

**GoB-Danida Agricultural Sector Programme Support
(ASPS)**

Fishery Programme

**Mymensingh Aquaculture Extension Component
Impact Evaluation Study**

The GoB/Danida Fisheries Support Unit

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GoB/Danida Fishery Programs - Map

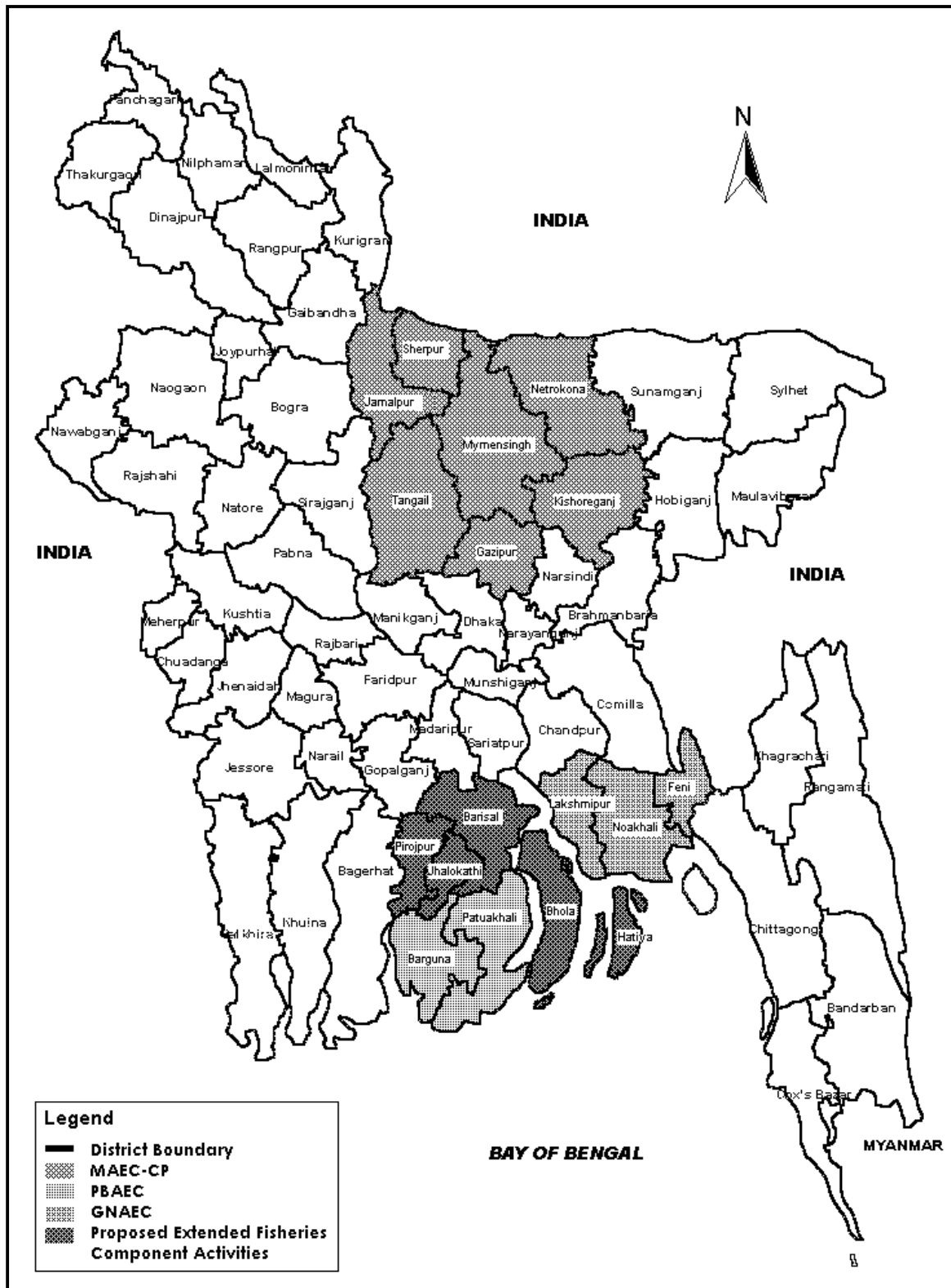


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Acronyms

ASPS	Agricultural Sector Programme Support
CBFM	Community Based Fisheries Management
CPA	Chief Project Adviser
CPUA	Catch per Unit of Area
CPUE	Catch per Unit of Effort
DAE	Department of Agriculture Extension
Danida	Danish International Development Assistance
DFID	Department for International Development (UK)
DG	Director General
DKK	Danish Crone exchange rate currently DKK1 = Taka8.84
DOF	Department of Fisheries
DTA	Danish Technical Assistance
FAO	Food and Agriculture Organization of the United Nations
FPSU	Fisheries Programme Support Unit
GNAEC	Greater Noakhali Aquaculture Extension Component
GNAEP	Greater Noakhali Aquaculture Extension Project
GOB	Government of Bangladesh
HH	Household
HYV	High Yielding Variety
ICLARM	International Center of Living Aquatic Resources Management
ICZM	Integrated Coastal Zone Management
IPM	Integrated Pest Management
IRR	Internal Rate of Return
IUCN	The World Conservation Union
JASRA	Joint Annual Sector Review Agreement
M&E	Monitoring and Evaluation
MAEC	Mymensingh Aquaculture Extension Component
MAEP	Mymensingh Aquaculture Extension Project
MOLF	Ministry of Livestock and Fisheries
MOU	Memorandum of Understanding
NARS	National Agricultural Research System
NGO	Non-Governmental Organisation
PBAEC	Patuakhali Barguna Aquaculture Extension Component
PBAEP	Patuakhali and Barguna Agriculture Extension Project
PL	Prawn Post Larvae
PPSU	Policy Planning Support Unit
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
SPS	Sector Programme Support
TOR	Terms of Reference
USD	US Dollar

Glossary

<i>Aman</i>	Crop during monsoon period
<i>Angula</i>	Fish fingerlings
<i>Aratdar</i>	Wholesaler
<i>Bazar Samity</i>	Market Organization
<i>Beparie</i>	Medium Trader
<i>Char</i>	Emergent land from the river sediment deposit/accretion process areas
<i>Doba</i>	Ditch
<i>Faria</i>	Small trader
<i>Hali</i>	Unit of four
<i>Jalmohal</i>	Fishery leased out by government for revenue
<i>Kutchra</i>	Earth/Straw
<i>Maund</i>	Unit of weight 37.5 kg
<i>Mouza</i>	Geographical area
<i>Nola</i>	Fish fry
<i>Paiker</i>	Trader
<i>Pona</i>	Fish Fry
<i>Pucca</i>	Stone/Concrete
<i>Thana</i>	Administrative unit same as Upazila
<i>Touts & Batpars</i>	Middleman
<i>Upazila</i>	Sub-district

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Executive Summary

The Mymensingh Aquaculture Extension Project (MAEP) has had a profound impact in raising the incomes of the rural poor. Furthermore, it has had a major economic impact on the region and Bangladesh as a whole.

Currently, 396,000 poor rural families (the target population of the project), earn significant incomes from pond aquaculture resulting from project activities. These families now earn Tk. 3,600 (USD 63) on average per year from pond aquaculture, representing approximately 13% of their annual income. In addition over 418,870 greater Mymensingh households (1.8 million people) would be below the Danida target group poverty threshold of Tk 40,000 in income per year if they were not engaged in MAEP promoted pond aquaculture.

The MAEP is one of the most successful development programs in Bangladesh and stands as an international development achievement of the first order.

Denmark has a long history of cooperation with Bangladesh in the fisheries sector. Danida's cooperation with the Department of Fisheries in Mymensingh started in 1977 with the construction of the Aquaculture Experiment Station (AES) and continues to this day in the form of Agricultural Sector Programme Support (ASPS).

Winrock International was engaged by Danida to assess technical, social and economic impact of the MAEP as well as to address the sustainability issues after completion of the project. Several intermediate impact studies have been conducted during the implementation phases of the project. These studies primarily focused on impact on the trainees. This study focuses on the impact on the Greater Mymensingh area, including Danida's target population.

The results clearly show a very impressive project impact:

- In all, 1,4 million households have adopted pond aquaculture and are earning on average Tk, 8,283 per year (USD 145)
- Average yield has risen from 4kg/Dec (1mt/ha) to 13,5kg/Dec (3,3mt/ha)
- Total annual yield has risen from 85 thousand metric tons (MT) in 1989 to 351 thousand MT in 2002
- Danida target group households reported a higher yield than non-target, wealthier pond owners indicating the suitability of the MAEP approach for smallholders,
- 40% of Bangladesh's aquaculture production comes now from 10% of the country's area – the 7-districts covered under MAEP;
- Annual revenue from fish cultivation has risen from USD 48 million in 1989 to USD 252 million in 2002
- At least 68% of respondents use manure, 72% use fertilizer and 72% use lime, this demonstrates adoption of the message delivered by the extension programme;
- 61% of respondents were stocking four or more of the recommended species

Furthermore, Participatory Rural Appraisals (PRAs) conducted among the target population have shown:

- Improved housing, education, and productive investments.
- That aquaculture income is critical to crisis coping strategies.

- Widespread involvement of the private sector.
- Women participate successfully in pond aquaculture activities.
- Poor families are able to adopt new practices.

