.

3.12 In both locations, however, access to the most productive beels is tightly controlled by outside leaseholders with the necessary resources and bureaucratic contacts. How the leaseholders choose to exploit these leases, and whose support they enlist in doing so are critical to the significance of fisheries to surrounding communities. The most important factors for local professional fishermen are whether they are allowed access to the deeper waters, on what terms and during what periods. For subsistence fishermen, the issue is whether they are allowed to fish at all in the leased area and how far around the leased area restrictions are enforced.

3.13 All indications from informants encountered during the RRAs are that the degree of correlation between proximity to a fisheries resource and dependence upon it are declining.

To capture a larger proportion of the benefits for themselves, leaseholders of the more important fisheries are increasingly willing to restrict or stop subsistence fishing on or even adjacent to their leased area and use hired professional fishermen from distant villages to fish out the deeper waters.

3.14 There are also frequent reports of local *mastan*, who have nothing to do with leaseholders, simply extorting money from people fishing on the floodplains. The fact that they are able to do so with relative impunity reflects the increasing perception of the previously "open" fisheries resources in the haor areas as a resource to be expropriated in whatever way possible.

3.15 Through its effect on the value of the fishery, flood control may influence a leaseholder's incentive structure. But the direction and degree of this influence is difficult to predict and the final outcome - his enforcement strategy - is still highly subject to differences in personal style. In short, access restrictions are too important and too unpredictable to allow measurement of impacts through paired comparisons.

Variation in community composition

3.16 In rural Bangladesh occupation is one of the primary determinants of social identity and members of the same social group tend to live together. In extreme cases a village may be dominated by people following the same profession, such as weavers or potters. Fishermen are no exception to this tendency of groups to congregate; indeed traditional fishermen, who were usually Hindu, may do so more than most, due to religious injunction and the added incentive of mutual protection provided by their minority status.

3.17 In such circumstances, finding representative communities for paired comparisons is particularly difficult.

Lack of suitable "control" areas

3.18 Another major constraint has been the difficulty in finding areas which both satisfy the criteria set for comparability and can be regarded as "unaffected" by flood control. This is a problem already encountered by several studies, such as FAP 12, trying to investigate the impacts of FCD/I using cross-sectional data. Even areas not directly located within flood control schemes have been effected by schemes located nearby. In some cases, notably those areas of Chalan Beel, not yet covered by flood control, this has led to important increases in average flooding depth. Elsewhere, the courses of rivers and the movement of floods has been altered, affecting fisheries down stream.

3.19 Besides directly noticeable effects on flooding patterns, flood control may be having a cumulative effect on fish stocks which will affect fisheries outside as well as inside flood control schemes. This may be particularly true in areas such as the North-East and the Sylhet Basin where it is reported that some haor areas now enclosed by FCD/I schemes were previously important breeding grounds for fish. These "mother" fisheries would have played a role in sustaining fisheries on a regional basis as well as locally. Kaoadighi Haor, now located inside the Manu Irrigation Project, is an example of this (FAP 6).

Other human interventions

3.20 In some areas, the impact of other forms of human intervention seem to have had an even greater impact on floods, and therefore on fisheries. The construction of roads and pathways has a direct impact on free flooding and, in many cases, effectively controls floods, whether or not this is an intended affect.

3.21 Even where culverts and bridges allow passage of streams and flood waters, canalisation of waters affects the fisheries: constricting the routes taken by migrating fish increases the ease with which they can be caught. At the beginning of the flood cycle, from May to July (depending on the region), and again during the drawdown period, in November and December, the impact of this channelling effect by human interventions can be clearly seen at almost every bridge, culvert or other point where flow is restricted and subject to intense pressure.

3.22 Cuts in flood control embankments operate in much the same way. It is reported that breaches made in embankments around the Manu Irrigation Project, intended to ease the effects of flash flooding on communities outside the scheme, are heavily exploited by local fishermen, both "professional" and part-time, as large numbers of fish, mostly juveniles, are seeking access to the floodplain during this period.

3.23 These effects, like those of access, are easy enough to identify in the field but would be almost impossible to allow for if paired comparisons were to be used as a means of measuring flood control impact.

Strategic location of fishing communities

3.24 This artificial creation of key points where fish movement is restricted is one of the important impacts of flood control measures on fisheries. As the case in Box 3.1 indicates, where a community has access, due either to their influence with the bureaucracy or their location, their relative dependence on fisheries can be considerably affected.

3.25 As some communities may benefit disproportionately from fisheries due to their location, the benefits to others may be significantly reduced. The value of paired comparisons with an outside village would be reduced in either case.

Box 3.1

In the south-east corner of the Pabna Irrigation Scheme, people living around Gajnar Beel report a dramatic reduction in fisheries since the completion of the Mujib Band in 1975. One small farmer stated that "The fish we used to eat in one meal before we'd be lucky to see in one week now." It is possible that the fisheries could be improved considerably, with minimum damage to agriculture, if the Talim Nagar sluice gate located on the Badai River was managed properly.

But the effects of canalisation are widely recognised: when this possibility was raised small farmers pointed out that the fishermen who own the lease to the Badai River immediately inside the sluice gate would catch most of the fish allowed to pass through the sluice gate. One respondent stated in despair "There's no solution ! Even if you let fish in the fishermen will catch them all."

Operation and maintenance

3.26 Another factor hampering measurement of impacts - in this case for both fish production and fisheries livelihoods - by inside/outside comparisons is the lack of functioning flood control schemes. Either because of poor design or poor maintenance and operation, many FCD/I schemes are subject to frequent breaching. Public cuts, by people both inside and outside (depending on the threat), are a frequent occurrence. In Manu Irrigation Project, almost any severe flooding in the Manu river results in cuts in the embankment as the constriction of water results in flooding levels damaging to the communities outside the embankment.

3.27 This limits the effectiveness of a scheme in protecting agricultural production, which is usually its primary justification, sometimes to the point where it is actually damaging. It also reduces its impact on fisheries. Local fishermen in the Manu Scheme feel that the frequent cuts in the embankment play an important role in sustaining fisheries in the haor as they tend to occur during the high floods early in the season, which carry the fish fry and fingerlings.

Paired Villages: What we found

3.28 Tables 3.2 to 3.4 summarise some of the local features of the eight village clusters covered by Rapid Appraisals so far which would complicate any attempts to estimate flood control impacts from difference between them:

Table 3.2 Characteristics of Paired Villages in NCR

NORTH - CENTRAL REGION	Features of communities
NC1-1 - Ichamati River : (Harirampur Thana)	• proximity to Padma River exploited extensively for subsistence fishing • although not "protected" by flood control considerably impacted by local paths and roads • large numbers of erosion victims from neighbouring villages • river very close-by but leased out - limited access for fisheries • 8 Muslim fishing households
NC1-2 - Satellite fishing community	• traditional Halder community • principle fishing ground - Jamuna & Padma Rivers • also fishing in local beels, *maital*, and ponds • main gears - *ber jal, jaki jal*
NC1-3 - Satellite fishing community	• traditional Halder community • principle fishing ground - Jamuna & Padma Rivers • also fishing in local beels, *maital*, and ponds • main gears - *ber jal, jaki jal*
NC2-1 - Kaliganga River : (Saturia Thana)	• dramatically affected by erosion by Kaliganga River and constant changes in river course • old river course in village (*kul*) providing important water resource • 1-2 Muslim fishing households
NC2-2 - Satellite fishing community	• traditional Rajbangshi fishing community • principle fishing grounds - Kaliganga and Ghior Rivers (control of *jalmahals*) • widespread involvement in *katta* fishing • main gears - *ber jal, veshal* (liftnet)

Table 3.3 Characteristics of Paired Villages in NWR

NORTH-WEST REGION	Features of communities
NW1-1 - Gajnar Beel (Sujanagar Thana)	• widespread disputes over use of *khas* land in beel areas • reported widespread seasonal fishing • reluctance to report gears during census
NW1-2 - Satellite fishing community	• Muslim non-traditional fishermen • apparently moved into fishing as local Hindu traditional fishermen moved out • mostly landless • principle fishing grounds - beel and floodplain • primarily small gears such as long lines, *current jal*, traps and spears
NW2-1 - Ichamati River (Santhia Thana)	• limited access to nearby river • frequent disputes over fisheries access
NW2-2 - Satellite fishing community	• Hindu traditional Halder fishermen • 60% of households have migrated since 1971, mainly due to loss of fishing activities • number of Muslim fishermen increasing rapidly, due to loss of land • fishermen denied access to most important local fishing grounds
NW2-3 - Satellite fishing community	• 40 Rajbanshi fishermen • 15 Muslim fishing households • 9 Hindu fish traders

Table 3.4 Characteristics of Paired Villages in NER

NORTH-EAST REGION	Features of communities
NE1-1 - Manu Irrigation Project (Maulvi Bazar Thana)	• limited access to principle beels • widespread fishing in floodplains • important involvement in livestock raising in haor
NE1-2 - Satellite fishing community	• traditional Namasudra fishing community • control of access to local *khal* • principle fishing grounds - floodplain, *khal*, occasionally hired to fish main beels
NE1-3 - Satellite fishing community	• traditional Maimul (Muslim) fishing community • many members leaving fishing for other occupations • some members hired by large leaseholder from same community
NE2-1 - Hakaluki Haor - Kulaura Thana	• mixed Hindu (Koista Das) and Muslim (Telukdar) farming community • widespread fishing activity on local floodplains • no access to main beels • subject to frequent flood damage • steady out migration of Hindu households to India
NE2-2 - Satellite fishing community	• small traditional Namasudra fishing community apparently moving over to agriculture • no access to principle beels • main fishing gear - *thela jal*, *veshal*, traps • principle fishing grounds - floodplain, small beels
NE2-3 - Satellite fishing community	• large tradition Maimul (Muslim) fishing community • limited access to principle beels when hired by local leaseholder

Table 3.5 Characteristics of Paired Villages in NER

SOUTH-WEST REGION	Features of communities
SW1-1 - Satla-Bagda Project	• mostly inhabited by Muslim farmers and Hindu sweet makers • growth of aquaculture since completion of project • growth in groundnut popularity in last 4-5 years
Satellite fishing communities	Not yet studied in detail
SW2-1 - Bagihar Beel (Kotwalipara Thana)	• much outmigration for work • widespread seasonal fishing activity • 7-8 Muslim households more intensively involved in fishing • main fishing gears - *current jal*, *jaki jal* • principle fishing grounds - local beels, *maital*, floodplains
SW2-2 - Satellite fishing community	• seasonal non-traditional Muslim fishermen • main fishing gears - *current jal*, *jaki jal*, traps
SW2-3 - Satellite fishing community	• traditional Gain (Hindu) fishermen • most own some land also - increasing dependence on farming • main fishing gears - *ber jal*, various gillnets, *current jal*, *veshal*, traps • principle fishing grounds - most local waterbodies: no reported access problems
SW2-4 - Satellite fishing community	• traditional Gain fishermen • no land ownership • mostly working as fisheries labour for SW 2-3 fishermen • main fishing gears - *current jal*, *ber jal*, traps

3.29 As this diversity of circumstance invalidates the measurement of impacts through paired comparisons, an alternative means had to be devised. The impacts of flood control on fisheries livelihoods will now be estimated using the results of the catch assessment studies as a starting point. The price data gathered in the marketing study will be used to translate changes in catch per unit area and changes in flooded area inside and outside FCD/Is into changes in gross fisheries incomes. This will then be divided between professional and subsistence fishermen, using the data on gear ownership and use from the socio-economic census and the catch assessment questionnaire.

3.30 Change in net income to fishermen (both subsistence and professional) will be calculated by deducting their payments to leaseholders (derived from the Access Survey), and costs of gear operation - gear maintenance and debt servicing, derived from the special studies. This will give a picture of changes in aggregate incomes in different regions or sub-regions (depending on the level of extrapolation that seems reasonable) due to FCD/I interventions.

3.31 These figures will then be placed in the context of the more detailed information obtained at the household level by the village studies. This marriage of the estimates of fishing income derived from manipulation of the fish catch assessment data with direct estimates is critical as it will allow: a cross check to be made to ensure broad consistency; fishing incomes to be placed in context of the other sources of income.

The details of this procedure can be found in para 3.155

Revised Components of Socio-Economic Programme

3.32 The socio-economic programme is divided into the following sub-components:

Village studies

3.33 Most of the primary data will be collected during the course of these studies, which form the core of the programme. Their objective is to provide:

- quantitative information on the relative importance of fisheries incomes to different groups at different times of the year in different regions, and
- a qualitative understanding of the processes that influence the flow of fisheries benefits.

The approach taken is discussed in para 3.39 (and following) and some of the initial findings in para 3.84.

Impact of flood control on pond aquaculture

3.34 Changes in flood regime will affect aquaculture. The dominant theme in much of the literature seems to be that a reduced risk of flooding will encourage pond owners to invest in the stocking of fingerlings and a more intensive management of their ponds. But the effects may not be unequivocally positive, as some pond owners rely on passive stocking by fingerlings or fry brought with the floods. After the floods recede these are allowed to grow naturally and harvested later. However, there is already an historic trend towards active stocking as part of improved management practice, irrespective of the effects of FCD/I schemes.

3.35 The overall outcome for aquaculture will depend on the balance between pond owners who respond to the opportunities for increased production through active stocking and those that simply accept reduced production due to a decline in passive stocking from the floods. This will be the subject of this study.

Details are given in para 3.107 and following.

Fish marketing study

3.36 The fish marketing study will examine different aspects of the fresh water fish marketing system and estimate the benefits accruing to various actors at different levels of the marketing network. Understanding who is involved in fish marketing, on what basis and the benefits that they derive from it will assist in gauging the social and economic impact of changes in fish production due to the FAP.

This study is discussed in detail in para 3.116 and following.

Institutional study

3.37 Based on secondary and primary data, this study will highlight the existing as well as historical and seasonal changes made in the institutional framework and regulations affecting fisheries and fishing communities.

This study is discussed in detail in para 3.145 and following.

Target Group Approach

3.38 In the present study, target group oriented approaches to open water fisheries and aquaculture undertaken by different NGOs will be evaluated. This will focus on approaches to community and group management of fisheries and aquaculture activities.

This study is discussed in detail in para 3.182 and following.

VILLAGE STUDIES:THE APPROACH TAKEN

Background

3.39 For most fishermen in rural Bangladesh, fishing is only one among a number of activities with which they support their families. Even among those classed as subsistence fishermen, its significance will vary. At one extreme, it could be a time-filling activity that pleasantly occupies an otherwise slack morning, supplementing fish consumption in a period of dietary adequacy. At the other, it could be the only means of earning income in a period of extreme hardship.

3.40 Though economists may, for convenience, try to place a single number on it, the significance of fish varies with circumstances - socio-economic, seasonal and geographic. The purpose of the village studies is to supply information that will allow the flows of benefits from fish production to be placed in context, to allow their significance to be assessed.

3.41 It was originally intended that through paired comparisons of villages, estimates could be made of the impact on the rural population of changes in fish production due to flood control. As noted, this approach has now been revised.