The MAEP Programme has had a very positive impact and has achieved broad penetration of carp polyculture in the seven target districts. The number of adopting households (1.4 million) far exceeds the number of directly trained households through MAEP efforts (100,000). This clearly shows that farmer-to-farmer transmission and the role of input suppliers (hatcheries, nurseries, and fry traders) has been very important in the wider dissemination of carp polyculture. It also shows that carp polyculture is sustainable because:

- The general cultivation practices are well known in rural communities,
- The inputs needed for carp polyculture are widely available from a vibrant private sector input supply chain and
- The demand for fish continues to grow and local outlets are available for the rural poor to sell their production.

An extension of the program, in its current form, is not needed for the sustainability of MAEP induced changes/impacts. MAEP has achieved sustainability through the widespread adoption and knowledge of carp polyculture technology and the establishment of a private sector input supply chain including hatcheries, nursery operations, and fry traders.

Presently there is consideration of continuing MAEP activities by national NGOs under the supervision of the DoF. National NGOs would provide credit and training to Danida target group households, the training cost would be covered by the interest rate charged. The DoF would have a supervisory role, conducting adoption/knowledge tests to ensure that the program is being run effectively.

In order to maintain the momentum in spreading of the practices and quality of the services the following recommendations should be taken into consideration:

- **NGO Fishery Credit/Training Program.** The NGO implemented fishery credit/training program should be highly focused on reaching rural poor households that have not adopted carp polyculture. The program should have very strong mechanisms to ensure that Danida target group beneficiaries are selected for training.
- **Monitoring of the NGO Credit Program.** It is recommended that the joint NGO/DoF monitoring of the program should be based on a random sample survey of trainee groups. The survey should include aquaculture adoption questions. The survey should also include an assessment of whether the households are new to carp polyculture production.
- **Application of MAEP Approaches.** The MAEP program has proven profoundly effective. The lessons of MAEP should be assessed and applied to fishery development programs in the whole of Bangladesh. While this impact study has not assessed the nature of activities undertaken by MAEP, it is clear that a strong technical focus in training and the development of a vibrant private sector input supply and marketing system are crucial to MAEP success.

1. Introduction

Bangladesh is largely formed by the fertile Ganges-Brahmaputra delta, which provides rich resources for fish production. This vast alluvial tract is rich in waterways and water bodies. 6 months of a year 6 million ha of Bangladesh's land area of 14.4 million ha is underwater.

Over the past ten years a broad range of social, economic, and political changes have taken place in Bangladesh that have affected the fisheries sector.¹ These changes include: decreasing access to natural assets, increased migration from rural areas, reduction in labour opportunities, improving infrastructure, changes in traditional social networks, increased pollution, and environmental degradation. These factors along with Government Policy initiatives have all had an impact on the development of the fisheries sector.

The Fisheries Sector remains a critical resource both to the economy and to the livelihoods of millions of poor people. Consumption of fish is still a major source of animal protein in the diet of rural households. The shrimp industry is the country's third largest export industry. Private sector investment has grown in terms of input and transportation. Significant growth potential in the Aquaculture sub-sector remains unrealized. Yet the expanding population and increased environmental degradation are a major threat to the expansion and management of the fisheries resource and there is strong evidence to suggest that over fishing has damaged fish stocks in inland open water bodies, estuaries and the marine environment.

Complex institutional and governance issues characterize the sector. The institutional challenges, including the public/private balance and the possible need to redefine the role of GoB departments, range from managing the complicated system of leases for water resources through to sustainability, accountability and ownership of development projects.

Donor investment in the sector over the past decade has tended to focus on the provision of public sector services, especially extension and human resource development. Recently, there has been increased investment directed towards research and the fisheries resource management. Pressure for interventions that generate a significant and wide ranging reform within the sector has increasingly become a priority; hence the need for well executed impact studies.

1.1. Bangladesh Fishery Sector

Yearly fish production in Bangladesh is estimated to be 2.2 million metric tons, with the Inland Capture Fisheries providing 33% of fish, the Marine Capture Fishery an estimated 26% and the culture fishery (freshwater and marine) more than 41%.²

Fisheries contributed about 6% of the GDP for Bangladesh in 2000. A full-time equivalent of at least 5.2 million people earned their livelihood from the fishery sector. This represents 9% of the labour force.³ In Bangladesh the fisheries sector functions as a safety net for the rural

¹ Note this section draws heavily on work done by Dr. Luke Colavito for the Bangladesh Fisheries Sector Review.

² This figure is based work done by Dr. Luke Colavito for the Bangladesh Fishery Sector Review Study using DOF production figures, BBS HES consumption figures, and expert opinions.

³ GDP percent and employment were estimated based on BBS 2000 HES production and price data and the average yearly wage earned in Bangladesh. The estimate of 5.2 million people equivalent employed is conservative because people in the fishery sector earn below average wages and a significant portion of fish is caught is for subsistence and not valued in price terms.

poor and provides an important source of food and animal protein for the poor. Over 70% of all animal protein consumed is from fish (BBS HES 2000).

Over the last ten years real fish production has increased, however, per capita consumption has increased only marginally, and fish prices have increased dramatically. Over the last five years, fish production and per capita consumption has shown a marked decline. While, fish prices over the last five years have increased dramatically at a rate of 2.3% annually.

Based on a forecast using a partial equilibrium model approach and conservative estimations of parameter values and economic growth, fish price is predicted to increase 2.75% annually while fish quantity is predicted to increase only 1.4% annually over the next 10 years. Rising prices mean that existing fish production systems will remain profitable and that higher cost feed based systems may become more profitable.

1.1.1. Inland Capture Fisheries

While available statistics place limits on the ability to analyse fisheries trends, there has been a clear decline in production of inland capture fisheries. The percent of fish captured in inland fisheries has declined from 57% in 1991 to 43% in 2000 based on conservative estimates.

Intervention in the open water fisheries have not been able to reverse declines caused by over exploitation of the resources, pollution, isolation of wetlands from main rivers through infrastructure projects, and direct conversion of wetlands to agricultural land. However, community based fishery activities have to some extent reduced that rate of decline in the resource and in specific locations have shown both high economic returns and ability to improve the livelihoods of the rural poor.

1.1.2. Inland Culture Fisheries

The loss in capture fishery production has been partially offset by increased production from culture fisheries. Over the last ten years aquaculture extension has received a high priority and can be considered a tremendous success in Bangladesh. Aquaculture extension efforts in Bangladesh have primarily focused on pond polyculture systems that require minimal inputs but can increase production substantially. Pond culture accounts for more than 80% of total culture production⁴. Culture fisheries production has increased from 12% in 1991 to at least 30% in 2000 and around 40% by 2003. Without the dramatic increases in production from aquaculture systems fish consumption would have shown a dramatic decline and price increases would have been even steeper.

1.1.3. Marine Fisheries

Marine fishery production has marginally increased over the last 10 years but relative share in fishery production has declined from 31% in 1991 to 27% in 2000. It should be noted that for the most part Sea water table fish are considered of inferior quality in Bangladesh.

1.1.4. Impact on the Poor

The decline in open water fisheries has clearly hurt the poor more than other socio-economic groups. Fulltime fishermen in Bangladesh are overwhelmingly poor and decreased inland capture output is lowering their incomes and forcing them to seek other occupations. The rural poor in general have also been negatively impacted by this decline in capture fisheries as they are much more likely to engage in subsistence fishing as part of their livelihood

⁴ Based on HES 2000 consumption data, production adjusted for conversion of dry to fresh fish.

strategy. Comparison of BBS HES consumption levels show that average consumption in the last 5 years has declined by about 12% but consumption for the poorest 22% of the population has decreased by 38%.

The dramatic increase in aquaculture production presents a complex picture of impacts on different socio-economic groups. In Bangladesh most culture production is from pond polyculture systems. Polyculture is well suited to the production systems of smallholders and major fisheries projects (supported by GoB, Danida, DFID, IFAD, WB, WorldFish, ADB, USAID, and others) have shown very positive impacts on raising smallholder incomes. However, the landless⁵ rural poor do not generally benefit directly from pond aquaculture as they lack ownership of ponds and have limited ability to rent ponds. However Pond polyculture and other commercial feed based aquaculture systems have generated substantial employment for the poor in a variety of activities including supplying fingerlings, digging and maintaining ponds, harvesting, marketing, transportation, and in employment in supporting industries such as hatcheries and feed production.

1.1.5. Exports and Imports

The fisheries sector contributes substantial foreign exchange earnings primarily from the export of shrimp and prawn. Bangladesh also exports smaller amounts of frozen and dried fish primarily for overseas ethnic markets. In 2000 about 18 billion Taka [USD 342 million] was earned from exports. This represents about 6% of total export earnings and represents the largest agricultural share of export earnings. Fishery sector exports have shown a very dramatic increase. The value of exports has risen 370% over the last 10 years.

Official statistics show minimal fish imports. However, there has been a significant increase in informal trade with imports from India and Burma. This informal trade is not documented in official figures. Estimates are that imports to Dhaka markets of carp's may be as high as 25% of sales. Fish prices are much lower in India and Burma. Catla price and Carp prices are respectively 75% and 20% higher in Bangladesh. This has important implications for the impact of WTO changes in trading rules. Opening of the Bangladesh market which is protected by high tariffs will result in substantially lower prices reduces / eliminating the profitability of some production systems but also very substantially increasing the welfare of consumers.

1.1.6. Production and Consumption Trends

Estimation of production and consumption trends in Bangladesh is limited by the quality and categories of available data for fish species and habitats. The DOF publishes annual production data, however, there are important limitations on the ability of DOF to assess fisheries production. The Bangladesh Bureau of Statistics (BBS) assisted by the World Bank conducts Household Expenditure Surveys (HES) about every five years. Three HES surveys were conducted over the last ten years in 1991-92, 95-96, and 2000. A number of projects also have developed data sets with production trends but these are limited to localized areas. It is widely accepted that the HES survey results are the most accurate measurement of consumption and expenditure patterns in Bangladesh.