Objectives

3.42 The major objective of this study is to assess the socio-economic condition of the fishing community, traders and others dependent on the production, trade or consumption of fish in a series of paired villages inside and outside FCD/Is. These studies will contribute to an understanding of the variations (inside and outside flood control schemes) in the:

- existing condition of fishing communities,
- social and economic relations in fishing and fish trading households with particular reference to women,
- change in size, status and structure of fishing communities,
- fisheries income distribution pattern,
- place of subsistence/part-time fishing as a livelihood strategy in a range of environmental conditions,
- role of fish in rural diet.

Selection of Regions

North Central Region

3.43 For FAP planning generally, North Central Region covers Dhaka, Manikganj and Tangail districts. The socio-economic studies of FAP 17 have not covered any sites in Tangail district because of the very intensive studies conducted in the area proposed for the CPP by both FAP 20 and FAP 16. This has meant that there was a substantial amount of socio-economic information already available and that there was a strong chance of respondent fatigue, reducing the quality of information gathered. Reflecting this the socio-economic team have established a field station in Manikganj - separate from that of the fisheries team, who are based in Tangail.

North west Region

3.44 This region comprises different thanas of Pabna, Sirajganj and Natore districts with its field station in Baghabari in Sirajganj district.

North East Region

3.45 North East Region comprises different thanas of Sylhet, Maulvibazar and Sunamganj district with its field station at Srimongal in Maulvibazar district.

South West Region

3.46 This region comprises thanas of Faridpur, Madaripur, Gopalganj, Shariatpur and Barisal districts with its field station established at Madaripur.

Selection of Flood Control Schemes

North Central Region

3.47 As there are no flood control embankments in the NCR covered by the FAP 17 socio-economic survey, this region is classified as an outside area and comparisons are to be made with the FCD/I impacted area of NWR, across the Jamuna river.

North West Region

3.48 The selection of FCD/I schemes for study in the North-West Region was influenced by the following considerations :

- The Pabna Irrigation Scheme, covering most of the area bounded by the Baral River to the north, the Jamuna River to the east and the Padma to the south, represents an

extremely important flood control scheme, currently operating more-or-less according to design, covering a large area and enclosing several areas which previously sustained substantial fisheries. Although it has only very recently been fully completed, parts of the scheme date back to the 1970s and therefore offer the opportunity to see long-term impacts on fisheries inside the scheme.

• The problems in finding suitable inside/outside comparisons in the NCR led to a search - led by information from the Land Resource Inventory - for areas with agro-ecological characteristics similar to the area around Manikganj. The area covered by the Pabna Irrigation Scheme largely belongs to the same agro-ecological region - the Low Ganges floodplain - and seemed to offer an opportunity of finding acceptable comparisons based on the criteria adopted by the study.

• The Chalan Beel Polders (A, B, C and D) are all flood control schemes enclosing areas of what is frequently referred to as one of the most important wetlands in Asia. Polders B and C were both possible sites which combined relative accessibility from a field station located in Baghabari and a reasonably intact infrastructure in terms of flood protection. Opportunities for good agro-ecological comparisons could be found across the Atrai River from these sites in the last remaining unprotected area of Chalan Beel. Polder C, however, is the site for an important beel restocking programme as part of the Third Fisheries Project, making it unsuitable for impact assessment. Polder B was therefore selected as a suitable site for an additional paired comparison within the Region.

• A large proportion of the alternative schemes in the region are either subject to frequent public cuts or are incomplete. Others are located in areas too far from the field station to be practicable.

The schemes selected for study were therefore the Pabna Irrigation Scheme (2 inside sites) and Chalan Beel Polder 'B' (1 inside site and 1 outside site).

North East Region

3.49 The North-East Region is dominated by the deeply-flooded Sylhet Basin and the haors it contains. This represents probably the single most important inland fisheries area in the country. Much of the flood control intervention in the area is by submersible embankments - a limited form of flood control specifically aimed at protecting standing *boro* crops against early floods only until the crop is normally harvested. After this, the

embankments are designed to overtop and allow free flooding. The impacts of such embankments on fisheries need to be assessed accurately as it is generally perceived that they may be less damaging to fisheries. Problems were encountered in identifying accessible schemes which function according to plan and have not been subject to restocking programmes.

3.50 Finding comparable agro-ecological areas inside and outside schemes was not generally difficult as soil associations tend to be broadly similar. However, the complexity of the distribution of agro ecological units meant that many villages straddle several different units, creating some problems regarding determining distribution.

3.51 Suitable comparisons were identified between the Shanghair Haor submersible embankment project and the relatively unimpacted Dekker Haor area, both immediately south of Sunamganj. In addition, the Manu Irrigation Project was selected as a major full FCD/I project where the long term impacts of flood control on a major fishery in Kaoadighi Haor should now be apparent. This is being compared with the Hakaluki Haor area east of Fenchuganj which is, as yet, unprotected and is reported to sustain a fishery of comparable importance. Both Kaoadighi and Hakaluki Haor have been identified as important breeding grounds and nurseries for migratory species by the FAP 6 Regional Study.

South West Region

3.52 Initially, interest in the South West Region was focused on the deeply-flooded peat lowlands east of Gopalganj, considerable areas of which are now protected by polders. A suitable agro-ecological comparison was identified inside the Satla-Bagda Project and outside in the area immediately to the north towards Bagihar Beel.

3.53 It was felt that there was a need to identify another inside-outside comparison located on relatively higher land. Considerable difficulty was subsequently encountered in locating a suitable scheme which actually controlled flooding. Many schemes in the area were found to be breached and not effective. The Chatla-Fukirhati Project in Banga thana was eventually selected. Although elements of it do not function, it was determined that it has had important impacts on flooding patterns and does offer a large degree of protection, if not to the extent originally intended. A suitable outside area was identified south of the Kumar River in Rajoir thana, around Pathankandi Beel.

Selection of Agro-Ecological Units

3.54 A valid inside-outside comparison requires that the agro-ecological characteristics of the two villages were similar before flood control, so important differences in resources are kept to a minimum. FAO (1988) has mapped agro-ecological divisions at three levels. These are regions, sub- regions and agro-ecological units (AEU).

3.55 The most detailed division is the AEU, a set of land types that typically occurs together. These land types relate directly to flooding depth and so to the potential of both agriculture and floodplain fisheries. The FAO land type classification is shown in Table 3.6

Table 3.6 FAO Land Types

Land Type	Normal Flooding
High land	Flood free
Medium High 1	Less than 30 cm
Medium High 2	30 cm to 90 cm
Medium Low	90 cm to 180 cm
Low	180 cm to 300 cm
Very Low	More than 300 cm

3.56 As the classification of land into AEUs is largely based on work done in the 1960s and early 1970s, they provide a picture of conditions prior to flood control, making them ideal for the purposes of the study.

3.57 The choice of AEU, from which villages were ultimately to be chosen, was determined by the characteristics of its wider agro-ecological subregion and the need to have comparable areas inside and outside FCD/Is. Originally it was intended that only AEUs with both inside and outside portions would be used. Where this was not feasible, AEUs with similar flooding depths and land capability were paired.

3.58 This procedure was followed in all areas except NCR. As only two AEUs were identified which offered a reasonable degree of comparability with sites in NWR (see above for rationale), there was an opportunity to select other clusters in the region to test subsidiary hypotheses or provide baseline information for future studies. One extra cluster was selected randomly from blocks located on an AEU (By 628) which was chosen as it covers very extensive areas in the region and could therefore be regarded as "representative" of a relatively large area. Another was chosen purposively on one of the AEUs already selected for cross-river comparison to test the effects of access restrictions on effort. In this case, the village selected randomly is on the banks of the Ichamati River, where fisheries access is closed, and the nearest large beel or floodplain is about 2

kilometres distant. The purposively selected village is immediately next to a major beel with a mixture of leased and open-access fisheries.

Selection of Villages

3.59 The choice of village for sampling required further pre-selection screening for a number of reasons:

- To have the villages representative of their respective AEU's, it was necessary to identify villages with a distribution of land types and flooding depths which corresponded, within acceptable limits of accuracy, to the general distribution defined for that AEU in the FAO Land Resource Survey of Bangladesh.

- Distorting factors such as intensive NGO activities, higher involvement in non-agricultural activities, appreciable daily labour opportunities in nearby towns or industries, uncommon cropping patterns etc. might reduce the representativeness of the villages for the purposes of the study. Hence it was felt necessary to identify those factors for each village. To do this, a rapid land type appraisal was made for the villages within the selected AEUs. This involved the following steps:

Step 1: Within the AEUs identified, up to five blocks were defined using the 1:50,000 maps from the Survey of Bangladesh. These blocks were selected so as to be of consistent size - 3 x 3 grid squares or 3 kms x 3 kms on the ground - and fall completely within the AEU. No blocks were defined where access would create problems for subsequent field activities.

Step 2: The mauzas falling within each block were identified using the 1:50,000 maps in conjunction with the Small Area Atlas of Bangladesh. Each *mauza* within a block was assigned a value equivalent to the number of households in the *mauza*. This provided a means of weighting the mauza sampling to give an equal probability of selection for all households. The values for all mauzas were then listed cumulatively and the mauzas were assigned an order using simple random sampling.

Step 3: Starting with the first selected block of a particular AEU, all the mauzas and villages comprising a mauza were visited by an appraisal team in order to rapidly assess the distribution of land types as defined by flooding depth and take an account of possible distorting factors such as NGO activities, cropping patterns, irrigation water availability,

non-agricultural labouring, landless labourers' activities etc. The villages were visited in the order established in Step 2.

After arriving in the village, the appraisal team drew a sketch map of the village and different transect lines on the map to cover the entire village. They then divided into groups and traversed the different transect lines. Households and villagers encountered on the transect lines were then questioned using prepared checklists. Both direct observation and information from the key informants were used to prepare an appraisal report. A copy of the checklist is shown in Appendix II.

The *mauza* identified in the Bangladesh Small Areas Atlas were used as an initial source for identifying discreet units to be visited during this first stage. However, the land type appraisals made it possible to identify community boundaries as recognised and understood by local people. Such was the divergence that it was necessary to redefine the sampling units. Many *mauza* contain several villages which are effectively separate social and economic entities. The distribution of land types and other data collected were specifically related to these new units, the definition and boundaries of which were those recognised by local people.

All the villages in each block were covered in each region with the exception of one or two in the NCR. Even so, the final sampling frame of communities was limited due to the wide range of factors identified in many villages which would act as "distortions" for future data collection.

Sometimes dramatic changes had occurred in flooding and land height distributions that were unrelated to FCD/Is; this made it difficult to identify villages which fell within the criteria for "representativeness" established by the methodology. In these cases, the land type appraisal data were used to establish a frame of villages where, even if they failed to match the AEU, the current agro-ecological characteristics of the outside village were similar to those of the inside village prior to flood control.

Step 4: From those villages identified as representative of a particular AEU, one was selected using simple random sampling, using random number tables. In all, four main villages were selected in each region.

3.60 Initial field work indicated the need to specifically sample fishing communities as "professional" or "traditional" fishermen tend to live in separate communities which would

not necessarily be represented in the main sample villages. The problem was then to select fishing communities in a consistent and representative manner.

3.61 Various possibilities were considered : selection in terms of relative access to leased water bodies, relative position in relation to different types of waterbody and relative distance from different types of water bodies were just some of the possibilities considered. However, field work carried out in the blocks being covered by the land type appraisals failed to establish a set of criteria that could be applied unambiguously. As a result it was decided to identify, purposively, fishing communities in the vicinity of the main sample villages with which there was interaction. This approach had the obvious advantage of ensuring that the fishing communities selected would be more easily accessible. In addition, it provided the opportunity to understand fisheries in a particular rural setting in more detail than would be possible looking at a widely dispersed set of communities.

3.62 The term "interaction" is open to a range of interpretations and a wide variety of different forms of interaction were found between the main sample villages and adjacent fishing communities. The criteria for selection had to be flexible. In general, fishing communities were selected from which fishermen exploited water resources located in or adjacent to the main communities. In many cases, people from the main communities would also exploit the fishery in the same waterbody, at least seasonally.

3.63 In the site selected inside the Manu Irrigation Project NER, a neighbouring *haor* is fished by a fishing community some six kilometres distant who work for the leaseholder. Direct fisheries interaction is limited to the surrounding floodplain during specific times of the year. The fishing community with access to the *haor* was selected along with another community immediately adjacent to the main sample village which exploits a range of local khals and waterbodies.

3.64 In the comparable outside site in Hakaluki Haor, one adjacent fishing community with no access to the principle fishing grounds was selected as they often interacted directly with local villagers in harvesting ponds and *kua* (fish pits) on the floodplain. Another, larger fishing village slightly more distant has greater access to some of the major beels in the area through a powerful community member holding a *jalmahal* lease. In addition, the two communities represent, respectively, both traditional Hindu (Namasudra) and Muslim (Maimul) fishing communities.

3.65 Table 3.7 shows paired sites inside and outside FCD/I schemes with the names of the selected schemes, AEUs and land type distribution.

Table 3.7 Village Paired Comparisons, AEU and Generalised Land Type Information

Scheme Name/Type	Inside/ Outside	Vill-age	AEU	AEU Land Type Distribution (%)					
				H	MH1	MH2	ML	L	VL
Pabna Irrigation Scheme - Gandahasti Beel (Full FCD/I)	Out	NC1-1	GL 655	15	7	0	23	55	0
	Out	NC4-1	GL 655	15	7	0	23	55	0
	In	NW1-1	GL 259	10	5	0	15	50	20
Pabna Irrigation Scheme Santhia (Full FCD/I)	Out	NC3-1	BY 630	28	7	34	10	21	0
	In	NW2-1	GL 248	45	5	15	20	15	0
Chalan Beel Polder B (Full FCD/I)	Out	NW4-1	GL 211	20	11	14	55	0	0
	In	NW3-1	GL 211	20	11	14	55	0	0
Manu Irrigation Project (Full FCD/I)	Out	NE2-1	SE 479	8	0	0	35	57	0
	In	NE1-1	SE 479	8	0	0	35	57	0
Shanghair Haor Project (Submersible Embankment)	Out	NE3-1	SE 442	15	1	14	65	5	0
			SB 451	4	0	0	6	30	60
	In	NE4-1	SE 442	15	1	14	65	5	0
			SB 452	6	0	0	7	67	20
Satla-Fukirhati Scheme (Full FCD)	Out	SW2-1	MO 574	0	0	0	26	72	2
	In	SW1-1	MO 854	0	0	0	84	16	0
Chatla-Fukirhati Scheme (Full FCD)	Out	SW4-1	GL 568	5	14	11	45	25	0
	In	SW3-1	GL 555	1	15	23	45	15	0

Village Census

3.66 A census was conducted in the selected main villages and fishing communities. Information was gathered from all household heads on their age, religion, education, family and on occupation, involvement in fishing, land, pond, gear and boat ownership.

3.67 To assist with the monitoring each household was classified according to its landholding and involvement in fishing. This allowed the sample to be stratified, so that the monitoring effort could be focused towards households for whom fishing was an important activity. Non-fishing households are also being covered, to provide a basis for comparison. (Ultimately, evaluation at the village level will re-correct for the monitoring bias.)

3.68 The standard BBS landholding categories were used: large landowners were defined as those owning 7.5 acres or more, medium landowners as those owning 2.5-7.5 acres, small landowners as those owning 0.5-2.5 acres, and landless as those owning less than 0.5 acres.