⁵ The term 'Landless' is used here to mean owning no land at all as compared with the 'technically landless' owning <0.2 ha who do participate in aquaculture activities with very small ponds or ditches 0.005ha in size.

Table 1-1 presents BBS HES estimates of per capita fish consumption from 1991 to 2000. Over the period from 1991 to 2000 overall per capita fish consumption increase from 12.6 kg to 14.03 kg (+10%). However, from 1995 to 2000 overall per capita fish consumption declined from 15.98 kg to 14.03 kg (-14%). This decrease in consumption is a clear indication of a substantial decline in the inland capture fisheries (detailed below). Most fish consumed in Bangladesh is Freshwater fresh fish (80% in 2000).

Table 1-1: Fish consumption trends based on BBS HES surveys in kg/year

	91-92	95-96	2000*
Fresh water	11.16	12.67	11.13
Sea Water	0.84	1.08	0.95
Dry Fish	0.43	0.43	0.38
Other Fish	0.17	1.80	1.58
Total	12.60	15.98	14.03

* From the 2000 BBS preliminary report - only total fish is available. Other categories are estimated as the same proportion in 1995

Table 1-2, and Figures 1 and 2 present fishery production data. Table 1.2 and Figure 1.1 present a comparison of DOF and HES estimation of fish production and consumption. Key points of the comparison between HES and DOF national level data are:

1. DOF data consistently underestimates production but gap has narrowed over time
2. DOF shows steady increase from 1991 to 2000, missing the decline in production (and per capita consumption) occurring between 1995 and 2000.

Table 1-3 and Figure 2 show the teams best estimates of production levels rationalizing the HES and DOF data. HES data is used for overall freshwater fish and Seawater fish consumption/ production. DOF data is used for capture fisheries. The inland freshwater fish catch is estimated as the residual between freshwater fish produced/consumed and capture fish produced as measured by DOF. This approach to estimation is based on consultation with fishery sector experts.

Table 1-2: Comparison of consumption and production data ('000 MT)

Category	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
HES Fresh	1,231	1,344	1,457	1,570	1,683	1,666	1,650	1,633	1,617	1,601
HES Sea**	561	578	594	611	628	622	616	610	603	597
HES Total	1,792	1,921	2,051	2,181	2,311	2,288	2,266	2,243	2,220	2,198
DOF Fresh	654	707	770	838	908	988	1,086	1,191	1,243	1,321
DOF Sea	242	246	251	253	265	270	275	273	310	334
DOF Total	896	952	1,021	1,091	1,173	1,258	1,361	1,464	1,552	1,655

Sources: BBS HES (1991, 1995, 2000), note interim year values are based on linear trend and DOF annual publication.

* From the 2000 BBS preliminary report only total fish is available. Other categories are estimated as the same proportion in 1995. ** It is assumed that dry fish are marine capture fish with a ratio of 10:1 fresh to dry conversion.

Table 1-3: Reconciled fishery production data, '000t

Description	1991	1993	1995	1997	1998	1999	2000	2001***	2002***
Inland Capture*	1,020	1,219	1,366	1,164	1,059	1,024	950	899	850
Inland Culture**	211	238	317	486	575	593	651	746	856
Marine**	561	594	628	616	610	603	597	592	587
Total	1,792	2,051	2,311	2,266	2,243	2,220	2,198	2,180	2,162

* Residual value from HES figure minus inland culture and Marine fish production

** DOF estimated figure *** Based in simple linear trend of last 5 years data.

Figure 1: Fisheries production a comparison of HES and DOF information.

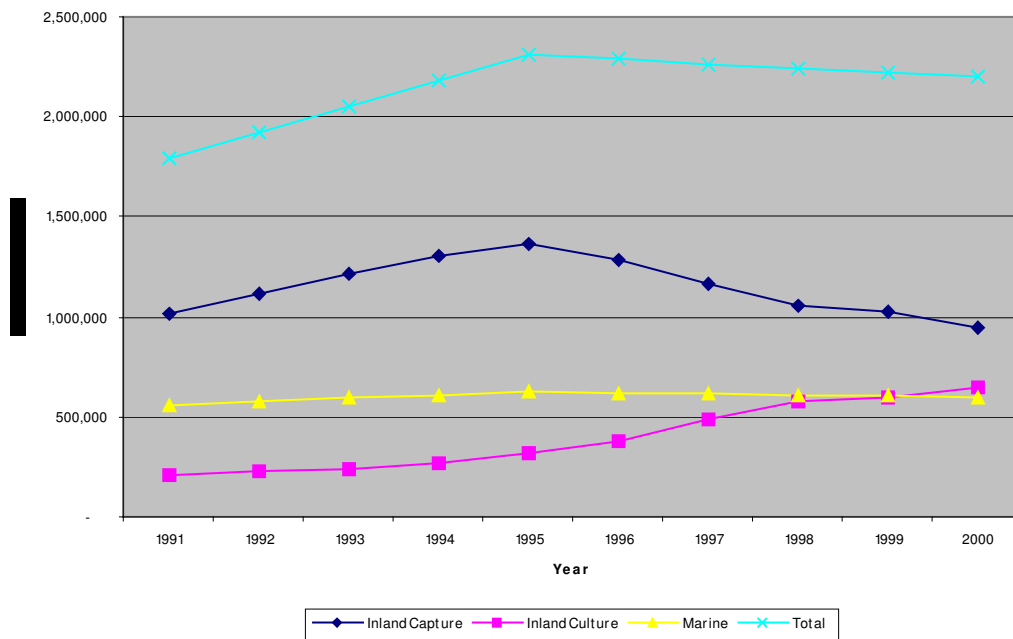
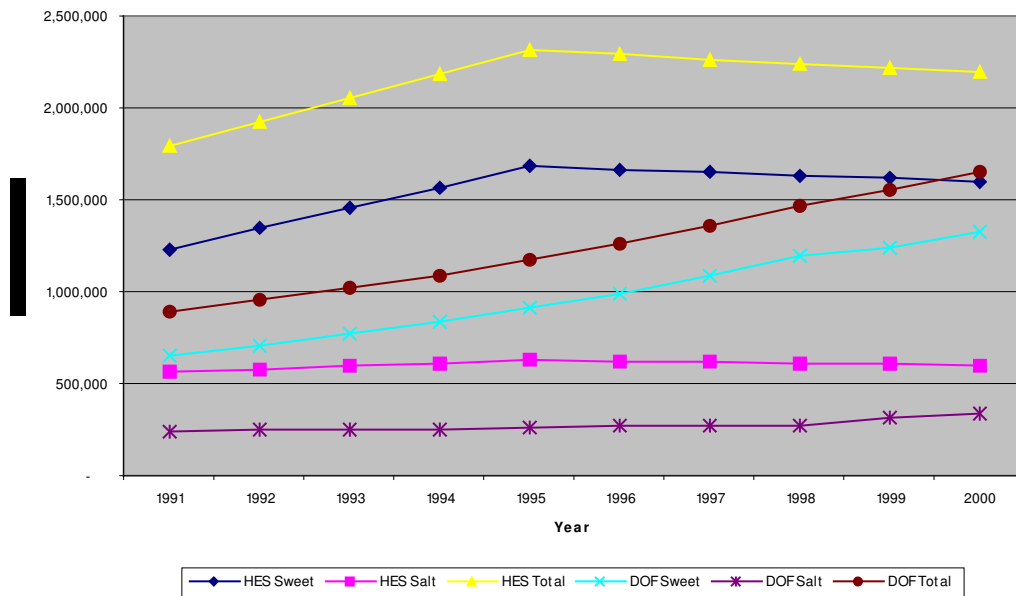


Figure 2: Fisheries production in Bangladesh.



It should be noted that official import and export statistics are small enough to have no substantial impact on the overall levels of production and consumption in Table 3. However, anecdotal evidence suggests that unofficial imports are important sources for the supply of the major urban markets in Bangladesh.

1.1.7. Growth of key sectors by fishery category

Table 1-4 presents the annual percentage growth for major fishery categories. Inland culture fisheries grew at 7% annually from 1991 to 1995 and 14% from 1996 to 2000. Inland capture fisheries grew at 5% annually from 1991 to 1995 and fell by 5.2% annually from 1996 to 2000

2000. It is likely that the growth in inland culture fisheries is likely overstated and that the decline and the increase in inland culture fisheries are underestimated.

Table 1-4: Changes in Fishery Sectors

Fishery	1991-1995	1996-2000
Inland Capture	5.06%	-5.24%
Inland Culture	7%	14.33%
Marine	2%	-0.79%
Total	4%	-0.79%

1.2. Danida Fishery Programs

1.2.1. DoF/Danida Fishery Components

The Danida financial support to the Agricultural Sector Programme Support (ASPS) to Bangladesh started in July 2000 with a 5-year perspective. The Programme currently has three components related to field extension in fisheries and aquaculture:

1. **The Mymensingh Aquaculture Extension Component.** In operation since 1989. Phase II started on 1st July 1993. Presently in a 2.5-year Consolidation Phase, 1st July 2000 to 31st December 2003
2. **Patuakhali-Barguna Aquaculture Extension Component.** Started on 1st October 1997 with a 7-year implementation period;
3. **Greater Noakhali Aquaculture Extension Component.** Started on 1st July 1998 with a 7-year implementation period.

1.2.2. MAEP

Danida has a long history of working with GoB in the fishery sector. Danida's cooperation with the DoF in Mymensingh started in 1977 with the construction of the Aquaculture Experiment Station (AES) later known as the Freshwater Aquaculture Research Station (FARS) now the Bangladesh Fisheries Research Institute (BFRI). This centre was built in 2 phases (1977-1983 and 1983-1987). In 1987 it was recommended to involve the FRI and its staff in aquaculture development. This led to the MAEP phase I, which started in 1989 with the main objective of disseminating the FRI research results to the Greater Mymensingh area as a means of increasing fish production and reducing poverty. MAEP proceeded to a phase two with an expansion of area and the current Consolidation Phase to be completed in 2003.

1.2.3. Consolidation Phase

MAEP is a consolidation phase of a project that started in 1989, and is implemented by the Department of Fisheries. It is similar in objectives, outputs and strategies to two other Danida supported aquaculture extension projects in Bangladesh, all of whom are part of the aquaculture sub-sector of Danida's Agriculture Sector Programme Support.

It is poverty alleviation-related in terms of a target group of relatively poor farmers and landless persons with access to a pond. Women pond operators and service providers are targeted at 30% of the total beneficiaries. Environmental impact assessments will be made of fish culture activities, and limitations will be encouraged on the use of chemicals.

The **development objective** of the MAEP consolidation phase is *a strengthened socio-economic position and physical well being of the target group of poor men and women farmers.*

The **immediate objectives** are:

- Increased number of the target group engaged in fish production in closed water bodies and related service activities.
- Improved capacity for aquaculture promotion and extension at thana level.

The **outputs** are:

- An increase in fish production by 36,000 fish farmers within the project area.
- 12,000 persons have received training and loans to start/improve their services such as harvesting, transport, processing, marketing and net making.
- NGOs have a sustainable capacity to extend credit for fish farming and provide social development services.
- Department of Fisheries (DOF) staffs at district and thana level have increased technical skill and social development knowledge.
- Extension Trainers will become local technical consultants rendering services to fish farmers.

1.3. Impact Study Objectives

Winrock International has been engaged to evaluate the comprehensive impact of the MAEP. The impact study has focused on four major areas:

1. **Technical:** including estimating adoption rate, production/yield levels, the extent to which recommendations have been adopted, constraints to the systems, and sustainability of production and extension systems.
2. **Social:** including analysis of Household (HH) level impact on income and spending, poverty alleviation, gender impacts, and secondary impacts.
3. **Economic benefits:** including increased incomes, economic welfare as measure by economic surplus, estimate the Internal Rate of Return (IRR) for project investment, estimate consumer impact through price impact, and estimate the economic impact on input industry participants and down stream marketing participants
4. **Sustainability:** this will represent an assessment of viable strategies to ensure that project benefits and extension systems are sustained.

Several intermediate impact studies have been conducted during the implementation phases of the project. These studies primarily focused on impact on the trainees. This study focuses on the impact on the Greater Mymensingh area, including Danida's target population⁶.

⁶ In consultation with Danida program staff, the Danida target group was defined as households earning less than Tk. 40,000 per year.

2. Methodology

A number of activities were carried out as part of the MAEP programs impact evaluation study. These activities included:

- **Household survey.** A stratified random survey of 600 households in the greater seven district Mymensingh area was conducted (details below).
- **PRAs.** The study team designed and implemented PRAs to assess household level qualitative impact of MAEP activities and interventions (results presented in **Section 4.0**).
- **Economic Analysis.** A number of analytical methods were applied to assess MAEP impact including development of partial enterprise budgets, development of economic surplus models to measure economic surplus, estimation of IRR for project investment. Further details are presented in **Section 5.0**.
- **Specialized Surveys.** Key informant interviews for assessment of benefits to input suppliers (hatcheries, nurseries, fry traders) and marketers (results presented in **Section 4.0**).

2.1. Household Survey Sampling Approach

A sampling frame was designed to ensure that MAEP impact could be estimated within a given level of confidence. Winrock developed the sampling frame with village units (mouza) as the geographic location for randomly selected cluster sampling.

Table 2-1 provides the key parameters of the final sampling frame. A confidence level of 95% and a confidence interval of 20% were selected. A confidence interval of 20% will easily enable detection of component impact.

Table 2-1: Sampling parameters

Item	Value	Source
Confidence level	0.95	Sufficient level
Confidence interval	0.2	Sufficient level
No. of samples.	600	Calculation (Strata * Sample)

The minimum sample size per cluster location (mouza) was fixed at 30 households in keeping with survey standards for minimum sample size for inter-cluster comparison.

It should be noted that sample size for large populations is not based on percentage of the population but is calculated based on the confidence level and the confidence interval selected and the number of strata for which sampling will be done.

To further improve sampling accuracy and to enable analysis of key factors influencing component objectives, four sample frame variables were selected (Table 2-2):

- **Component Activity.** The presence of component activity should be correlated with increased levels of income and achievement of component objectives.
- **Favorable/Unfavorable Area.** Areas that are unfavourable, lack electricity and rickshaw access during the monsoon season. From these areas it is harder to access inputs and market surpluses.

- **Urban/Rural.** Urban areas represent these most favored areas in terms of input supply and marketing.
- **Flooding.** Areas prone to flooding are less suitable for year round production activities and may be more suited to seasonal smallholder livestock and fish production strategies.

Table 2-2: Impact study household survey sample frame.

Urban/ Rural	Favored/ Non-favored	Flooding/ Non-flooding	MAEP I-II/ Non-MAEP	MAEP Con./ Non-MAEP	Strata Name	Strata Number
R	F	NF	M	M	FNFMM	1
U	F	NF	NM	M	FNFNMM	2
R	NF	NF	M	M	NFNFMM	3
U	F	NF	M	NM	FNFMNM	4
R	F	NF	NM	NM	FNFNMNM	5
R	NF	F	NM	NM	NFFNMNM	6
R	NF	NF	M	NM	NFNFNMNM	7
R	NF	NF	NM	NM	NFNFNMNM	8

Target Group. It should be noted that Danida has specific objectives for benefiting and uplifting poor households. Danida-supported programs have specific criteria in terms of income and land holdings defining target and non-target groups. It has been a challenge in Danida programs to ensure that program resources are directed toward target groups since it is often easier for program staff to achieve production/income targets working with wealthier households. For this survey, a simple definition of household income below Tk 40,000 was adopted to define the Danida target population. Results are presented for both target and non-target populations. This will enable later impact studies to assess overall Danida impact on both populations and to see if Danida programs have contributed to reducing the income gaps between these groups.

2.2. Sampling Debate: Component Area vs. Upazila

During development of the survey protocols, there was a debate on whether to conduct the baseline surveys for each Upazila or by component area. The Winrock Team recommendation was to use a stratified sampling approach (as outlined) for the entire seven districts of MAEP area since results will be statistically valid and survey costs will be minimized.

2.3. Survey Design and Implementation

Instrument Design. The survey design was based on a review of Bangladesh livelihood program surveys, consultation with external and internal experts, and field PRAs conducted in the seven district MAEP area. The survey instruments were then field tested and modified based on feedback from field staff and program experts.

Training. Training emphasized consistent understanding of the content of questions and the meaning of codes.

2.3.1. Survey Implementation.

Recall Method. It should be stressed and noted that this survey relied on the recall method for the last relevant period to estimate indicators. Individual recall is subject to substantial errors. The principal is that on average errors above and below true levels will average out.

Enumerators were trained to assist the farmers in understanding the questions and reporting results to fit the questions.

Data processing. Survey forms were reviewed for completeness and consistency and then inputted in Microsoft Access database using a template based on the actual survey form. Data were then further reviewed and cleaned.

Analysis. Analysis was performed using SPSS software. Tables presenting key findings and indicators are developed and presented in this report. The full database has been provided to the Danida program. This database will allow for the exploration and analysis of a variety of key relationships.

At the village level, a PRA exercise was used and a household list was developed categorizing households into four groups for sampling (target group with livestock and pond, target group without livestock and pond, non target group with livestock and pond, and non target group without livestock and pond). Non-livestock households and pond owners are included in the sample as a control group for comparison. Non-target populations are included to assess overall component impact and to estimate secondary impact on the target population through generation of employment.

3. Quantitative Survey Results

3.1. Productivity

Table 3-1 presents the production impact in the seven MAEP districts for the target and non-target pond population. Target group refers to farmers earning less than Tk. 40,000 per year. Here the target group is the poorer segment of the entire population and in this context should not be confused with MAEP direct trainees. MAEP has trained about 100,000 households who generally meet the target group criteria of income less than 40,000 per year. The results clearly show an enormous project impact. Average yield has risen from 4kg/Dec⁷(1mt/ha) to 13.5kg/Dec (3.3mt/ha). Yield was assessed in two ways for the study.⁸ **Current overall yield has risen from 85 thousand metric tons (MT) in 1989 to 351 thousand MT in 2002.**

Table 3-1: MAEP production impact.

Description	1989		2001		Change 1989 - 2001	
	Target Group	Non target Group	Target Group	Non target Group	Target Group	Non target Group
Households	324,876	826,439	396,190	1,007,853	22.0%	22.0%
HHs with Pond (%)	10%	24%	10%	24%	0.0%	0.0%
Pond Area (dec.)	7.9	22.7	7.9	22.7	0.0%	0.0%
Yield (Kg/Dec.)	4	4	13.8	13.4	245.0%	235.0%
Production (MT)	10,328	75,138	43,374	307,916	320.0%	309.8%

** The conservative assumption was made that percent pond owners and HH area in pond remained constant.

Danida's target group with ponds was found to be 10% of the overall population (1.78 million people). 34% of households reported using ponds for fish cultivation. Importantly Danida target group households reported a higher yield than non-target, wealthier pond owners, indicating the suitability of the MAEP approach for smallholders. The production from the MAEP districts of 329 thousand MT represents about 39% of the 850 thousand MT of inland culture fisheries production in Bangladesh.⁹ This is of particular interest because the MAEP 7-District area equates to 10% of the surface area of Bangladesh. Close to 40% of Bangladesh's aquaculture production from 10% of the area demonstrates the clear benefits of the MAEP approach of sound technical training and public/private service delivery providing inputs, technology transfer and micro finance. This indicates the suitability for wider application of the MAEP approach, it should however be noted that MAEP is in a unique position with good road and communications within the locality and to the major fish markets in Bangladesh. MAEP also has a thriving hatchery and nursery sector.