3.69 The possibility of simply adopting the traditional fishing categories of professional, part-time and subsistence fishermen was considered but rejected as too crude. The principal problem was with the heterogeneity of professional fishermen - who can vary from large fishing entrepreneurs, owning a number of boats and numerous gears, to simple fishing labourers who do not even own a push net. But there were also difficulties with the distinction between subsistence and part-time fishermen. As a result households were divided into six fishing categories determined by gear ownership, gear investment and the number of months in which income was obtained from fishing. These were defined as indicated in Table 3.8.

Table 3.8 Definition of Fishing Categories

Category	FAP17 Classification	Criteria
FMC1	High investment High involvement	Gear investment = > Tk.1,000 Months fishing income > = 4
FMC2	Low investment High involvement	Gear investment < Tk.1,000 Months fishing income > = 4
FMC3	High investment Low involvement	Gear investment = > Tk.1,000 Months fishing income < 4
FMC4	Low investment Low involvement	Gear investment < Tk.1,000 Months fishing income < 4
FMC5	"Subsistence"	Owns gear but gets no income
FMC6	"Non-fishing"	No gear and no income

3.70 This two way classification into four land categories and six fishing categories, gave 24 potential sub-categories into which households might fall. In practice many of these sub-categories were likely to be empty, for instance there are very few fishermen who own more than 2.5 acres, there are almost certainly none who own more than 7.5. Nevertheless it was decided to collapse the first four fishing categories together when sampling in the main villages. This left three fishing categories: those receiving income from fishing, those owning gear but not getting income and those with neither fishing gear nor income. This left 12 potential sub-categories - a more manageable number.

3.71 For the satellite fishing villages/clusters, which were sampled to expand the sample of professional fishermen, stratification was according to fishing category alone. Only the households in the first four categories (FMC1 to FMC4, as defined in Table 3.8 above) were considered.

3.72 A simple pre-coded questionnaire was developed to collect information on the present position of the respondents in terms of family size, education,employment and occupation of the family members, migration history, land ownership, land type and use of each crop production plot. Information on possession of assets like agricultural tools and machineries, livestock, transport etc. was also collected. Information on food deficit, clothing and indebtedness last year was collected as poverty indicators. The income generating activities of all household members was also recorded.

A copy of the baseline survey questionnaire is shown in Appendix II.

Household Monitoring

3.73 Household monitoring of the income, activities and food consumption of all the respondents to the baseline survey has been started. The monitoring period extends for one year from mid-January 1993 to mid January 1994. Eleven different groups of enterprises are being monitored; of these, the four that relate to fishing are being covered in detail, with summary data being collected on the rest.

Table 3.9 Enterprise Types Covered in Monitoring

Code	Enterprise Type	Activities
AE	Agriculture	Income earning crops, vegetables, fruits, trees and forest bushes are included under this category. 35 enterprises pre-coded.
LV	Livestock	Income earning poultry birds and domestic animals are included under this category. 3 enterprises.
AL	Agricultural labour	Agricultural labour covers man-days spent and income earned from providing labour for farm activities to others. This includes labour on daily, contract or on exchange basis.
NL	Non-agricultural labour	All labour used for non-agricultural purposes either on daily basis, contract basis, volume basis. Services in government/NGO/private organizations are included in this category.
FW	Food for Work	Infrastructural works such as earth works, embankment construction or repair, roadside tree plantation works etc. is often sponsored by the government, who pay the labourers in food (mostly wheat). These are an important source of income for the poorest households at some times of the year.
SE	Self Employ-ment	Skilled labour - carpenter, potter, blacksmith, goldsmith etc. and transport labour, as well as professionals like doctor, teacher, engineer, lawyer etc. and trade and business.

Code	Enterprise Type	Activities
GM	Gear making	Making and maintenance of fishing gear is included in this category. Gear making for both commercial and household uses are included.
FT	Fish Trading	Different types of fish traders are included in this category. Activities related to each type of fish trader are considered as separate enterprise. 4 enterprises.
FE	Fishing	Income received from fishing by different types of gears are included in this category, with each gear type being considered a different enterprise.
FC	Fish Culture	Income and activities related to fish culture in pond, ditches, etc. are included in this category. 4 enterprises.
ES	Expenditure Saving	Activities which do not earn cash income directly but play an important role in the households' livelihood are included in this category: post harvest operations, food processing, gleaning, fuel collection, grazing etc. 15 enterprises.

3.74 To obtain an understanding of seasonal variations in the dietary importance of fish for different socio-economic groups, food consumption is being monitored. A questionnaire has been developed, which is to be administered by the female research assistants to the female members of target households on the composition of meals over the previous 48-hours. Particular attention will be paid to fish, and details sought on where fish was obtained and whether it was bought or caught. In addition, information on the frequency of fish consumption over the previous week will be obtained.

3.75 This monitoring of food consumption will, at best, provide indications regarding the actual nutritional significance of fish. However, at a minimum, it should provide a clearer idea of the relative importance of fish compared to other food stuffs.

A copy of all the monitoring forms are shown in Appendix II.

Rapid Rural Appraisal (RRA)

3.76 The study methodology outlined above is intended to quantify incomes and time-use to assess the seasonal importance of fisheries relative to other livelihood strategies of different socio-economic groups. A more open-ended approach to research was needed to understand many of the factors that might explain these variations: social and political factors influencing access to leased water bodies, the historical changes in fishing communities and their perceptions of fisheries resources.

3.77 A series of Rapid Rural Appraisals were therefore carried out in each of the village clusters. These were seen as having the following advantages:

- helping identify key issues influencing the fisheries in the village clusters and regions selected.
- familiarising field teams with the communities in which they were to be working.
- ensuring that the whole team, from senior Dhaka-based staff to field-level research assistants achieved a reasonably consistent understanding of the research issues.
- training field staff in non-quantitative approaches.
- team-building.

3.78 The principle research goals of the RRAs are listed below. These have evolved considerably in response to field experience. In general, RRAs have tended to become progressively more focused on a specific set of issues as the importance of these issues has become clearer. There has also been considerable regional variation in the relative importance of different topics. The checklist provided in Appendix II is a complete list of all the topics covered in all villages, though the level of detail obtained on each topic in individual locations tended to vary according to their local importance.

3.79 Initially, RRAs have been carried out in only two of the four village clusters in each region; the remaining clusters will be covered at a later date.

3.80 The principle research goals for the RRAs were to:

- understand the historical and seasonal factors influencing water and resources in the target areas.
- identify uses of water bodies and conflicts over waterbody use.
- identify social and occupational groups and their relative involvement in fisheries.
- understand local people's perceptions of flood and flood control measures and their impacts on fisheries.
- understand womens participation in fisheries and other rural enterprises.
- clarify the goals and activities of the study to local people and, as far as possible, ensure their participation in the subsequent survey and monitoring activities of the project.

3.81 RRAs were conducted as follows:

Step 1 A RRA team consisting of socio-economic consultants, regional supervisor and research assistants of the respective region was formed for each region.

Step 2 The regional supervisor organised a village meeting on the morning of the first day, to which all the villagers, particularly village leaders and members of different socio-economic groups were invited. Members of the RRA team addressed the villagers indicating the objectives of RRA and the subsequent studies which were to follow in the village.

Step 3 After the meeting, members of the team were divided into three groups. One group, consisting of female members, was exclusively for interviewing female household members to assess the participation of the women in agriculture, fishing and other enterprises. The other two groups dispersed to interview villagers of different socio-economic groups.

At this stage, each team prepared a sketch map of the village with the help of the villagers, showing the location of the homesteads of different social, ethnic and economic groups. Key informants and several homogeneous socio-economic groups were interviewed at this stage. While a general checklist was used all efforts were made to keep the discussions with the villagers open and frank.

Step 4 All team members met in the evening of the first day to discuss their experiences and identify key issues needing detailed investigation.

Step 5 On the second day, the team members were divided into three groups, each with a particular area of responsibility: fisheries, employment, institutions and marketing and social issues. Historical change, seasonal change and gender roles for each area were investigated.

Step 6 All the team members met in the evening to discuss the findings and identify gaps where more information was needed. The task of writing specific sections of the report was delegated to individual members in this meeting.

Step 7 On the third day, gaps were filled using a checklist to interview key informants. Individual members started writing their assigned part of the report on the same day.

Step 8 All the team members met in the evening of the third day and the individual members presented their reports. After thorough discussions, necessary modifications were made. The contents, maps, charts, graphs etc. needed for the report were listed and finalized at this stage.

The checklists for RRA are shown in Appendix II.

Special Studies

3.82 During the course of the RRAs and other work carried out in the field, a series of important issues were identified which could not easily be covered during the course of routine, quantitative monitoring.

3.83 Where these issues have been identified, they have been assigned relative priorities, and developed into special studies. These will be undertaken by individual research assistants in the field, supported by senior staff.

A breakdown of these studies by region is shown below in Tables 3.10 to 3.13.

Table 3.10 NORTH – CENTRAL

Study No.	Study Title	Data Collection Approach	RA Inputs Required	RA Responsible
1.	Study of access & rights to fisheries	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Samiul Alam
2.	Regular price data from primary markets	Ad Hoc Questionnaires	Regular collection of data/ collation of data	Samiul Alam
3.	Vulnerable groups and fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Siddiqur Rahman
4.	Role of women in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Sadiqa Akhter
5.	Role of children in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Siddiqur Rahman
7.	Migration of fishing communities	Topical RVA / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information	Jahurul Kabir
8.	Costs & earnings of fishing gears & craft	Special Studies / Ad Hoc Questionnaire	Collection of data from limited sample	Bashir Chowdhury
9.	Rites & rituals associated with fisheries	Anecdotal Information	Collation of anecdotal information	Homaira Khan

Table 3.11 NORTH – WEST

Study No.	Study Title	Data Collection Approach	RA Inputs Required	RA Responsible
1.	Study of access & rights to fisheries	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Mahabat Ali
2.	Regular price data from primary markets	Ad Hoc Questionnaires	Regular collection of data / collation of data	Bishwajit Roy
3.	Vulnerable groups and fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Shirin Sultana
4.	Role of women in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Ferdous Ara
5.	Role of children in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Shirin Sultana
6.	Management of regulators	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Tajul Islam
7.	Migration of fishing communities	Topical RVA / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information	Bishwajit Roy
8.	Costs & earnings of fishing gears & craft	Special Studies / Ad Hoc Questionnaire	Collection of data from limited sample	Santi Howlader
9.	Rites & rituals associated with fisheries	Anecdotal Information	Collation of anecdotal information	Ferdous Ara
10.	Muslims in fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Mahabat Ali

Table 3.12 NORTH – EAST

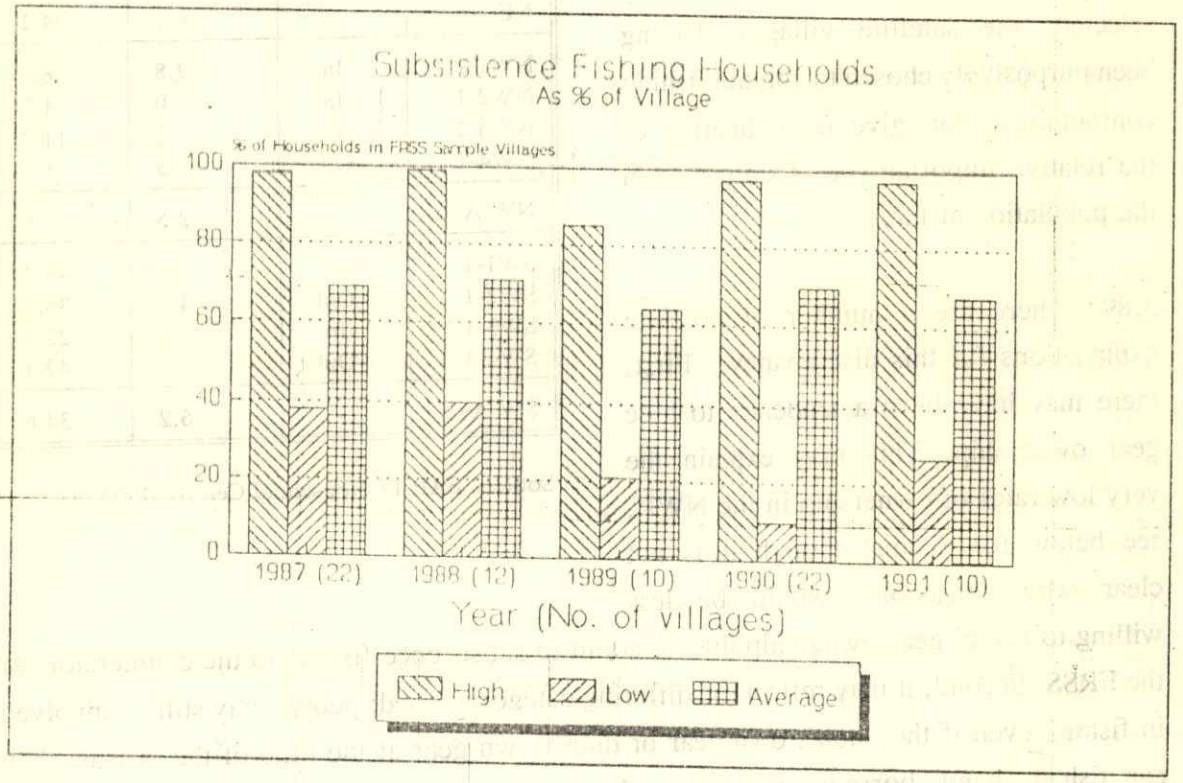
Study No.	Study Title	Data Collection Approach	RA Inputs Required	RA Responsible
1.	Study of access & rights to fisheries	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Abdul Rouf
2.	Regular price data from primary markets	Ad Hoc Questionnaires	Regular collection of data / collation of data	Jashimuddin
3.	Vulnerable groups and fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Jashimuddin
4.	Role of women in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Khaleda Akhter
5.	Role of children in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Mahbuba Shirin
6.	Management of regulators	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Atiquzzaman
7.	Migration of fishing communities	Topical RVA / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information	Atiquzzaman
8.	Costs & earnings of fishing gears & craft	Special Studies / Ad Hoc Questionnaire	Collection of data from limited sample	Nazrul Islam
9.	Rites & rituals associated with fisheries	Anecdotal Information	Collation of anecdotal information	Mahbuba Shirin
10.	Muslims in fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Abdul Rouf

Table 3.13 SOUTH–WEST

Study No.	Study Title	Data Collection Approach	RA Inputs Required	RA Responsible
1.	Study of access & rights to fisheries	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Shahidullah
2.	Regular price data from primary markets	Ad Hoc Questionnaires	Regular collection of data / collation of data	Kartik Mandal
3.	Vulnerable groups and fishing	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Shameema Akhter
4.	Role of women in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Rebeka Sharmin
	Role of children in fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Shameema Akhter
6.	Management of regulators	Topical RVAs / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information / collection of secondary data	Kartik Mandal
7.	Migration of fishing communities	Topical RVA / Anecdotal Information / Ad Hoc Questionnaires	Collation of anecdotal information	Sayeduzzaman
8.	Costs & earnings of fishing gears & craft	Special Studies / Ad Hoc Questionnaire	Collection of data from limited sample	Yunus Khan
9.	Rites & rituals associated with fisheries	Anecdotal Information	Collation of anecdotal information	Rebeka Sharmin
11.	Occupational mobility into & out of fisheries	Anecdotal Information / Special Studies	Collation of anecdotal information / case studies	Sayeduzzaman

3.84 The initial RRAs and the preliminary analysis of the village census suggest that there is considerable regional variability in the fishing communities and the management of fisheries and that the proportion of households dependent on fishing may be overstated.

3.85 The census of the main villages found far fewer subsistence fishing households than was expected. In the literature, there is a general acceptance that subsistence fishing is practised by the vast majority of households; the World Bank Fisheries Sector Review[6], for instance, cites a figure of 73% for 1987/88. The FRSS data available at FAP 17, which covered a subset of their surveyed subsistence villages, indicates that this figure is broadly representative of the period 1987 to 1991 (see Figure 3.1 below).



3.86 The main villages covered by the socio-economic survey generally show a much higher percentage of non-gear owning households than would seem to be consistent with this picture. The difference is important because FRSS takes the proportion of households engaged in subsistence fishing as a multiplier against the total number of households given by the 1981 BBS Census to find total subsistence catch[7].

[6] World Bank (1991)

[7] The total number of rural households adjusted for subsequent population growth is more appropriate.

Table 3.14 Household Fishing Types, Main Villages

Main Village	Inside/ Outside FCDI	Profess-ional Fishermen	Other Households	
			Gear Owning	Non-Gear Owning
Code	In/Out	%	%	%
NC1-1	Out	1.7	49.6	48.7
NC2-1	Out	0.5	30.6	69.0
NC3-1	Out	1.6	43.8	54.7
NC4-1	Out	9.8	61.0	29.3
NC Avg.	-	1.8	42.3	55.9
NE1-1	In	0	30.2	69.8
NE2-1	Out	0	38.3	61.7
NE3-1	In	0	30.7	69.3
NE4-1	Out	0.7	42.1	57.1
NE Avg.	-	0.1	34.1	65.8
NW1-1	In	7.8	8.9	83.2
NW2-1	In	0	1.2	98.8
NW3-1	In	0	11.2	88.8
NW4-1	Out	0.5	8.7	90.8
NW Avg.	-	2.5	7.6	89.7
SW1-1	In	0	44.3	55.7
SW2-1	Out	4.3	35.8	59.8
SW3-1	In	15.0	22.8	62.2
SW4-1	Out	0	47.1	52.9
SW Avg.	-	6.2	34.6	59.2

Source: FAP 17 Household Census, 1993

3.87 Table 3.14 below shows the breakdown of the village between professional fishing households, gear owners and non-gear owners. There are only two villages out of the 16 surveyed where the proportion of gear owning households exceeds 50%, even when professional fishermen are included. Both are in North Central.

3.88 Only main villages are considered here because they were randomly selected; the satellite villages, having been purposively chosen to contain fishing communities, can give no indication of the relative importance of fishing within the population at large.

3.89 There are a number of possible explanations for this discrepancy. First, there may have been a tendency to hide gear ownership. This may explain the very low rates of ownership in the NWR, see below for details; though it is not clear why households would be less willing to reveal gear ownership than to admit to subsistence fishing to the enumerators of the FRSS. Second, it may reflect the differing categories used: people may still be involved in fishing even if they don't own gear or didn't own gear at the time of the census: they can fish by hand, borrow gears from others, or buy gears before the start of the next flooding season (*thella jal* cost less than Tk.100 and rarely last much more than a year). Third, the villages chosen may simply be unrepresentative.

3.90 If no clear reason for this discrepancy emerges in the course of the village monitoring, it may be necessary to investigate other villages to rule out the third hypothesis. Variations that will condition interpretation of field data are discussed in the next section.

3.91 Involvement in fisheries seems to be strongly influenced by the availability of alternative employment. The development of industry along the Dhaka-Aricha highway has opened up possibilities for income-generation without which fisheries might assume greater importance as part of households' survival strategies. The intense activity by NGOs has also had an important influence in providing poorer households in general, and women in particular, with a greater range of livelihood options than in the other region.

3.92 For landless labourers, the demand for labour on earthwork seems to absorb a great deal of surplus labour in the countryside which might otherwise have been channelled into fisheries. The seasonal breakdown of income sources for a series of households in two villages in the region shown in Figure 3.2 gives some idea of the relative importance of different sources of income.

3.93 Proximity to the main Padma River provides an opportunity for many households in Harirampur Thana to fish seasonally for hilsa using *sangla jal*, a clap net. It seems that this occasional fishery is tolerated, as is subsistence fishing on many floodplains in the area. In one case, on a reach of the Padma subject to the New Fisheries Management Policy, it was reported that professional fishermen have to pay for access whereas non-professionals using the same gear are allowed to fish freely.

3.94 Indeed, though there are local variations, the issue of access seems less controversial than elsewhere. Most accounts of conflict related to fisheries seem to centre on official confiscation of the illegal *current jal*.

3.95 Traditional fishing communities in the region tend to be small and widely scattered. They are not necessarily concentrated in the vicinity of water bodies and are usually found as clearly delimited *para* within larger agricultural communities. The exceptions are the larger riverine fishing communities located on the banks of the Jamuna and Padma Rivers. The movement of traditional fishermen into other occupations seems to be very limited. Some larger fishing communities are located nearer to the main rivers. Traditional fishermen are relatively mobile, many living in the hinterland of the main rivers fish seasonally in the Padma or even the Meghna. An example of the range of operations is given in Figure 3.3 below for a traditional Rajbangshi fishing community in Singjuri, Ghior Thana.

3.96 There are usually at least four or five non-traditional, Muslim fishermen in each community, who fish throughout the year. Seasonal fisheries play an important role as a source of food and income during the flood season, often as an activity of last resort for very marginal households, such as erosion victims.

Figure 3.2

SEASONAL CALENDAR : INCOME LEVELS from DIFFERENT SOURCES

North – Central Region

KEY : = Fisheries income / activity = Agricultural labour = Other income sources

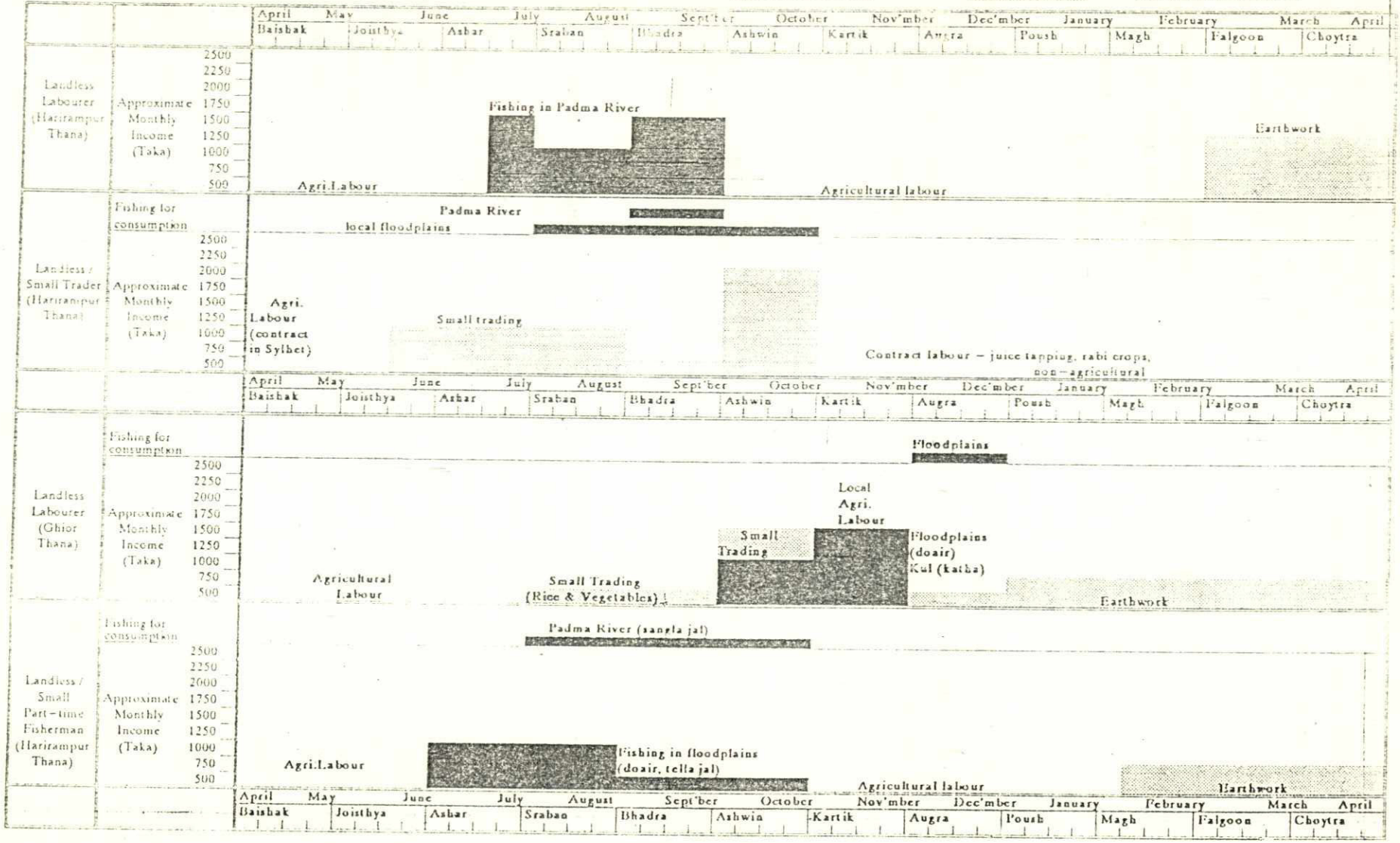


Figure 3.3

SEASONAL CALENDAR : Showing levels of activity for different income sources + relative income levels

Region : NW Thana : Sujanagar

Village : 1 – 1 FCD Status : Inside

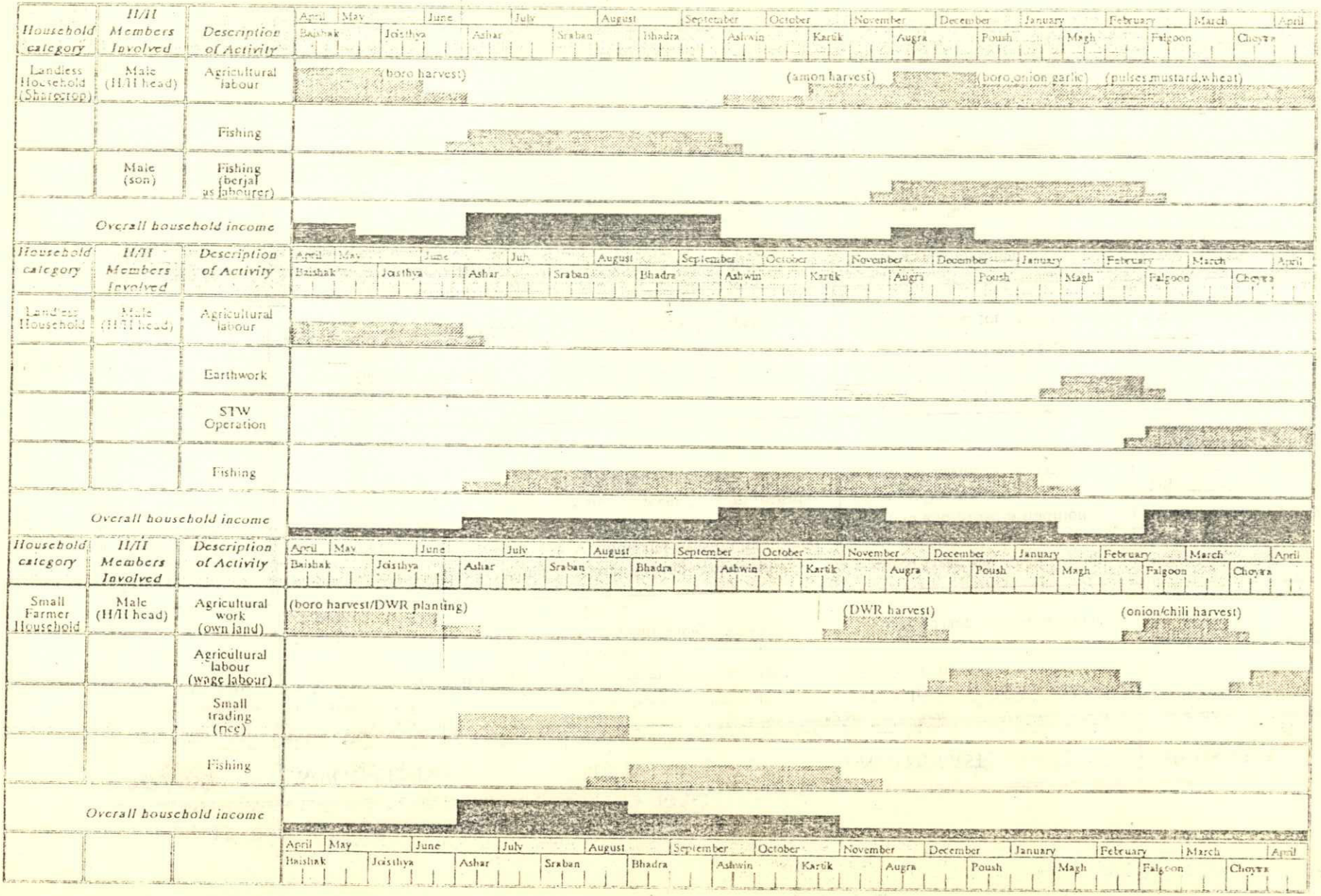


Table 3.15 Regional Differences in Fisheries Involvement

REGIONS	NORTH-CENTRAL	NORTH-WEST	NORTH-EAST	SOUTH-WEST
Areas / schemes studied to date	Manikganj District • Ichamati River - Harirampur Thana • Kaliganga River - Ghior Thana	Pabna Irrigation Project • Gajnar Beel - Sujanagar Thana • Ichamati River - Santhia Thana	Manu Irrigation Project - Maulvi Bazar Thana Hakaluki Haor - Kulaura Thana	Satla-Bagda Project - Bagihar Beel - Kotalipara Thana
Professional fishing communities	• many, small traditional fishing communities • almost all Hindu	• large fishing communities • Hindu and Muslim traditional fishermen • many recent Muslim recruits to fishing	• mixed large and small fishing communities • Hindu and Muslim traditional fishing communities • some fishermen-cum-farmers	• few traditional or full-time fishermen • many farmers and labourers fishing seasonally • Muslim and Hindu fishermen • many recent Muslim recruits to fishing
Fisheries access	• restricted on rivers • more open on beels and floodplains • more extensive open fisheries	• tightly restricted on most productive waterbodies • strict enforcement • limited period for open fisheries	• very tightly restricted on most productive waterbodies • strict, often violent enforcement • limited period for open fisheries	• access more open • extensive period for open fisheries • widespread pond fisheries
Social groups involved in seasonal / subsistence fisheries	• many small farmers fishing • many subsistence fishermen	• reticence over revealing fishing activity • strongly conditioned by control of access	• widespread involvement in seasonal fishing • strongly conditioned by control of access	• very widespread involvement in seasonal fishing • many landless entering fishing

North-West

3.97 Across the Jamuna from the Manikganj area in North-Central, fisheries in the North-West Region inside the Pabna Irrigation Scheme present a very different picture. The area is somewhat lower-lying and, despite flood control, there are still many extensive beels and wetlands supporting important fisheries, which are jealously guarded.