Table 3-2: Contribution of Pond Income to total HH Income (2001)

Description	HH Pond Area (dec.)	Revenue (Tk/Dec.)	Pond Income (Tk/Year)	Total Income (Tk/year)*	% Of HH Income
Target Group	7.9	565.6	3,596	27,345	13.2%
Non target	22.7	556.9	10,126	99,476	10.2%
All households	18.6	559.4	8,283	79,122.	10.5%

* Income at 80% of revenue.

⁷ Decimal is a local unit of area measurement equivalent to app. 40 square meters, 1 ha = 247 decimals.

⁸ Yield was calculated by species for the main household pond and by price/income for other household ponds. Results were almost the same from both sources 3.3 vs. 3.25 mt/Ha

⁹ Source: Draft figure from the Fishery Sector Review 2002. There is considerable controversy about overall production from pond and other sources in Bangladesh. Nation wide representative samples are not currently available.

Income generation. The MAEP production impact translates to very substantial contributions to household revenue and income. Table 3-2 details the household income impact. Target and non-target households report similar revenue of 566 and 557 (Tk/Dec/Year). Target groups report revenue of Tk. 4,495 per year per household. Of this 20% is for costs of production leaving an average annual income of Tk. 3,596 for target households and Tk. 10,126 for non-target households. For the poor pond producers this represents 13.2% of their income.¹⁰

Table 3-3 details the aggregate income generated from culture fisheries in the MAEP districts. Target group households reported an annual revenue of Tk 1.4 billion (US 24 million) from fish cultivation. Overall annual income generated in the MAEP districts is Tk. 11.2 billion (USD 201 million). This annual return simply dwarfs the Danida and DoF investment in the MAEP project phases (less than USD 15 million over 13 years). MAEP is one of the most effective development projects in Bangladesh and for that matter in the developing world.

Table 3-3: MAEP impact - total income (2001)

Description	Total Income (Tk/year)	Total Income (USD/year)
Target Group	1,424,000,000	24,648,000
Non target	10,206,000,000	176,576,000
All households	11,630,000,000	201,224,000

Conservative calculation shows that annual revenue from fish cultivation has risen from USD 48 million in 1980 to USD 252 million in 2001. **This is an annual increase of over USD 201 million from 1989 to 2001.**

3.2. Adoption of New Practices

An assessment of MAEP technology adoption was also made as part of the impact study survey. Table 3-4 details the major practices that MAEP trainings included. The results show extensive adoption of the MAEP recommended practices including at least 68% of respondents using manure, 72% using fertilizer, and 72% using lime,

Table 3-4: Adoption rates of MAEP pond aquaculture practices.

Practice	Yes
Application of cow manure	68%
Application of poultry manure	23%
Application of urea	72%
Application of TSP	67%
Feeding aquatic plants	30%
Feeding leaves/grass	44%
Feeding rice bran	88%
Feeding oil cakes	62%
Lime	72%
Use of Balanced Feed*	2%

* Not a recommended practice

The survey included a visual inspection of respondents' ponds. From this visual inspection it was found that 61% of respondents were stocking 4 or more of the recommended species.

¹⁰ It should be noted that this income comes at a critical period and is part of the family crisis coping strategy.

3.3. Socio-economic characteristics of Project Areas

This chapter presents some selected aspects of the people in the Project areas. As can be seen in Table 3-5 all households irrespective of strata have on average 2 children.

From ethnic point of view, the areas seem to be homogenous in that 98 percent are Muslims and there is no significant minority population (Table 3-6).

School enrolment information (Table 3-7) shows that the Pond Target group sends the children less frequently than the more affluent, Non-target people do.

3.3.1. Children in the Households

Table 3-5: Average Number of Children per HH

Strata	0-15 Years			0-5 Years		6-10 Years		11-15 Years	
	Total	Male	Female	Male	Female	Male	Female	Male	Female
Pond Target	1.91	0.91	1.00	0.25	0.33	0.37	0.42	0.30	0.25
Pond Non-target	2.01	0.97	1.03	0.34	0.45	0.36	0.28	0.28	0.31
Non-pond Target	1.94	1.02	0.92	0.38	0.31	0.41	0.33	0.22	0.28
Non-pond Non-target	1.90	1.04	0.86	0.34	0.35	0.37	0.28	0.33	0.23
Total	1.95	1.00	0.94	0.35	0.35	0.39	0.32	0.27	0.27

3.3.2. Ethnicity and Religion

Table 3-6: Religion of Households by Strata

Strata		Muslim	Hindu	Buddhist	Rakhain	Christian	Total
Pond Target	N	56	1				57
	%	98.20%	1.80%				100.00%
Pond Non-target	N	143	2				145
	%	98.60%	1.40%				100.00%
Non-pond Target	N	262	5		1		268
	%	97.80%	1.90%		0.40%		100.00%
Non-pond Non-target	N	126	4				130
	%	96.90%	3.10%				100.00%
Entire PoP	N	587	12		1		600
	%	97.80%	2.00%		0.20%		100.00%

3.3.3. Educational Status

Table 3-7: School Enrolment by Age Group in %

Strata	Male		Female	
	5 - 10	11 - 15	5 - 10	11 - 15s
Pond Target	85.71%	52.94%	91.67%	64.29%
Pond Non-target	98.08%	95.00%	95.00%	91.11%
Non-pond Target	88.29%	68.33%	88.64%	80.00%
Non-pond Non-target	93.75%	74.42%	94.59%	96.67%
Total	91.38%	75.00%	91.53%	84.76%

3.3.4. Occupation of the Respondents and HH Heads

Table 3-8: Primary Occupation of Household Heads by Strata

Strata		Farming	Day labourer	Service	Business	Rick./Van puller	Other	Total
Pond Target	N	30	6	3	7	4	7	57
	%	52.6%	10.5%	5.3%	12.3%	7.0%	12.3%	100.0%
Pond Non-target	N	73	2	22	31	1	17	146
	%	50.0%	1.4%	15.1%	21.2%	0.7%	11.6%	100.0%
Non-pond Target	N	86	71	11	31	17	52	268
	%	32.1%	26.5%	4.1%	11.6%	6.3%	19.4%	100.0%
Non-pond Non-target	N	57	4	18	26	3	21	129
	%	44.2%	3.1%	14.0%	20.2%	2.3%	16.3%	100.0%
Entire PoP	N	246	83	54	95	25	97	600
	%	41.0%	13.8%	9.0%	15.8%	4.2%	16.2%	100.0%
N means number of samples								

3.3.5. Land Ownership and its Use

Table 3-9: Own Cultivable Land by Season by Strata in decimals

Strata	Aus	Aman	Boro/Rabi
Pond Target	21.00	34.08	32.11
Pond Non-target	49.47	133.07	114.88
Non-pond Target	12.60	28.37	44.58
Non-pond Non-target	35.34	76.32	106.82
Total	30.76	73.76	81.07

Note: Those have cultivable land

Table 3-10: Total Operated Land by Season by Strata in decimals

Strata	Aus	Aman	Boro/Rabi
Pond Target	20.92	40.82	42.85
Pond Non-target	52.92	131.28	121.31
Non-pond Target	15.31	39.15	65.57
Non-pond Non-target	38.17	86.24	130.02
Total	32.17	77.00	95.05

Note: Those operated any cultivable land

4. Qualitative Results

In this section, qualitative results from the PRAs and Key Informant Interviews are presented.

It is important to note here that the interviews were held informally and that facts given by respondents were not independently verified. The answers were noted as they were given - inconsistencies might therefore occur.

4.1. Gender Issues

The PRAs are the main source of information related to gender in general and changes for women in particular.

All PRAs conducted showed that women are generally satisfied with changes during the past 10 years. Most respondents told that many important decisions are taken jointly by man and wife. Women participate more and more in fishery related activities, although marketing still remains the domain of men. The mobility of women has increased, allowing them to move outside the *bari* more freely.

NGOs direct their micro-credit activities at women, which adds to empowerment.

4.2. PRA Results Kustia Nadir par

Mouza : Kustia Nadir par (non favorable village)

Union : Kustia

Thana : Mymensingh Sadar

4.2.1. Technology Transfer

In general, people are aware of fish culture and how it can be aided by using modern technologies. Danida inspired the villagers to develop pond and rice field fish culture during the early 90's. Before Danida's intervention villagers used to follow a more traditional approach.

Many pond owners as well as many people who did not own ponds, participated in MAEP trainings. About 25% of fish farmers in this village follow the improved/ modern technology, 50% of the farmers partially follow the messages and the remaining 25% follow the traditional approach. The reasons given by people for following the traditional approach are:

- Insufficient money to follow the suggested technology.
- They do not understand the importance of the training messages.

The people who follow the training and demonstration messages understand and give additional feed to their fishes. They understand that for good production there is no alternative to the use of rice bran, oil cake, cow dung, green grasses, etc. They also understand the importance of water quality and the need for maintenance of the pond. Many also understand how to deal with fish diseases and other problems.