3.98 Conflicts between different groups of fishermen, and between fishermen and non-fishermen over access to waterbodies seem to be a common occurrence. This tension regarding access to fisheries is reflected in the contradictory data received on several occasions regarding fishing and fishing gear ownership. Around Gajnar Beel, it was generally reported that large numbers of local people are engaged in seasonal fisheries and considerable detail was obtained about the background and status of local fisheries. However, during a census of the same communities, very few people admitted to owning fishing gears.

3.99 Considerably more work is needed in this region before coming to any conclusions about the relative importance of fisheries to different groups.

Up until the 1940s, no Muslims in the Gajnar Beel area were engaged in fishing, which was entirely an occupation for "traditional" Hindu fishermen. During the late 1940s, one Muslim from the village started fishing "secretly". When the village *panchayat* found out, they were reportedly furious and ordered him to stop fishing immediately as they felt his actions were demeaning the whole Muslim community. He subsequently left the village. However, by the late 1960s, the activity he had started had been taken up by many landless Muslim households who found it, at that time, to be far more lucrative than agricultural labour.

(More recently, since the area was embanked, fisheries production is reported to have declined by about 75% and there seems to be some decline in the numbers of people fishing. One respondent reported that the *ber jal* which he used to operate with a group of fellow labourers is no longer viable, and he is now only using smaller gears such as traps and long lines.)

3.100 Quite large numbers of traditional, and non-traditional but full-time, Muslim fishermen are found in the area. According to some respondents, the extensive involvement of Muslims in fishing was originally fiercely opposed. The following account was given by an older man near Gajnar Beel who had been among the first Muslims in this village to take up fishing as a seasonal activity. Examples of the seasonal significance of fisheries for different households is shown in Figure 3.3. Regional differences in fisheries involvement are summarized in Table 3.15

North-East Region

3.101 The North-East presents a very particular picture compared with other regions. The deeply-flooded haor areas of the Sylhet Basin are renowned for their productivity and play an important part in local household livelihood strategies. Until relatively recently, these wetlands represented a largely open resource that was exploited in many different ways. During the winter season, the drawdown of flood waters left extensive grazing lands, which supported large populations of cattle, and numerous forms of wild food. However the haors are chiefly famous for their fisheries.

3.102 As in NWR, the value of these fisheries encourages tight control over access. While the deepest beels have been subject to leasing for a long time, local people report a steady increase in the strictness of enforcement. More alarmingly, lessees have tended to expand the areas controlled beyond the legal boundaries of their *jalmohals*, with a corresponding decrease in the area left "open". Disputes over access are common and often lead to violence.

3.103 In spite of this, a great many people are still engaged in fisheries as a supplementary activity. The timings of peak fishing periods differs from other parts of the country, as early flash flooding can produce high flood levels in May or even April.

South-West

3.104 The situation in the SWR, based on experience to date in the peat lowlands in and around the Satla-Bagda Project, is different again. There seem to be fewer traditional fishing communities playing the role of "professionals". Whereas in most other regions, there are fishermen clearly regarded as specialists who tend to be those hired by leaseholders to harvest their *jalmahal*, ponds, *katta* (brushpiles) and *kua* (fish pits), in the South-West this role seems to be less specialised. Many people who call themselves "fishermen" are also engaged in agriculture.

3.105 One reason for these high levels of involvement in fishing may be the large amount of surplus labour in the area during the slack agricultural season (June to October), reflected in the large numbers of people who migrate seasonally. Some move relatively locally, to Jessore or Khulna and find temporary labouring jobs . However, large numbers also move to Dhaka for longer periods.

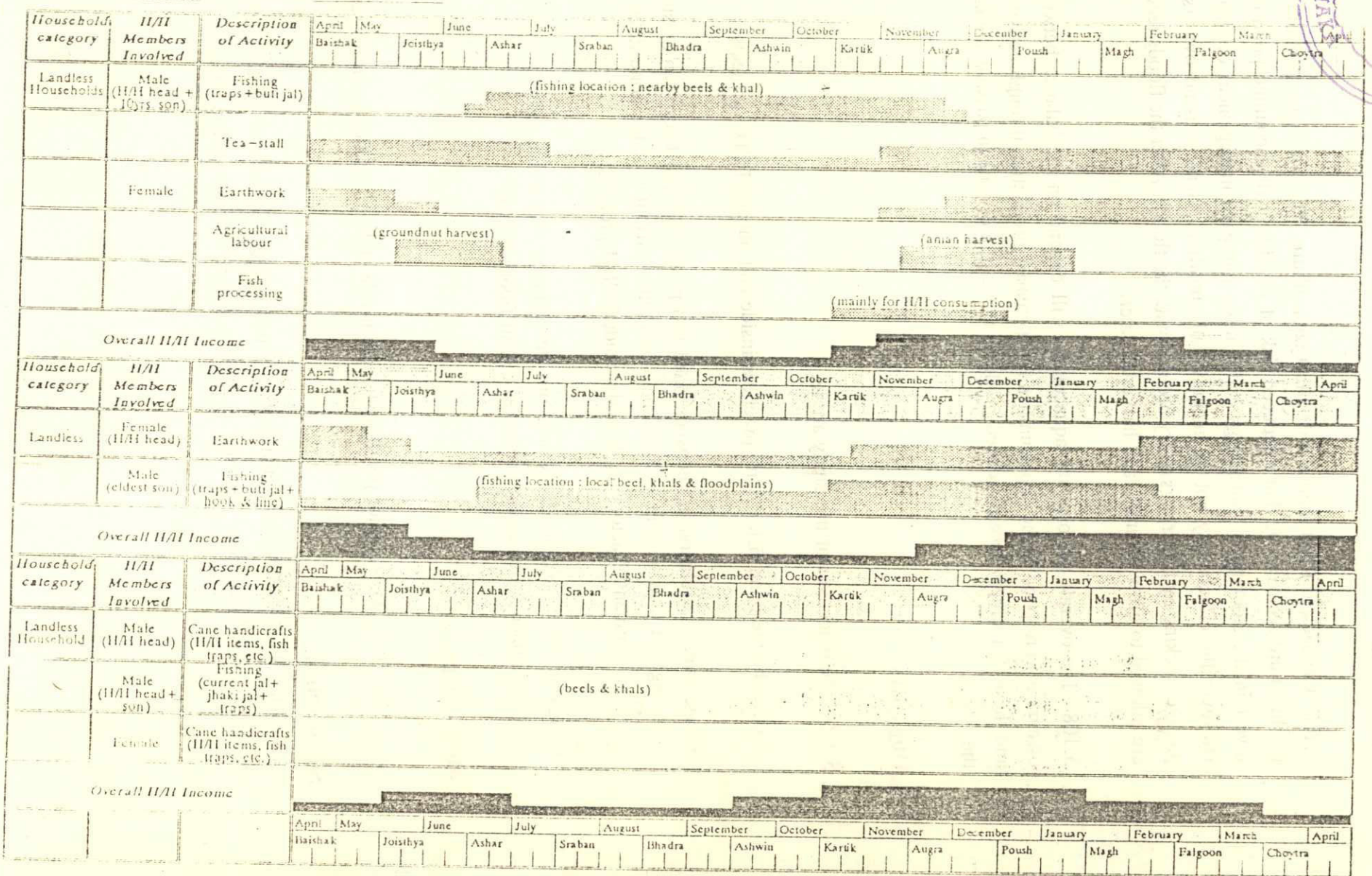
3.106 For those who stay, fishing represents one of the few options for sustaining family livelihoods through the flood season. This is also reflected in the number of households also engaged in making fishing gear. Figure 3.4 gives an example of the seasonal breakdown of different activities for several households in the South-West Region.

Figure 3.4

SEASONAL CALENDAS showing levels of activity for different income-sources + relative income levels

Region : SW Thana

Village : 2 – 1 FCD Status Outside



IMPACT OF FLOOD CONTROL MEASURES ON POND AQUACULTURE

Background

3.107 Changes in flood regime will affect aquaculture. The dominant theme in much of the literature seems to be that a reduced risk of flooding will encourage pond owners to invest in the stocking of fingerlings and a more intensive management of their ponds. However the effects may not be unequivocally positive, as many pond owners rely on passive stocking by fingerlings or fry brought with the floods. After the floods recede these are allowed to grow naturally and harvested later.

3.108 The overall outcome for aquaculture will depend on the balance between pond owners who respond to the opportunities for increased production through active stocking and those that simply accept reduced production due to a decline in passive stocking from the floods.

Objectives

3.109 The objectives of this study are to:

- describe the pond fish culture practices inside and outside FCD/I projects.
- determine the relationship between pond fish production practices such as stocking, feeding and management and the socio-economic attributes of the pond/ditch owners and environmental factors inside and outside FCD/I projects.
- suggest policy measures for aquaculture development that would contribute to mitigate losses to open water capture fisheries due to flood control.

Methodology

3.110 The study will monitor pond production inside and outside flood control schemes.

Site selection

3.111 This study will be conducted at the 16 main villages selected in the FAP 17 socio-economic study. Methodology for the selection of these villages has been described earlier

in this report. There are three principal advantages to this use of the main socio-economic villages:

- Due to the selection criteria followed (see para 3.59 and following), the villages are broadly representative of their region and carefully paired for valid inside/outside comparisons.

- Research assistants engaged in household monitoring can collect data for the present study with no added logistical problems.

- Rapid Rural Appraisal has or will be done at all these villages and data on the socio-economic condition of all households, market infrastructure etc. required for the present study are already available.

Selection of respondents

3.112 For each of the 16 selected villages, a census has been completed for the socio-economic study. With this study in view, all respondents were asked about pond ownership and whether their ponds had been cultured or not.

3.113 Of the 40 households selected, all those with ponds or ditches are included in the present study. In addition, a list of large farm households (who have been excluded for the main survey) having more than 7.5 acres of land was collected and separated from the census list. Those having ponds or ditches form the population of large farmers.

3.114 These large farmers were then divided on the basis of whether or not their ponds/ditches were cultured. From each of these two groups two large farmers were selected using simple random sampling. As the number of households having ponds/ditches varies, so does number of respondents in each village.

Collection of information

3.115 Information on fish culture activities, expenditure incurred and income earned from ponds and ditches of the respondents is being collected by regular monitoring. Information on ponds and ditches (collected in the baseline survey) and on fish culture activities (collected in the monthly monitoring form of Fish Culture Enterprises) will also be collected from the sampled large farmers. The baseline survey questionnaire and Fish Culture Enterprise monitoring form are shown in Appendix II.

FISH MARKETING STUDIES

Background

3.116 The fish marketing study will examine different aspects of the fresh water fish marketing system and estimate the benefits accruing to various actors at different levels of the marketing network. Understanding who is involved in fish marketing, on what basis and the benefits that they derive will assist in gauging the social and economic impact of flood control on fish production due to the FAP.

Objectives

3.117 It was originally hoped that this study would have been able to provide a detailed understanding of the system of fresh water fish marketing in the floodplain areas of Bangladesh. This would have required an investigation of the flows of fisheries products through the system, from primary producers to the ultimate consumers, and the associated costs and benefits to the different actors in the system.

3.118 Such a study would have required monitoring of:

- Volume of fisheries products passing through various levels of markets at different times of the year.
- Inward and outward movement of fish from collection points and assembly markets.
- Market charges and practices at landing points, assembly markets, wholesale markets and terminal markets.
- Prices of fish species by quality at different times of the year.
- Details of costs and margins associated with fishing trade at different markets.
- Quantity of fish loss at landing points, assembly markets and wholesale markets.
- Market infrastructures and availability of cold storage & icing facilities at different levels of markets.
- Modes of transportation.

3.119 The magnitude of this task became apparent as the socio-economic team were also becoming aware of the demands that would be made of the field teams for the village studies. There was not enough manpower to do both studies as originally outlined. The concept of both sets of studies has been modified; but the marketing study - being more peripheral - has been trimmed more. The revised objectives are now to:

- Provide a bibliographical review of research on fish marketing.
- Conduct a study of costs and returns to different agents in the marketing system.
- Study market integration, using secondary data sets already available.
- Investigate long term trends in fish prices.

3.120 In addition, detailed information is being collected on the role of fish marketing in the livelihood strategies of the households involved in village monitoring.

Methodology

Bibliographical review

3.121 A working paper will be prepared to present an overview of fish marketing in Bangladesh, based on bibliographical review of major research works on the subject.

Study of costs and returns

Data collection

3.122 Both primary and secondary data sources will be used. Monthly price data for important wholesale markets are available from the Directorate of Agricultural Marketing. Price data collected through primary market survey will provide producer prices. Information on detailed cost components will be collected from primary sources through a survey of sample markets.

3.123 A comprehensive and structured survey of a large number of primary, secondary, and tertiary markets by repeat visits is beyond the present scope of study due to resource constraints. Instead, data will be collected by intensive interviews of "key informants" in selected primary, secondary and tertiary markets.

Primary market survey

3.124 Surveys will be conducted at primary markets/landing places, close to the villages monitored under the main socio-economic survey. Information will be collected on prices and by major species and on the details of marketing costs. Four primary markets/landing places nearest to socio-economic sample villages have been selected in each study region. Proximity to fisheries sites will be the other criterion in the selection of the primary markets. Key informants and selected respondents in each market will be interviewed using a structured questionnaire. The Research Assistant (I&M) will carry out the interviews under the guidance and supervision of the Lead Researcher (I&M). This information will be used as an input for the cost and return study, market integration study and marketing

infrastructures review. Information on fish marketing will also be available from the socio-economic household survey. These data will be used for the analysis of credit mechanisms for fish trading, and the role of intermediaries in the primary markets.

3.125 Monthly prices of major species are being collected from the sample primary markets by the regional socio-economic survey teams. One of the Research Assistants from each team is collecting fish price data from each market on a particular day in every month.

Secondary/tertiary market survey

3.126 Surveys are being carried out at three secondary markets and one tertiary market in each study region by interviews of key informants and selected respondents to collect information on marketing infrastructure, prices of major species and the marketing costs.

3.127 The three large wholesale markets of Dhaka are being visited and interviews held. Key informants include the presidents and secretaries of the traders association/market associations, leading arotdars, and other market intermediaries. During this phase, middlemen traders supplying fish to the Dhaka wholesale markets will be interviewed to identify major link markets.

Selection of respondents

3.128 Respondents are stratified to represent each of the functions in the marketing chain: wholesalers (*farias/beparies/chalanies*), *arotdars*, cold storage operators and transport operators. In addition, fishermen selling directly to the sample markets in study regions will also be interviewed.

3.129 Information will also be collected on ice factories situated close to the sample markets.

3.130 A breakdown of the respondents to be interviewed in given in Table 3.16

Table 3.16 Respondents for Marketing Survey

Market Type	No. Mkts	Respondent Type	No. per Market	Total
Dhaka wholesale	3	Arotdar	3	9
		Chalani	3	9
		Transport agency	-	2
		Cold Storage Operator	-	1
SubTotal	3	-	-	21
Secondary	12	Fishermen	3	36
		Arotdar	3	36
		Bepari	3	36
		Retailer/Nikari	3	36
SubTotal	12	-	-	144
Primary	16	Fishermen/Producer	4	64
		Faria	3	48
		Arotdar	3	48
		Retailer/Nikari	2	32
Sub Total	16	-	-	192
Total	-	-	-	357

Interviews of respondents

3.131 Interviews of selected respondents are being carried out over a period of six months by the Lead Researcher (I&M) and Research Assistant (I&M). Information on prices and costs is obtained from primary records such as invoices, vouchers, cash books, and transaction registers, maintained by arotdars in each market segment. Information on daily average quantities of fish traded, prices obtained, and costs incurred for trading activities by the respondent traders during the preceding peak and lean periods is obtained by recall. Information on market characteristics and infrastructures is collected by direct observation and interviews of key informants.

Estimation of marketing margins and returns

3.132 The fish marketing chain may be divided into two segments for margin analysis. The first segment is from the landing points/primary markets to the assembly markets/secondary markets. The second is from the assembly markets to urban wholesale markets. For each segment, the gross marketing margin (GMM) is computed as the difference between the sequential prices i.e. P_a-P_r. The sum of all such sequential price spreads in each segment of the marketing chain yields the GMM. The price spread in each market segment is the sum of marketing costs and the net marketing margin(NMM).

The general formula for computing net marketing margin is, $NMM = GMM - \sum_i C_{is,a}$

$$GMM = \sum_k (P_a - P_r)_k$$

In each k th market segment, $P_a - P_r = \sum_i C_{is,a}$

Where, GMM = gross marketing margin

NMM = total net marketing margin obtained by all intermediaries e.g.,
s = suppliers, a = arotdars,
P_r = price prevailing in the first point of the marketing chain, i.e. primary market;
P_a = price prevailing in the last point of the k th segment of the marketing chain;
C_i = marketing cost of i th component (e.g., transport cost, labour cost, processing cost, etc.)

3.133 The NMM includes the overhead costs of marketing, and thus comes closer to measuring profitability than GMM. All financial costs including utility charges, depreciation on equipment, imputed value of labour provided by intermediaries etc. are included. Cost and return data will ultimately be expressed per Kilogramme of fish traded. Return on capital will be calculated as an annual average rate of return.

Integration of Fish Markets

3.134 The literature on the issue of market integration is divided. Some reports indicate highly segmented markets, with producers receiving low prices and traders reaping monopoly profits; others indicate a highly integrated market, with active competition at most levels and price differentials that reflect real marketing costs.

3.135 Using price data from the Directorate of Agricultural Marketing, this issue has been investigated by FAP 17. The approach taken was to look at price movements, to see the degree of inter-market correlation. The underlying hypothesis was that if marketing of fish were highly competitive, there would be a high correlation of prices: a rise in price in market A should lead to a flow of fish from and, so, a parallel price rise in market B. Price correlations were investigated between a number of wholesale markets spread throughout the country.

3.136 Ten wholesale markets were selected, for which a more complete data set was available[8]. The markets were Dhaka, Mymensingh, Rajshahi, Rangpur, Khulna, Satkhira, Chittagong, Habiganj, Dinajpur, Rajbari. Missing data were a severe problem in the smaller wholesale markets where seasonalities are expected to be more marked. Omission of these markets because of too many missing values may have introduced a bias, in that nothing can be said about integration of the smaller markets with the larger ones.

3.137 Three approaches were used to test for market integration:

- simple price correlations across markets by species,
- correlations using first differences, and
- correlations of residuals derived from deseasonalising and detrending of each price series.

3.138 Simple price correlations suffer from the drawback of not allowing for independent seasonal and trend factors which could result in various independent series being highly correlated. The other two methods (particularly the last) take explicit account of such a possibility.

3.139 The main findings of this study were as follows: Simple price correlations indicate that there is a high degree of convergence in trends of absolute prices across markets, for all the species considered. Thus for example, Dhaka *rui* prices were highly correlated with prices in all other markets (except Mymensingh, where there were a large number of missing values). It is interesting to note that for the most highly traded fish (hilsa), a strong, positive price correlation was observed for all the markets.

3.140 Correlations of first differences were generally weaker. Thus for example, out of a total of 50 pairs of observations for *rui*, 30 were significant. There were fewer significant correlations for *hilsa, katla* and *shingi* (23, 21 and 16), and almost none for *koi*.

3.141 Correlations of residuals obtained from detrending and deseasonalising the data (a linear trend and a multiplicative seasonality was assumed) retains the high degree of

[8] Although initially data were obtained from the Directorate of Agricultural Marketing for all the markets covered, only a sub-set of ten markets were finally selected to minimise the number of missing observations encountered.

association for *rui*, *katla* and *hilsa*. For *koi*, correlations are systematically weak, while for *shingi*, the position is only slightly better.

3.142 On the basis of the above evidence and putting greater store by the results obtained from the correlations in residuals (which is theoretically more firm as it explicitly accounts for exogenous, independent influences on the price series), the wholesale markets for the major (more traded) species of fish (*rui, katla, hilsa*) are much better integrated, with 36, 38 and 23 significant correlations. *Koi* and *shingi*, which are sold live, probably suffer from reduced storability and marketing-transportation problems, which is shown up in the fewer correlations found (6, 12).

Long Term Fish Price Trends

3.143 Fish prices are widely perceived as having risen rapidly over the years as a result of dwindling supply and rising demand. The data from the Directorate of Agricultural Marketing (DAM) used in the market integration study has been used to assess the empirical basis for this belief. It was hoped that price movements might help build a larger picture of how aggregate fish production had changed due to flood control interventions.

3.144 Wholesale monthly and annual (nominal and real) prices were used to examine time trends in the prices of the major species of fish, for the period 1975-92. Fish price trends were assessed by deflating wholesale nominal prices by the wholesale price index from BBS. There was a problem in interpreting the results because of a one-off jump in fish prices in the 1983/84. The reason for this jump remains unclear, as DAM ruled out the most natural explanation: a change in the data collection procedures. Except for *rui* and *katla*, there was no statistically provable trend in real prices on either side of this jump, perhaps because each series was too short relative to the intra-annual seasonal variability. There was however a real price increase for all species for the whole period considered. Prices had definitely increased more in Dhaka than anywhere else in the country.

INSTITUTIONAL STUDIES:ACCESS SURVEY

Background

3.145 The institutional studies undertaken by FAP 17 as part of its socio-economic research programme have been restricted, like those on marketing and for the same reasons. Rather than spread limited resources too widely in an attempt to cover areas already studied in depth by others, or which are only on the periphery of project interest, primary research has been focused on core concerns. On other areas, where information is required as background, use will be made of secondary sources and the outputs of other recent/current projects - Third Fisheries (WB/ODA), Implementation of New Fisheries Management Policy (Ford Foundation), Institutional Strengthening in the Fisheries Sector (FAO/UNDP).

3.146 The most important factor influencing the flow of fisheries benefits, and hence the socio-economic implication of changes in fish production, is freedom of access to the resource. In many of the more valuable fisheries, access is restricted by formal leasing arrangements. Most anecdotal evidence suggests that the introduction or expansion of the leasing system over the last two decades has significantly reduced the proportion of the value of the fishery accruing locally. There has been a tendency for leases to go to outsiders. Part of the reason urban elites are able to out-compete their local rivals in bidding for leases is their greater financial muscle and influence over the bureaucracy. But they are also less constrained - by considerations of fellow feeling or the calculus of local politics - from excluding subsistence fishermen from the leased area. So they are able to get a higher return from their investment.

3.147 But formal leasing is not the only factor: in the floodplains individuals may establish rights over fish accumulating in *kathas* constructed on their land, or local bodies may claim rights to levy fees from those fishing particular *khals*, or *mastans*, often with support from elements of the local elite, may simply extort supplementary fees for fishing.

3.148 Areas of true open access fisheries do remain and some leaseholders do respect the traditional rights of local people to subsistence fishing. Nevertheless access charges represent an important element of the costs paid by fishermen.

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3.149 In consequence, an Access Survey has been added to the list of those outlined in the Inception Report and now represents the only area of primary research by FAP 17 on fisheries institutions.

Objectives

3.150 The objectives of this Access Survey are to:

- identify the regional variation in the importance of leasing.
- trace the historical evolution of the leasing system and the way in which it is enforced.
- identify the costs of leases to the leaseholders.
- provide a basis for calculating leaseholder income (and fishermen's access costs) using data from the Fish Catch Assessment Studies (CAS).
- monitor the effects of flood control on leasing arrangements.

Methodology

3.151 The issue of access will be approached from a number of different angles. At the highest level, information will be collected by the fisheries team on the *jalmohals* that cover their catch assessment sites. The type of land will be classified. If the fishery is leased, the agency responsible for issuing the lease will be identified, as will the leaseholder and his place of residence. This information will be used to assess the relative significance of leasing in different regions and habitats and the frequency with which leases are granted to outsiders. This process has now been completed in two regions.

3.152 The socio-economic field team will also investigate access to all the waterbodies, major and minor, in or adjacent to the main villages already under study. Selected villages will be mapped. Where study villages are adjacent to CAS sites, more detailed study will be undertaken.

3.153 A separate, Dhaka-based team will undertake a series of more detailed studies on access restrictions at selected catch assessment sites. RRA techniques will be used rather than formal sampling. A variety of questionnaires have been developed (see Appendix II), covering:

- historical evolution of access restrictions and means of enforcement.
- leaseholder expenditure.
- terms of access for different gears through the season.

3.154 Surveys have been undertaken in NCR and NWR at sites covering a range of habitats. In general the influence of leasing is more prevalent in NWR.

ASSESSMENT OF SOCIO-ECONOMIC IMPACTS

Background

3.155 The original design of the socio-economic study placed the entire burden of estimating flood control impact on inside-outside comparisons of villages. It was assumed that a proper pairing of pre-FCDI agroecological conditions would be sufficient to ascribe differences to the effects of flood control. It was recognised that there might be "distorting factors" that might cloud the interpretation, such as unusually intensive levels of irrigation or NGO activity - hence the need for the supplementary information gathered during land type appraisals that would allow some check on this. But these "distortions" were to sources of income other than that from fisheries: to the background not the foreground of the study.

3.156 As noted above the experience on the RRAs made it apparent that there were also localised factors capable of significantly "distorting" the flow of fisheries benefits, even to the point where a fisheries resource of national significance might have almost no value to many of the local communities. Leaseholders' exclusion of local fishermen from the important "mother fishery" of Hakaluki Haor in Sylhet is one example of this. A reconsideration of study design was therefore necessary. The value distribution study described in this chapter is the result.

Objectives

3.157 This study will seek to:

- bring together the results of the FAP 17 fish catch assessment studies with the price data gathered in the marketing study to estimate the gross value of fisheries income per unit area inside and outside FCD/Is.

- calculate the division of this income from each site between professional and subsistence fishermen, using the data on gear ownership and use from the socio-economic census and the fisheries CA01 form.

- estimate the flow of income to the leaseholder, using the information on access charges and leaseholder costs obtained by the Access survey.

- calculate the net income flow to fishermen (both subsistence and professional) by deducting their payments to leaseholders, and costs of gear operation (including gear maintenance and debt servicing).

- place the net income flows in context derived from the socio-economic village studies.

3.158 This information will be used to derive a local or sub-regional picture, using as a frame for extrapolation either the block level data gathered during the land type appraisals or, if available, the BBS National Census of 1991.

Methodology

Calculating the value of fish production

3.159 Translation of the catch per site in kilogrammes to its monetary value is straightforward. The catch per species per gear per month is a direct output of the fish catch assessment study. This figure must be multiplied by the unit price paid to the fisherman to estimate total values.

3.160 Rather than interview individual fishermen, fish prices are being collected monthly in each region at four markets. To arrive at producer prices, a downward adjustment has to be made to compensate for gross marketing margins. This procedure will ease collection, overcome some of the problems associated with the producer practice of selling the catch as a mixed lot and produce a figure more representative of the regional picture.

3.161 Gathering data on the market price of each of the 250 recorded species was clearly unfeasible, as the majority would not be continuously represented in every market. A list of common species which were likely to be present at most markets was prepared. Their prices will be used as an indicator of the prices of a group of similar species. Culinary similarity was taken as the principal argument in defining groups, though morphological similarities often resulted in a high degree of convergence between biological and marketing groups.

3.162 Market grouping is taken as an indication of price correlation, not identity. Prices per kilogramme of species within the same group are not the same; for instance, *rui* is

grouped with *mrigal*, though the former always sells at a premium. Where differentials are clear they will be adjusted for.

3.163 Using this data set quantities of fish caught at each site by each gear type will be translated into corresponding catch values. Table 3.17 provides an illustrative example of the value of output per site.

Table 3.17 Value of Output per Site, per Month

Site	Habitat	In/Out	Month	Catch Kg.	Value Tk.
NC02	Secondary River	Outside	Feb	104	3224
			Mar	72	3066
			Apr	513	22424
NC05	Beel	Outside	Jan	34	1319
NC06	Main River	Outside	Jan	63	3671
			Feb	3	85
			Mar	23	1033
			Apr	148	4063
NC07	Canal	Outside	Jan	13	501
			Mar	66	2843
NC10	Canal	Inside	Feb	21	1088
			Mar	120	6497
			Apr	18	1100
NC11	Floodplain/Beel	Inside	Jan	73	2603
			Feb	186	10664
			Mar	40	1831
			Apr	134	6888
NC12	Secondary River	Inside	Jan	43	1343
			Feb	776	31829
			Mar	45	1251
			Apr	19	885
NC12	Secondary River	Inside	Jan	14	597
			Feb	38	1404
			Mar	27	1299
			Apr	34	1732
NC14	Floodplain	Inside	Jan	546	23953
			Feb	321	12956
			Mar	82	4513
			Apr	44	2676
NC14	Floodplain	Inside	Jan	51	1998
			Feb	61	2282
			Mar	164	7768
			Apr	63	3830

Site	Habitat	In/Out	Month	Catch Kg.	Value Tk.
NC15	Beel	Inside	Jan	288	12329
			Feb	235	9516
			Mar	172	7616
			Apr	341	18791
NC16	Secondary River	Outside	Jan	595	16922
			Feb	977	32505
			Mar	1072	44140
			Apr	2459	103826
NC18	Floodplain	Outside	Feb	44	1665
			Mar	79	3776
			Apr	5	297
NC19	Beel	Outside	Jan	706	23401
			Feb	88	3569
			Mar	84	4452
			Apr	24	1224
NC21	Secondary River	Outside	Feb	51	1860
			Mar	76	3051
			Apr	83	3776
NC22	Canal	Outside	Apr	3	152
NC24	Beel	Outside	Jan	142	6507
			Feb	77	3134
			Mar	166	10600
			Apr	82	4862
NC25	Secondary River	Outside	Jan	300	9983
			Feb	108	3789
			Mar	330	13193
			Apr	332	14791
NC26	Canal	Outside	Jan	278	10017
			Feb	42	1614
			Mar	183	5996
			Apr	296	16675
NC28	Beel	Outside	Jan	55	2087
			Feb	1502	112441
			Mar	133	3569
			Apr	48	2545
NC29	Secondary River	Outside	Jan	38	1428
			Feb	74	2348
			Mar	302	14394
			Apr	60	2946
NC30	Canal	Outside	Jan	129	4756
			Feb	71	3118
			Mar	272	10662
NC31	Floodplain/Beel	Outside	Jan	139	5940
			Mar	41	1969

*Note: Table excludes production from *katha* and *kua*.