There are many people in the village involved in fish culture who make a good profit from fish; but who have not been trained by Danida. They learned the procedures of fish culture from those neighbouring farmers who received the Danida training. In cases where there has been a problem in fish culture, they have taken advice from experienced farmers. During the last 5-6 years the villagers have not received any support in fish related activities from the MAEP project.

It was reported by the villages that in cases of serious fish diseases that they should visit the office of the Upazila Fishery Officer with samples of the affected fish. They complained that the Fishery officers usually did not visit their village or ponds. They further reported that MAEP staff and other government people visited their village during the project tenure.

Proshika (NGO) is active in this village with a literacy project but they do not have any staff with fishery experience. Villagers receive support for many activities from Proshika and other small NGOs but not for fish related activities.

During the Focus Group Discussion people informed us that their village has potential for fish culture, but due to the following limitations it has not expanded to a desired level:

- The village is linked with Upazila HQ and the growth centres, by very poor quality road.
- There is no electricity (power supply) in this village.
- Pona paikers do not come very often to this village due to bad communication.
- Many ponds dry up during dry season.
- Upazila HQ is far away and the road is bad. Transportation costs are high and the village is almost inaccessible in the wet season, so fishery officers and other service providing people do not visit the village.
- There is no nursery in the village or in the nearby villages. They procure their fingerlings from Muktagacha town, which increases the price. In some cases, the mortality rate of the fingerlings increases because of transportation.
- Due to communication problems, they have difficulty in selling their fish in the outside markets. They are forced to sell in the local market and do not obtain a good price for their fish.
- Some people are interested in establishing a nursery but have insufficient capital to start.

To overcome these problems the villagers have made the following suggestions:

- Development of the road network and improvement of existing roads.
- Connecting the village with rural power supply
- Arrange follow up training on fish culture
- Establishment of nurseries in the village
- Expansion of credit facilities in the village

The villagers stated that fish culture is expanding slowly in the village and some of them have started fish culture in the rice fields during the *Aman* season. However, for higher growth the above-mentioned measures should be taken up.

Generally, they stock fingerlings in April to grow on and sell in October/November. In this village people do not sell fish by weight. The growth of fish is good in general – the fish stocked in April can be sold in October. If the growth is good each piece of fish may have a value of up to Tk. 30. Smaller size fishes are sold in *Hali* (4 fish makes a hali).

4.2.2. Impact

According to their priorities and importance, the village people ranked their livelihood strategies as follows:

- Agriculture (rice production)
- Small business
- Day labour
- Service (Job in GO/NGO)
- Fish culture
- Fish catching/selling
- Rickshaw/van pulling
- Shop keeping
- Poultry/live stock raising
- Construction labour
- Rice husking mill
- Saw mill

Women are involved in some fish related activities such as pond maintenance and feeding. Apart from these activities, they are active in production of vegetables in and around the homestead and ponds. About 25% of fish farmers engage hired labour for annual/periodical maintenance of pond and 75% of farmers do these jobs using family labour. Where family labour is used, 75% of women are involved.

4.2.3. Well being

The people in the village reported that their livelihood situation has improved over the project period and that the following improvements are very prominent:

- Improved food consumption
- Many people are free from debt
- Improved housing condition
- Some people could purchase land
- Able to send their children to school.
- Family income has increased

However, the villagers indicated three major reasons for their improvement:

- Increased modern rice cultivation in the area
- Increased mobility and opportunities of diversified employment in non farm sector
- Fish culture increased

4.2.4. Sustainability

People are interested in fish culture but progress is slow. However, if the following problems are not solved, it may reduce growth of fishery activities or affect the farmers:

- Poor/ inadequate road communication
- No electricity
- No hatchery in the area
- No support from fishery department
- No support from NGOs on fishery activities
- Inadequate credit facilities

People reported that they are using power tillers for agriculture and that the use of draft animals is declining. This has resulted in a general decline in the availability of cow dung. People are forced to purchase cow dung for use in fish culture.

4.2.5. Impact on Gender Issues

Female members of 50% of households are involved in fish culture related activities. Women very often perform the following activities:

- Maintenance of ponds
- Feeding fish and fertilizing fish ponds
- Vegetable cultivation in and around the homestead and pond.
- Encourage children to swim in order to oxygenate the fish ponds
- Selecting/sorting good fingerlings during purchase of fingerlings from paiker.
- Stocking fingerlings
- Occasionally some women catch fish by hook or small net

The female family members do not go to the market to sell fish and they aren't generally involved in fish marketing.

Decision Making Process

Women are participating or influencing more decision-making processes regarding family level activities. They usually visit the health centre alone or take someone with them in cases where the husband is absent. They are able to spend money if they feel it is urgent/important.

In general the husband and wife take decisions jointly, such as house repair, sending children to school, purchase of cattle, marriage, etc. When husbands are absent, wives take decisions in emergencies, which do not involve major investment.

The women are more empowered in the decision making process if their husbands are working in the cities or abroad. The wives make decisions, which they later discuss with their husbands.

4.2.6. Impact on the Environment

People do not use pond water if they use cow dung for fish culture. Most of the people use tube well water for domestic and drinking purposes. Some poor people who have no frequent access to the tube well use small quantities of cow dung in the pond. This enables them to use the pond water for bathing and the cleaning of clothes, but they never use pond water for drinking purposes.

People do not use chemicals for cleaning of fishponds. Pond water becomes polluted during the dry season and increases incidence of scabies.

4.2.7. Crisis Coping

People recognize that mid May to mid July and mid November to mid January are the best months in the year and that the worst months are mid September to October and March to April. During these two bad periods poor people face food crises, small/marginal farmers can manage food but have no spare money for clothes (details are in the bar chart). 10 years ago the situation was much worse.

Presently they cope with the seasonal crises by:

- Outward migration to towns/cities for construction/transport labouring
- Selling poultry birds and livestock
- Selling vegetables
- Fish culture
- Mortgage land
- Petty trading
- Women engage themselves in domestic work for neighbours

4.2.8. Mobility

People are more aware about the outside world. In search of jobs or avenues for fortune many people have migrated to the cities staying outside the village. Poor people regularly migrate in the crisis months to work as construction/transport labour in the towns and cities.

Women are allowed to visit the Thane health centre and the nearest town by themselves. Many of the women are able to travel to the district HQ.

4.2.9. Violence

People stated that violence is not a big factor in this area. There is no incidence of fish theft, however, they place some bamboo branches to protect their fish. The women are frequently going out for work and education.

Problem of delinquent boys has increased in the village compared to the situation 10 years ago. However, no major incidences have occurred yet. Most of the social conflicts and problems are still solved at village level through arbitration.

4.3. PRA Results Monder bazaar

Mouza: Monder bazaar (favorable Village)

Union : Douhakhola

Thana : Gouripur

4.3.1. Technology transfer:

Most of the people in this village are doing fish culture in their ponds, water bodies and in the rice fields following modern technology, learned from the Danida Project. Danida inspired the villagers to adopt pond and rice fish culture during early 90's. Before Danida's intervention villagers used to do fish culture in their ponds only following the traditional approach.

Many pond and non-pond owners participated individually in fish related training sessions organized by Danida. About 75% of fish farmers in this village follow the improved/ modern technologies fully learned from training and demonstrations. The remaining 25% of farmers use the partial messages from the training and experience from previous fish culture.

Following the training and demonstration messages for fish culture many farmers are getting much higher production per unit area. On average they produce about 16 Kg per decimal. In this area fish is sold by weight but *ponas* are sold in batches. In one spot check it appeared that a farmer sold about 14 *mounds* of fish in the market and about 2 *mounds* of fish remained in his pond (total 16 *mounds*) from his 54 decimals of pond. On an average he produced about 12 Kg of fish per decimal. The farmer sells fish at regular intervals and restocks with new fingerlings at the same time.

Fish culture in low-lying rice land is quite common in this area and the production rate is about 2.25 to 3.5 kg per decimal depending on water depth and duration. The villagers stated that one way or another most of the people are involved in fish culture or fish related activities. Most popular activities are:

- Fish culture in ponds or in dobas.
- Fish culture in rice fields
- Nursery business

The villagers indicated that fish culture in rice fields is the most highly profitable business amongst the fish activities. In this village fish culture is an important activity, which, is also reflected in the priority of the livelihood strategies of the villagers. The livelihood strategies of the village people are presented here with priority ranking:

- Agriculture (rice production)
- Livestock raising (cow/goat fattening)
- Poultry birds
- Fish culture
- Vegetable cultivation (commercial purpose)
- Day labour
- Construction labour
- Rickshaw/ van pulling

- Fish selling
- Small trading/shop keeping
- Industrial/factory labour
- Service/job in GO/NGOs
- Fishermen
- Rice threshing
- Power tiller operation
- Plant nursery
- Fish nursery
- Net making
- Rice mill
- Saw mill

Women are involved in fish related activities; pond maintenance, feed making and feeding fish, apart from these activities they are active in production of vegetables in and around the homestead and ponds. About 50% of fish farmers engage hired labour for annual/periodical maintenance of ponds. The remaining 50% of farmers do these jobs by utilizing family labour.

4.3.2. Well Being

Over the years, the village people from all categories have made improvements in their livelihood situation. However, the poorest people also made some improvements but not as much as the others did. The villagers have invested their savings or earnings in the following items:

- Improved food consumption
- Improved housing conditions (except for a small number most of the houses are now tin made)
- Many people are free from debt
- Some people could recover land from mortgage or purchased land
- Installed hand tube wells for drinking water and constructed sanitary latrine.
- Capable of sending their children to school.
- Capable of spending money for medical treatment
- Employment opportunities increased

The villagers have indicated three major reasons for their improvement:

- Increased modern rice cultivation in the area
- Fish culture increased
- Improved road communication(passable in all seasons) increased the mobility
- Employment opportunities created in non-farm sector.