3.164 For this calculation it was simply assumed that the price spread between producer and market prices was 20%, a figure derived from the analysis of prices for major carp from both the Directorate of Agricultural Marketing and the FRSS riverine survey; and no adjustment was made between the prices of indicator species and others within their group. These figures will therefore have to be revised once true marketing margins are known more clearly and inter-species differentials have been investigated. The site values will then be translated into monetary values per unit area once site areas have been computed accurately.

Division of income between subsistence and professional fishermen

3.165 To assess the potential impact on livelihoods, it is essential to know who is catching the fish. As a first stage this involves a division of the catch between subsistence and professional fishermen. There are two potential sources of information on gear ownership and use already available within the project: the village census and the CA01 fish catch assessment form. These will ultimately be supplemented by the data from household monitoring.

3.166 Gear use has been thoroughly documented through the fishing effort surveys. Who is using these gears can be derived from the CA01 form. The detailed socio-economic characteristics available from this form are shown in Tables 3.18 and 3.19 below, which gives information on the *thella jal*, a push net, and the *veshal jal*, a large triangular lift net mounted on a bamboo frame, commonly seen in roadside canals.

3.167 These provide an interesting contrast in the socio-economic characteristics of their users. The *thella jal* is primarily a subsistence gear, as it is small, cheap and easily constructed but cannot be used in deeper water. (Data on habitat use given here should be treated with caution, as it aggregates across all CAS sites and has no clear relationship to overall distribution of usage[9].) Of those operating it, 93% had other work (primarily farmers and agricultural labourers), only 17% fished every month and 86.8% claimed that they would eat all that they caught. The *veshal jal* on the other hand was operated largely by fishermen who fished every month (74.9%), who had no other source of employment (63.5%) and who sold all their catch (96%).

[9] A correct breakdown will be estimated later, using the site information on fishing effort, from the FE01 forms; ideally this would be extrapolated to the regional level.

Table 3.18 Socio-Economic Characteristics of Gear Users, Thella jal

Region	: NC	Main River	: 7.9%
Main Bengali Name	: Thella jal	Secondary River	: 10.7%
English	: Other net	Canal	: 9.1%
FAP 17 Gearcode	: 255	Beel	: 9.9%
FRSS Code	: 0	Floodplain/Beel	: 55.4%
Interviews with CAO1	: 242	Floodplain	: 7.0%
Average Members in Team : 1.3		Interviewees:	
Team includes:		Fishing every month	7.4
- Females	14.7%	Household heads	45.9%
- Children (under 16)	46.4%	Hours fishing that day	2.0
Catch disposal:		Days fished previous week	2.8
- All to be sold	4.5%	Those with other work	98.3%
- Some sold, some eaten	5.8%	Of which, primary occupation:	
- All to be eaten	89.7%	- Farmers	13.4
Ownership:		- Agricultural labourers	43.3%
- Self	96.3%	- Fish traders	0.0%
- Unit	0.0%	- Other traders	9.7
- Other	3.3%	- Job holders	6.3
		- Student	27.3%

Source: FAP 17, CAO1 data

Table 3.19 Socio-Economic Characteristics of Gear Users, Veshal jal

Region	: NC	Main River	: 45.2%
Main Bengali Name	: Veshal jal	Secondary River	: 51.6%
English	: Lift net	Canal	: 3.2%
FAP 17 Gearcode	: 266	Beel	: 0.0%
FRSS Code	: 0	Floodplain/Beel	: 0.0%
Interviews with CAO1	: 47	Floodplain	: 0.0%
Average Members in Team : 1.6		Interviewees:	
Team includes:		Fishing every month	97.9%
- Females	0.0%	Household heads	89.4%
- Children (under 16)	2.7%	Hours fishing that day	12.4
Catch disposal:		Days fished previous week	4.3
- All to be sold	100.0%	Those with other work	17.0%
- Some sold, some eaten	0.0%	Of which, primary occupation:	
- All to be eaten	0.0%	- Farmers	0.0%
Ownership:		- Agricultural labourers	50.0%
- Self	85.1%	- Fish traders	50.0%
- Unit	10.6%	- Other traders	0.0%
- Other	4.3%	- Job holders	0.0%
		- Student	0.0%

Source: FAP 17, CAO1 data

3.168 Table 3.20 below gives a comparison of some of the gears that occurred frequently in NCR, NER and NWR in the period from January 1993 onwards. The degree of similarity in the catch disposal, proportions of respondents with other work and hours fished is striking, though there are points of divergence. At this time of year *ber jals* are clearly operated by professional fishermen, with almost all catch being sold and those having no other work never less than 75%. Hand fishing occupies the other end of the spectrum, with the vast majority of the fish being eaten. *Jhaki jals* come the closest to occupying a middle ground, with catch disposal being split more equally. Regional differences are also worth noting. Professional fishermen work longer hours in the NE; perhaps because of topography: in the *haor* areas the basins tend to be much larger and so travel times to deep water fishing will be longer. Passive gears are, naturally, worked for longer hours than active gears; and professionals fish longer than subsistence fishermen.

Table 3.20 Characteristics of Users of Some Major Gears

Name	Code	Region	No.	Other Work	Catch Disposal (%)			Hours Fished
					Sold	Eaten/Sold	Eaten	
Ber jal	45	NC	84	7.1	100.0	-	-	6.4
		NE	88	19.3	98.9	1.1	-	8.5
		NW	65	24.6	100.0	-	-	8.3
Current jal	88	NC	123	74.8	72.4	15.4	12.2	16.8
		NE	74	55.4	77.0	5.4	17.6	17.4
		NW	108	70.4	72.6	8.2	19.2	13.4
Jhaki jal	164	NC	285	28.1	75.1	5.3	19.6	3.8
		NE	105	61.9	51.4	7.6	41.0	4.9
		NW	201	62.7	65.6	5.5	28.9	4.6
Thella jal	255	NC	242	98.3	4.5	5.8	89.7	2.0
		NE	166	84.9	21.7	13.3	65.0	3.1
		NW	65	81.5	29.2	7.7	63.1	3.7
Monofila-ment Net	282	NC	47	53.2	95.7	4.3	-	10.4
		NE	42	33.3	100.0	-	-	16.1
		NW	58	48.3	87.9	6.9	5.2	10.4
Hand fishing	307	NC	89	91.0	11.2	1.1	87.7	2.2
		NE	20	95.0	10.0	25.0	65.0	2.3
		NW	58	98.3	3.4	5.2	91.4	3.4

3.169 This data allows the value of the catch to be divided between professional and subsistence fishermen. To find the proportion of catch value sold, eaten or both, the total value of catch per gear is multiplied by the proportion of fishermen using that gear in that region claiming each means of disposal. If 100 kg of fish valued at Tk.3,500 are caught in a month by *thella jal*, this is divided according to the ratio 4.5:89.7:5.8 (see

Table 3.18). The same procedure is then followed for the other gears catching at that site in that month, to arrive at distributional sub-totals for the month. This information can then be used as a means of characterising the fisheries of different habitats through the year.

3.170 Table 3.21 below is an illustration of the variation in the distribution of catch value for habitats in NCR for the months January to April 1993. The fish catch data set is that used elsewhere in this report, and is thus preliminary, as are the programs and price information which have been applied to it: these values will be subject to revision.

Table 3.21 Differences in Catch Value

Habit	Location	Amount	Sold	Sold & Eaten	Eaten
Beels	Inside	Kg.	6569	2813	38709
		%	13.7	5.8	80.5
	Outside	Kg.	124490	4742	44909
		%	71.5	2.7	25.8
Floodplain	Inside	Kg.	15044	1908	28799
		%	32.9	4.2	62.9
	Outside	Kg.	4930	749	10052
		%	31.3	4.8	63.9
Khal	Inside	Kg.	4618	326	3691
		%	53.5	3.8	42.7
	Outside	Kg.	20063	1973	14890
		%	54.3	5.3	40.3
Secondary River	Inside	Kg.	13933	1274	24999
		%	34.7	3.2	62.2
	Outside	Kg.	235108	6716	28191
		%	87.1	2.5	10.4

Estimation of catch value accruing to the leaseholder

3.171 One of the most important factors affecting the distribution of the value of catch, particularly on the more valuable fisheries, is the access charges levied or restrictions placed by the lessees of *jalmohals* and the shares taken by landowners of the fish that are caught in *kuas* and *katha* at the end of the drawdown.

3.172 Using the information gathered as part of the Access Survey, described in the last chapter, it will be possible to assess the proportion of catch value that is taken by the

leaseholders. Data are being collected on access charges in terms of fees and catch shares required by leaseholders at different times of the year for different gears.

3.173 Where a catch share system is being followed and the share is known, the calculation is simple. Where a fee is paid, knowledge of the number of fishermen paying on a particular waterbody is necessary to derive an estimate of revenue. This may prove more difficult, as only the leaseholder may have this information and he will have a clear incentive to understate. Efforts will be made to gauge the number of fishermen using different waterbodies from the household monitoring, this will be cross-checked against the effort data from the FE01 forms and the numbers of days fished on each waterbody from the CA01 forms.

3.174 The above procedure will give total gross revenue. From this will be deducted the leaseholder's costs, which are to be gathered as part of the access survey.

Calculation of net income flows to fishermen

3.175 The net incomes of fishermen are defined as gross revenue less leaseholder charges (which will be calculated as indicated above), gear costs, interest payments and any other fishing expenses.

3.176 Gear costs will be calculated from information gathered during the census and household monitoring. The typical costs and ages of the most common gears found in the household census are shown, broken down by gear category, in Table 3.22 below.

3.177 It will be noted that most gears have to be bought every one or two years, though seine nets tend to be more long lived. Most gears cost less than Tk.1,000, with the exception of the seine nets, the *current jal* and the *veshal jal.* The two nets that stand out in terms of their cost are the *ber jal* and the *sati ber jal,* its close relative. These are considerably more expensive, with an average household investment of around Tk.13,500; but even this is an understatement since, as used, they can cost from Tk.100,000 to Tk.200,000. The reason is that these gears require large teams to operate them; many households own only a portion of a net, which they join to the portions of other team members.

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Table 3.22 Fishing Gears: Costs and Ages

Category	Name	Code	No.	Years Owned (%)					Av. Cost
				<1	1-2	2-3	3-4	>4	Tk.
Gill nets	Current jal	88	137	88	8	3	1	0	1,121
	Koi/fashi jal	123	295	81	13	5	0	1	567
Seine nets	Ber jal	45	381	33	24	13	8	25	13,622
	Uttar jal	68	13	69	8	8	0	15	1,366
	Deol	89	41	54	37	7	0	2	546
	Ferra jal	126	8	75	13	13	0	0	2,270
	Kathi jal	175	46	65	17	15	2	0	3,640
	Moi jal	202	83	34	22	24	6	14	832
	Konaber jal	268	68	40	7	19	6	28	13,483
	Hat panch	276	20	30	50	15	0	5	2,920
	Chabi jal	293	5	20	20	40	0	20	1,087
	Satiber jal	304	5	0	0	0	0	100	7,000
	Dora jal	325	24	67	21	8	0	4	2,203
Lift nets	Veshal jal	266	285	21	24	22	12	20	3,363
	Dharma jal	105	53	51	19	17	2	11	103
Scoop nets	Uttar jal	68	46	65	30	2	0	2	48
	Afa	321	39	62	26	10	0	3	440
Clap nets	Shangla jal	234	34	50	24	12	9	12	218
Traps	Doiar	95	343	79	11	5	2	3	115
	Polo	222	134	71	19	6	2	1	58
	Deal	286	28	46	39	11	4	0	89
	Kadum	311	6	100	0	0	0	0	10
Hooks & lines	Sip	30	101	96	3	0	1	0	30
	Tana barshi	152	8	75	25	0	0	0	20
	Daun	272	84	95	2	0	1	1	51
	Nol barsi	278	13	100	0	0	0	0	8
Spears	Koch	170	133	50	20	11	11	9	100
Other gears	Akra	298	7	43	14	0	14	29	26
	Jhaki jal	164	675	36	26	17	8	13	668
	Thella jal	255	443	79	15	4	1	1	180

3.178 More detail will be obtained on gear operation, ownership and repair during the course of the routine monitoring and the special studies. This will be used to finalise the picture of gear costs.

3.179 Indebtedness for gear purchase can be assessed in Tables 3.23 to 3.26 below. It should be noted that as the sampling procedure has been weighted towards fishing households, no overall distribution of gear ownership can be derived at this stage. Indebtedness varies across fishing categories and regions with, not unnaturally, higher

indebtedness among category fishermen. Fishermen in NCR seem generally to be the least encumbered by debt. It is not yet clear why this is. In the wider literature, stories of fishermen bonded in perpetuity to the *arotdar* or the *mohajan* are so common, that fishermen's indebtedness would seem almost axiomatic. Generally, these figures do not support this view. This may be because respondents were unwilling to reveal their indebtedness - a sensitive subject - in the course of the rushed and rather impersonal census survey. Monitoring should clarify this.