The people stated that fish culture is expanding very fast in the village and they generally restock immediately after any catch. Many farmers are doing fish culture in rice fields and some have started prawn culture in the ponds.

4.3.3. Sustainability

It is a kind of silent revolution in the village. People in the village have made remarkable progress especially in fish culture and fish related activities. However, the following problems should be addressed urgently for further sustainability of fish activities.

- Declining fish price due to imported fish in the market
- Price of fish feed is increasing
- Quality fingerlings are not sufficiently available
- Fish diseases are increasing (about 10-12 percent of fish are affected by diseases in winter)
- Good price is not ensured due to domination of middle men
- No arrangement/facilities are there for an expanded market
- Cross breeding is becoming a serious problem
- Shortage of quality and mature brood fish in the hatchery
- No government control of the hatcheries.

In addition the fish farmers mentioned that they do not get any support services or technical advice from the Upazila Fishery Officer.

4.3.4. Impact on Gender Issues

Women are now contributing to family income in a more active way. Development of fisheries in the village has created employment opportunities for both men and women. In the case of female family members, 70% of them are directly or indirectly involved in fish culture or fish related activities. Except for a few, they generally aren't involved in fish marketing.

Women often perform many of the following tasks:

- Maintenance of ponds
- Grading of rice bran and production of balanced fish feed
- Feeding fish and fertilizing of fish ponds
- Vegetable cultivation in and around the homestead and ponds
- Selecting/sorting of good fingerlings during purchase of fingerlings.
- Stocking fingerlings
- Occasionally some women catch fish by hook or small net

Apart from fish related activities some of them have started independent home based activities such as cow rearing and vegetable growing on a commercial basis.

Decision Making Process

Along with an active role in income generating activities, participation of women is gradually expanding more in the decision making process at the family level. In general, husband and

wife take decision jointly in matters such as house repair, sending children to school, marriage, purchase of land/cattle etc. Wives are able to influence their husband in fixing the priority for investment. They usually visit the health centre alone and they are able to take decisions and spend money if they feel it is urgent or important – if their husbands are absent.

The women are more empowered in the decision-making processes if their husbands are working in cities or abroad. The wives take decisions that they later discuss with their husbands.

4.3.5. Impact on the Environment

People do not use pond water if they use cow dung or poultry litter for fish culture. Most of the people use tube well water for domestic and drinking purposes. Some poor people who have no frequent access to the tube well they use small quantities of cow dung in the pond. This enables them to use the pond water for bath and cleaning of clothes, but they never use pond water for drinking purposes.

People do not use chemicals for cleaning of fishponds. Pond water becomes polluted during the dry season and causes increase in scabies incidence.

4.3.6. Crisis coping

People recognized that the mid May to mid August and mid November to mid January are the best months in the year and that the worst months are March to April and mid September to October. During the bad months, very poor people have some food crises, but the better of poor some how manage to buy food but they do not spend money on clothes (details are in the bar cart).

Presently they cope with the seasonal crisis:

- Outward migration is very limited (many opportunities exist for work: textile mill, rice mill, transport/construction labour, fish related activities in nursery/hatchery, fish harvest etc.
- Selling poultry birds and livestock
- Selling vegetables
- Fish culture
- Petty trading
- Women engage themselves in domestic work for neighbours

People stated that the situation is better now compared to that of 10 years ago. The main reasons are increased employment opportunities due to:

- Improved rice cultivation around the year
- Increased fish culture
- Improved infrastructure (road communication and power supply etc)
- Establishment of factories/industries
- Increased technical knowledge

4.3.7. Mobility

People in this village are well connected with the towns – most of the men go to the district HQ every day to get their daily necessities. People from all categories (except poor) use to travel to Dhaka and Mymensingh very frequently for jobs and study. Poor people also visit Mymensingh town to work as construction/transport labourers.

Majority of women visited Mymensingh town on many occasions for various reasons like treatment, visiting relatives, shopping etc. Women are able to visit Upazila health centre and the nearest Upazila town by themselves. Many of the women are able to go to the district HQ alone.

4.3.8. Violence

People stated that violence is not a big factor in this area. There is no incidence of fish theft because most of the villagers are involved in fish culture. Villagers give fish to the poor (free) during fish catching or on social occasions. The women frequently go out for work and education.

4.4. PRA Results Shattati

MAEP Phase II

Mouza: Shattati (favorable village)

Union :Agaia

Thana :Purbadhala

4.4.1. Technology Transfer:

About 70% of households in this village are involved in fish culture or fish related activities of which 30% are involved in rice fish cultivation. Most of the people in the village are aware of fish culture following modern technologies.

Danida supported NGOs inspired the people in this village for pond and rice-field fish culture during mid 90's. The village people were organized in groups by the NGOs and received training on fish culture and fish related training from NGOs and Danida. Many people did not join in the group but learned the fish culture technology from neighbours or through farmer-to-farmer communication. About 25% of fish farmers in this village follow the improved/modern technology that was fully learned from training and demonstrations, 50% of farmers follow partial messages from the training sessions and the remaining 25% follow the traditional approach.

The people following the traditional approach gave the following reasons:

The people who followed the training and demonstration messages for fish culture understand the importance of additional feed for fish and therefore give additional feed to their fish. They know about the importance of water quality and the maintenance of the ponds. Some of them also know how to handle fish diseases, etc. There are many farmers in the village making good profit from fish culture using Danida messages about fish culture. In they have a problem in fish culture they take advice from more experienced farmers because there has been no support from Danida for the last 4-5 years.

Some people who have profitable multiple livelihood strategies and some poor people having limited resources are involved in fish culture but do not follow the training messages. The first category is not serious about fish culture, because they have little time to look after the fish or are less interest in fish culture. These people realize that they are not getting good production. The second category have financial crisis, which limits them from serious fish culture. Some people do not understand the messages of the modern techniques of fish culture thus they feel it is cumbersome and there are problems to procure good fingerlings, feed, diseases treatment and marketing etc.

The people in the village mentioned the limitation of marketing facilities, and the reason for it is gradual deteriorating condition of road from the villages to the Upazila HQ and towns over the years. Due to this limitation they cannot sell their fish outside individually.

In cases of serious fish diseases they have to visit the office of the Upazila Fishery Officer with samples of the affected fish. Fishery office people never visit their village or their pond but many Danida fishery officers and some government people visited their village during the project tenure.

However, the people stated that, even with all the above-mentioned problems and limitations the fish culture is expanding slowly in the village and some of the villagers have started fish culture in the rice fields during the *Aman* season.

4.4.2. Impact

According to the priority and importance the village, people ranked their livelihood strategies as follows:

- Agriculture (rice production)
- Poultry/live stock raising
- Day labouring
- Rickshaw/van pulling
- Fish culture
- Fish catching/selling
- Small business
- Service (Job in GO/NGO)
- Fish nursery
- Shop keeping
- Construction labour
- Tailoring
- Power tiller
- Threshing mill
- Rice husking mill
- Mechanics
- Tree nursery
- Saw mill

The villagers stated that due to introduction of new technology in modern variety cultivation, expansion of improved fish culture and expansion of road network and other infrastructure projects, new employment opportunities have been created for the village population.

Women are also involved in some fish related activities like pond maintenance and feeding; apart from these activities they are active in production of vegetables in and around the homestead and ponds. About 25% of fish farmers engage hired labour for annual/periodical maintenance of ponds. The remaining 75% of farmers do these jobs using family labour. In cases of family labour involvement, women are involved in 60% of cases.

4.4.3. Well Being

The people in the village recognized that their livelihood situation has improved a lot over the period. The following improvements are very prominent:

- Improved food consumption
- Many people are free from debt
- Improved housing conditions
- Many people could release their mortgaged property and some could purchase land
- Able to send their children to school.
- Family income has increased

The villagers indicated three major reasons for their improvement:

- Increased modern rice cultivation in the area
- Increased mobility and opportunities of diversified employment in non-farm sector
- Fish culture increased

4.4.4. Sustainability

People are interested in fish culture but progress is slow. The major threat to fish culture in this area is the low market price of fish. They feel the following reasons are responsible for this:

- Shortage of quality fingerlings
- Fish diseases
- Forced to sell their fish with low price through middlemen like *Paiker/Faria/Aratder*
- Lack of extended market facilities

They feel the solutions to overcome these problems are as follows:

- Establishment of hatchery and nurseries
- Role of DOF should be increased to solve the problem of fingerlings and diseases
- NGO support should be re-established to provide services related to fish
- Facilities should be created (including linkage development) to sell fish in the bigger markets in towns and cities directly

During the Danida period many fishery people used to visit the village and there was no problem getting suggestions and information on any fish related problems. Upazila Fishery Officers also visited the village frequently but presently nobody visits their village and they no longer get any good services. However, NGO people still visit their village and provide fish related suggestions. Their suggestions are not bad but it does not contain advance technologies and/or messages for improved alternative approaches.

4.4.5. Impact on Gender Issues

Many women are NGO group members and have received credit for income generating activities. They have also received training on fish culture from the Danida supported local NGO. They learned many techniques and are experienced in pond fish culture. Female members of 60% of households are involved in fish culture related activities and women very often perform the following activities:

- Purchase fish feed and quality assessment of feed
- Feeding fishes and fertilizing fish ponds
- Selecting/sorting good fingerlings during purchase of fingerlings from paiker.
- Stocking fingerlings
- Maintenance of ponds
- Vegetable cultivation in and around the homestead and ponds.