Table 3.23 Gear Ownership by Fishermen Category, North Central Region

Fisherman Category	Gear Category	Households Owning (%)	Owning Households			
			Gears (No.)	Investment (Tk.)	On Credit (%)	Self Made (%)
1	Gill nets	15	1.0	1,605	18.4	5.3
	Seine nets	87.7	1.0	15,265	38.3	38.3
	Large lift nets	39.1	1.1	4,291	16.2	74.7
	Small lift nets	0.4	1.0	500	0	100
	Scoop nets	0.4	1.0	30	0	100
	Clap nets	2	1.4	240	0	80
	Katha	0.4	1.0	75,000	100	0
	Traps	9.5	15.3	459	8.3	54.2
	Hooks & lines	3.6	315.1	449	11.1	22.2
	Cast nets	60.9	1.2	806	5.8	85.1
	Push nets	5.1	1.2	249	0	53.8
	Other gears	4.3	1.0	2,109	9.1	100
2	Gill nets	9.6	1.0	425	37.5	0
	Seine nets	3.6	1.0	600	0	100
	Small lift nets	1.2	1.0	50	0	0
	Scoop nets	2.4	1.0	38	0	50
	Clap nets	9.6	0.9	194	0	75
	Traps	19.3	7.4	199	6.3	68.8
	Hooks & lines	6	154.4	107	0	20
	Cast nets	25.3	1.0	707	4.8	71.4
	Push nets	12	1.1	235	0	50
3	Gill nets	20	1.0	1,500	0	0
	Seine nets	20	1.0	30,000	100	100
	Small lift nets	20	1.0	50	0	0
	Traps	20	2.0	70	0	100
	Cast nets	80	1.0	875	25	100
4	Gill nets	6.7	1.0	110	0	50
	Small lift nets	13.3	1.0	54	0	0
	Scoop nets	3.3	2.0	50	0	100
	Clap nets	36.7	1.0	227	27.3	72.7
	Traps	33.3	5.2	144	10	60
	Hooks & lines	3.3	20.0	20	0	100
	Cast nets	10	1.0	600	33.3	66.7
	Push nets	13.3	1.0	213	0	25
	Other gears	3.3	1.0	80	0	100

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Fisherman Category	Gear Category	Households Owning (%)	Owning Households			
			Gears (No.)	Investment (Tk.)	On Credit (%)	Self Made (%)
5	Gill nets	13	1.0	328	0	12.5
	Seine nets	23.8	1.0	5,225	11.4	31.8
	Large lift nets	1.6	1.0	4,000	33.3	100
	Small lift nets	14.6	1.0	99	0	11.1
	Scoop nets	8.6	1.0	33	0	68.8
	Clap nets	6.5	1.1	235	0	33.3
	Traps	37.8	2.7	85	0	57.1
	Hooks and lines	7	6.5	22	0	38.5
	Spears	1.1	1.0	85	0	100
	Cast nets	34.1	1.1	737	4.8	28.6
	Push nets	32.4	1.0	95	0	10
	Other gears	0.5	1.0	150	0	100

Table 3.24 Gear Ownership by Fishermen Category, North West Region

Fisherman Category	Gear Category	Households Owning (%)	Owning Households			
			Gears (No.)	Investment (Tk.)	On Credit (%)	Self Made (%)
1	Gill nets	27.2	4.7	8142	17.7	12.9
	Seine nets	52.2	1.1	11651	37.0	26.1
	Large lift nets	11.0	1.2	5420	40.0	48.0
	Scoop nets	0.4	1.0	60	-	-
	Traps	60.5	32.2	1673	25.4	52.9
	Hooks and lines	6.1	251.6	403	21.4	42.9
	Other gears	0.9	5.0	4500	50.0	100.0
	Cast nets	36.4	1.2	1050	36.1	45.8
2	Gill nets	5.4	3.8	522	45.5	9.1
	Seine nets	2.5	1.0	640	20.0	40.0
	Traps	13.4	12.3	495	18.5	29.6
	Hooks and lines	5.4	209.8	333	18.2	9.1
	Other gears	3.0	2.8	103	-	-
	Cast nets	15.3	1.0	756	35.5	22.6
	Push nets	1.0	1.0	150	-	-
3	Gill nets	50.0	3.3	1143	-	-
	Seine nets	7.1	1.0	4000	100.0	-
	Bag nets	7.1	1.0	700	100.0	-
	Traps	57.1	44.4	3394	62.5	50.0
	Cast nets	21.4	1.0	1067	-	66.7
4	Gill nets	4.8	1.8	438	25.0	-
	Seine nets	2.4	1.0	800	50.0	-
	Traps	6.0	5.4	260	20.0	20.0
	Hooks and lines	3.6	116.7	53	-	-
	Other gears	2.4	2.5	48	-	50.0
	Cast nets	9.6	1.0	563	37.5	12.5
5	Gill nets	18.2	2.0	905	25.0	-
	Seine nets	22.7	1.0	33200	40.0	-
	Traps	13.6	1.0	40	-	-
	Cast nets	40.9	1.1	589	11.1	33.3
	Push nets	4.5	1.0	250	-	-

Table 3.25 Gear Ownership by Fishermen Category, North East Region

Fisherman Category	Gear Category	Households Owning (%)	Owning Households			
			Gears (No.)	Investment (Tk.)	On Credit (%)	Self Made (%)
1	Gill nets	23.4	1.1	2475	30.7	1.3
	Seine nets	53.9	1.0	3192	53.2	1.2
	Large lift nets	36.4	1.2	2638	23.9	7.7
	Scoop nets	3.7	1.0	582	25.0	25.0
	Katha	0.9	1.0	2667	-	100.0
	Traps	15.6	28.5	1134	12.0	12.0
	Hooks and lines	10.9	410.6	189	8.6	2.9
	Spears	0.6	3.5	150	-	-
	Cast nets	15	1.1	714	20.8	52.1
	Push nets	28	1.0	428	10.0	17.8
2	Gill nets	1.1	1.0	433	-	-
	Seine nets	4.1	1.0	493	54.5	9.1
	Scoop nets	8.3	1.0	328	31.8	4.5
	Traps	2.3	15.7	556	16.7	33.3
	Hooks and lines	13.9	404.4	207	13.5	10.8
	Cast nets	10.9	1.0	548	6.9	37.9
	Push nets	31.2	1.1	261	12.0	18.1
3	Gill nets	25.0	1.0	1800	-	-
	Seine nets	50.0	1.0	5750	50.0	-
	Large lift nets	25.0	1.0	2500	-	-
	Traps	50.0	17	600	-	100.0
	Cast nets	25.0	3.0	800	-	-
4	Seine nets	7.7	1.0	80	-	-
	Scoop nets	7.7	1.0	60	-	-
	Traps	23.1	1.3	112	-	-
	Spears	7.7	1.0	50	-	-
	Push nets	23.1	1.0	30	-	-
5	Gill nets	5.3	1.1	993	-	21.4
	Seine nets	12.5	1.0	2221	18.2	6.1
	Large lift nets	0.8	1.0	2500	-	-
	Small lift nets	7.2	1.0	102	5.3	-
	Scoop nets	11.4	1.2	205	6.7	6.7
	Katha	0.4	1.0	2800	-	100
	Traps	16.7	1.4	103	-	9.1
	Hooks and lines	0.4	4.0	25	-	-
	Spears	3.0	1.6	123	-	37.5
	Cast nets	7.2	1.0	695	-	15.8
	Push nets	60.5	1.0	53	1.3	3.8
	Other gears	0.4	1.0	350	-	-

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Table 3.26 Gear Ownership by Fishermen Category, South West Region

Fisherman Category	Gear Category	Households Owning (%)	Owning Households			
			Gears (No.)	Investment (Tk.)	On Credit (%)	Self Made (%)
1	Gill nets	46.2	14.9	569	24.7	9.4
	Seine nets	31.0	1.2	3728	43.9	29.8
	Large lift nets	20.1	0.7	2068	10.8	45.9
	Scoop nets	0.5	2.0	3000	100.0	-
	Traps	17.4	22.7	912	28.1	28.1
	Hooks and lines	14.7	256.1	372	18.5	3.7
	Spears	26.6	2.2	291	20.4	14.3
	Cast nets	37.0	1.0	786	17.6	55.9
	Other gears	27.2	12.7	1487	24.0	84.0
2	Gill nets	30.3	14.2	313	36.7	23.3
	Seine nets	1.0	1.0	800	-	-
	Traps	7.1	3.6	136	-	-
	Hooks and lines	31.3	365.8	105	9.7	12.9
	Spears	27.3	1.7	214	11.1	7.4
	Cast nets	16.2	1.0	463	12.5	56.3
	Other gears	4.0	2.8	313	25.0	100.0
3	Gill nets	42.9	8.3	179	33.3	-
	Seine nets	57.1	1.0	2675	50.0	-
	Traps	28.6	6.0	300	50.0	50.0
	Hooks and lines	28.6	102.5	125	100.0	-
	Spears	14.3	1.0	50	-	-
	Cast nets	14.3	1.0	1200	-	100.0
	Other gears	14.3	7.0	400	100.0	100.0
4	Gill nets	20.5	6.7	289	55.6	-
	Traps	2.3	1.0	30	-	-
	Hooks and lines	4.5	27	40	-	50.0
	Spears	4.5	1.0	60	50.0	-
	Cast nets	20.5	1.0	303	11.1	22.2
5	Gill nets	23.2	5.5	178	5.7	-
	Seine nets	0.7	1.0	2000	-	100.0
	Traps	14.6	1.5	63	-	18.2
	Hooks and lines	8.6	17.5	24	7.7	23.1
	Spears	26.5	1.4	92	-	17.5
	Cast nets	65.6	1.0	396	2.0	46.5
	Other gears	2.0	20	567	-	100.0

3.180 Sources of loans and forms of loan repayment are being investigated as part of the monitoring survey and in the institutions and marketing survey. This information will be used to estimate what further deduction has to be made from gross fishing revenue to reflect credit repayment.

Placing Income Flows in Context

3.181 The preceding analysis should allow a calculation of the approximate change in net incomes, for professional and subsistence fishermen and leaseholders, in different regions due to FCD/I interventions. These figures will then be placed in context of the more detailed information obtained at the household level by the village studies. This marriage of the estimates of fishing income derived from manipulation of the fish catch assessment data with direct estimates is critical as it will allow: a cross check to be made to ensure broad consistency; fishing incomes to be placed in context of the other sources of income.

TARGET GROUP APPROACHES TO AQUACULTURE

Background

3.182 A very large proportion of the rural population of Bangladesh depends, to some degree, on the open water capture fishery. It is an important economic resource and support for livelihoods; where it is damaged, the social and economic consequences may be profound.

3.183 Flood control schemes often damage fisheries. Though the benefits they bring to other sectors can be important, they are enjoyed principally by those least affected by the decline in the fishery. Crude economic returns may be positive, but some compensating mechanism is necessary before this form of development can be considered desirable from the wider, social perspective.

3.184 Pond aquaculture is a technology with good returns under the right circumstances. One of the factors that often holds it back is the risk of flooding, which can result in heavy losses. Where flood control significantly reduces that risk (and simultaneously reduces the supply of wild fish, thus boosting prices), aquaculture may develop rapidly, particularly if initial assistance is provided.

3.185 Given the large numbers of under-used ponds, there would thus seem to be potential of using aquaculture to compensate "target groups" of those adversely affected by a loss to the capture fishery. The purpose of this study is to investigate the potential for this.

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Objectives

3.186 The overall objective is to identify past NGO successes in this field and to see how the approaches used might be adapted or developed to help mitigate the impact of the FAP.

3.187 The specific objectives are to :

- review past initiatives by NGOs in the development of aquaculture for targeted groups.
- identify the most appropriate models for the development of aquaculture by NGOs for the benefit of the target groups.
- assess the likely availability of the resources necessary to promote TGAs on the scale necessary.

Methodology

Review of past involvement of NGOs in fisheries

3.188 There are numerous local, national and international NGOs operating in Bangladesh. Many of them have promoted fisheries for the benefit of the resource poor, particularly the landless, marginal and small farmers.

3.189 Some of the approaches followed in different NGO fishery programmes have been investigated and compared (e.g. Zakaria, 1985). But there have been no major studies on the extent of NGOs participation in fishery resource development. Nor has there been an extensive study of the comparative merits of alternative approaches. A baseline study was therefore conducted to:

- describe the range and extent of NGOs participation in the fisheries sector.
- describe and determine the approaches followed by NGOs with particular reference to the promotion of aquaculture through target groups.
- identify a list of NGOs to be included in a more detailed study aimed at identifying an efficient Target Group Approach for aquaculture.

3.190 The sample frame for the survey was a list of NGOs involved in the development of fisheries produced by the ADAB. While this list was not completely exhaustive, since it covered only those qualified to be members of ADAB, nearly all the more important NGOs were included.

3.191 These agencies were categorized as locals, those working within a limited geographic area within Bangladesh; national, those working almost throughout Bangladesh; and international, those working in Bangladesh and other countries and managed by foreign personnel.

3.192 The criteria for the inclusion of NGO's in the study were devised in consultation with IVS-ADAB personnel working in the fisheries sector, and with ICLARM, an international research centre specialising in aquatic resource management.

3.193 The criteria were length of involvement in fisheries, type of beneficiaries, linkage-coordination with ADAB.

Table 3.27 Distribution of Sample NGO's for the Baseline Study.

Type of NGO	NGOs in Fisheries Sector No.	Selected for Study No.	%
Local	96	13	62
National	3	2	10
International	8	6	28
Total	107	21	100

3.194 Twenty one NGOs were selected for this study. The distribution of the sample is shown in Table 3.27. The sample represents 20 percent of the total NGOs working within the fisheries sector in Bangladesh. A simple structured and semi-structured questionnaire was used and completed by the organisation itself.

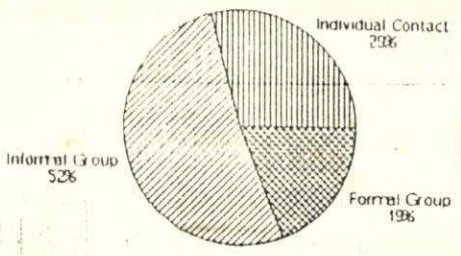
3.195 All the international NGOs were involved in a variety of activities, including agriculture, livestock, fishery, family planning, literacy and education, food for work, road construction and maintenance, and EPI. The national NGOs were involved in the same broad range of activities as Internationals. The local NGOs, naturally, tended to operate over a narrower activity range.

3.196 There were nine different types of fishery programme undertaken by NGOs. Pond fisheries was the most common, being undertaken by all except one of the NGOs studied, followed by open water fisheries.

3.197 A few of them were involved in rice-fish and integrated fish culture, fresh water prawn culture, cage culture, coastal shrimp culture, and fish processing. There were six NGOs (29%) which had hatchery / nursery programmes.

3.198 The approaches to the beneficiaries of the fisheries programmes covered the spectrum: individual contact, informal group and formal group (Figure 3.5). Some had more than one form of contact. Sixteen (more than 50%) followed an informal group approach. About one fifth of them used formal groups.

Figure 3.5 Distribution of NGO approaches to aquaculture.



3.199 The NGOs surveyed had 258 target groups on average, though there was considerable variation and a small number of NGOs with a large number of groups. PROSHIKA had by far the most, with 1,631 groups.

3.200 The magnitude of the problems faced in organizing a target group was categorized into none, sometimes, and always. Only two out of 21 NGOs indicated that they had "always" experienced problems in organizing their target groups. There were eight NGOs out of 21 (38%) which had experienced no problems. More than 50 percent of the NGOs, including BRAC, PROSHIKA and JC, experienced some degree of difficulty in organizing target groups.

3.201 A recent NGO fish culture workshop identified five major constraints to aquaculture development (ADAB/ITDG, 1992). The most problematic found in this study were the influence of local elites. This was experienced by PROSHIKA, GUP, UTTARAN, and JTS. The conflict between the group members about stocking density of fingerlings and economic stress was the next most controversial issue (Gill and Mothhar, 1982; Nuruzzaman, 1991; Bhuiyan, 1992, Shah at el., 1992). The other problem as identified by the NGOs was the arrangement of leases from pond owners as well as from the government. When leasing from private owners, the biggest problem is multiple ownership of ponds. For the government owned water bodies, bureaucratic delay and obstruction are major hindrances.

Intensive Study of Selected NGOs

3.202 A more detailed study of selected NGOs is now underway involving field visits to local offices and group interviews with randomly selected beneficiary groups. The objective of this phase will be to gain a better understanding of the logistical and procedural delays in identifying suitable target groups, to see how these may be overcome.