- Occasionally some women catch fish by hook or small net

The female family members do not go to the market to sell fish and they generally do not get involved in fish marketing.

Decision Making Process

Women are participating or influencing more in decision-making processes regarding family level activities. They usually visit the health centre alone or take someone with them in cases where the husband is absent. They are able to spend money if they feel it is urgent/important.

In general husband and wife take joint decisions for major investments such as house repair, sending children to school, purchase of cattle, marriage, etc but in absence of husband wives take decisions in emergency situations which do not involve major investment.

Women are more empowered in decision-making processes if their husbands have migrated to work in the cities or abroad. The wives take decisions that they later discuss with their husbands.

As women are involved in income generating activities and contributing towards family income, in such situations they feel more confident in creative activities. They have stated that their conditions are better than their mothers and grand mothers. They also stated that there is no female harassment (due to the changed situation) from their husbands.

4.4.6. Impact on the Environment

People do not use pond water if they use cow dung for fish culture. Most of the people use tube well water for domestic and drinking purpose. Some poor people who have no frequent access to the tube well they use small quantities of cow dung in the ponds. This enables them to use the pond water for bathing and cleaning of clothes, but they never use pond water for drinking purposes.

People do not use chemicals for cleaning of fishponds. Pond water becomes polluted during the dry season and increases scabies.

4.4.7. Crisis Coping

People recognize that the mid May to mid July and mid November to mid January are the best months in the year and worst months are mid September to early November and March to early may. During these bad months poor people face food crisis and small/ marginal farmers can manage food but they do not spend money for cloths (details are in the bar cart). 10 years ago the situation was much worse.

Presently they cope with the seasonal crisis by:

- Selling poultry birds and livestock
- Fish culture
- Selling vegetables
- Consumption of savings
- Consumption loan
- Outwards migration in towns/cities for construction/transport labour
- Mortgage land

- Women engage themselves in domestic work for neighbours
- Reduce food consumption (2 meals instead of 3 meals)

4.4.8. Mobility

100% of men have visited Mymensingh and 75% have visited Dhaka in search of jobs and other activities. Poor people regularly migrate out in the crisis months to work as construction/transport labourer in the towns and cities.

Women are able to visit the Upazila health centre. 25% of women have visited district HQ and 10% have visited Dhaka. The situation was different 10 years ago.

People stated that the reasons for increased mobility are:

- Improvement of Communications
- NGO intervention
- Increased income
- Find new jobs
- Fish culture – to get good fingerlings etc.

4.4.9. Violence

People stated that violence is increasing gradually – because of political instability and conflict. Numbers of *Touts* and *Butpers* has increased and they try to influence/interfere in all social and public activities. The influence of village leaders has been reduced. Currently the good village leaders do not feel encouraged to join in the village arbitration. Gradually the conflicts regarding natural resources and social issues are addressed by *Thanas* and legal institutions.

In some cases the victims of violence are not in a position to demand justice because of the power of *Mastans* and *touts*.

4.5. PRA Results Longair

Mouza:Longair (unfavourable Village)

Union :Langair

Thana :Goaffargaon

4.5.1. Technology Transfer:

Most of the people who have ponds or water bodies in this village have received training on fish culture. Male and female members were organized by NGO and formed into groups. These training sessions were organized into male and female groups by NGOs supported by Danida. Most of the villagers are doing fish culture following modern technology. Before Danida's intervention, villagers used to do fish culture in their ponds only following the traditional approach.

About 25% of fish farmers in this village follow the improved/ modern technologies fully learned from training and demonstrations. 50% of farmers use partial messages from trainings together with experience from previous fish culture. The remaining 25% follow the traditional approaches. Following the training and demonstration messages for fish culture, many farmers are now getting much higher production per unit area. On average they produce about 12 Kg per decimal. Fish culture in low-lying rice land is reported by the people in this village

In terms of fish related services they usually get these from the NGOs. They also have communication with the Upazila fishery officer but he does not visit the village. If there is a problem, villagers visit him at his office for advice.

In this village about 50% of people engage hired labour for their pond maintenance. The remaining 50% of people engage family labour. In those ponds 30% of households utilize female family members in order to reduce costs.

In this village the usual harvest cost is about 20% of catch value. However, the harvest cost is dependant on fish size and concentration. In some cases harvest costs come down to 10% of the catch value. Sometime the pond owner goes to market with the harvester during the fish sale in the market. 25% of the fish are sold in the market and 75% are sold to *paikers*.

4.5.2. Impact

Ten years previously the major activity was agriculture – rice production and latterly vegetables. After the NGO intervention people were encouraged to start fish culture. They started fish culture in an organized way in 1994/5. The villagers indicated that fish culture is a profitable business. In this village, fish culture is an important activity, which is also reflected in the priority of the livelihood strategies of the villagers.

The livelihood strategies of the village people are presented here with priority ranking:

- Agriculture
- Fish culture
- Poultry birds and livestock
- Rickshaw/ van pulling
- Small trading/shop keeping

- Day labour
- Earth cutting
- Construction labour
- Fish selling
- Industrial/factory labour
- Service/job in GO/NGOs
- Fishermen
- Rice threshing
- Power tiller operation
- Plant Nursery
- Cottage industry
- Cooking
- Net making
- Mechanics

Women are involved in fish related activities; pond maintenance, feed making and feeding fish, apart from these activities they are active in production of vegetables in and around the homestead and ponds.

4.5.3. Well Being

Over the years, the village people from all categories have been able to make improvements in their livelihood situation. However, the poorest people also made some improvements but not as much as the others did.

The villagers have invested their savings or earnings in the following items:

- Improved food consumption
- Improved housing condition (some could make tin made roof)
- Many people are free from debt
- Some people could recover land from mortgage or purchase land
- Installed hand tube wells for drinking water and constructed sanitary latrine.
- Able to send their children to school.
- Employment opportunities increased

The villagers have indicated three major reasons for their improvement:

- Increased modern rice cultivation in the area
- Fish culture increased
- Improved road communications increasing mobility
- Employment opportunities created in non-farm sector.

4.5.4. Sustainability

Fish culture is gradually increasing in the area. People have not faced any problems so far, so were unable to comment about threats concerning sustainability. However, they need increased support regarding fish culture. Presently NGO's are active in credit activities and help villagers in all regards however, the NGO people do not have a strong background regarding fish related expertise. In addition, the fish farmers mentioned that they do not get any on site support services or technical advice from the Upazila Fishery Officer.

4.5.5. Impact on Gender Issues

Women are now involved in fish culture and contribute towards the family income. In case of female family members, 60% of them are directly or indirectly involved in fish culture or fish related activities. They don't get involve in fish marketing; however, many of the following activities are often performed by the women:

- Maintenance of ponds
- Feeding fish and fertilizing of fish ponds
- Vegetable cultivation in and around the homestead and ponds
- Stocking fingerlings
- Arrange swimming to oxygenate pond water.
- Occasionally some women catch fish by hook or small net

Participation of women is gradually expanding more in decision-making process at the family level. In general husband and wife take decision jointly but the husband's opinions get priority in major investment issues such as house repair, sending children to school, marriage, purchase of land/cattle etc.

They usually visit the health centre alone and they are able to take decisions and spend money if they feel matters are urgent or important – if their husbands are absent. The situation was much worse 10 years ago.

4.5.6. Impact on the Environment

People do not use pond water if they use cow dung or poultry litter for fish culture. Most of the people use tube well water for domestic and drinking purposes. Some poor people who has no frequent access to the tube well they use small quantities of cow dung in the ponds. This enables them to use the pond water for bathing and cleaning of clothes, but they never use pond water for drinking purpose.

People do not use chemicals for cleaning of fishpond. Pond water becomes polluted during the dry season, and causes increase in scabies incidence.

4.5.7. Crisis Coping

People recognized that the mid April to mid August and mid November to mid January are the best months in the year and worst months are March to April and mid September to October. During these two bad periods some poor people have some food crises, but the small and marginal households can some how manage food but have no spare money for clothes (details are in the bar cart). Presently they cope with the seasonal crisis:

- Selling poultry birds and livestock
- Selling vegetables
- Fish selling
- Consumption of savings
- Consumption loan
- Outward migration for transport/ construction work
- Mat making
- Tapestry making
- Reducing food consumption
- Women engage themselves in domestic work for neighbours

4.5.8. Mobility

People in this village are well connected with the towns. People from all categories frequently travel to Mymensingh and Dhaka for jobs and study. Poor people also visit towns and cities to work as construction/transport labourers.

Sharifa Begum - Case Study

Sharifa Begum is living with her husband in the village. They have 2 sons and 1 daughter. Initially they were living in an extended family unit with her mother-in-law, in poor social conditions. Now they have their own family. She received training from NGOs on fish culture and was given some credit. Using this knowledge and credit she and her husband started fish culture in the village. Her husband also engaged himself in agriculture as a share cropper and petty trading. Gradually they could manage some savings and using these savings they started a small grocery shop in the village. Now the husband spends more time in the shop and she manages fish culture, poultry, livestock raising and all domestic responsibilities with her skill and hard labor.

Sharifa and her husband mortgaged in 65 decimals of land – they grow rice there. They purchased 3 cows and 2 goats. In additions she has a number of poultry birds at her house.

She rented in 20 decimals of pond where she is culturing fish. She is now owner of 10.5 decimals of homestead land – there she constructed 3 houses of which one has a tin roof. They are planning to change the roofs on the other two houses. She is now growing vegetables around the homestead and has planted fruit trees.

She is not satisfied with these physical and natural assets, she is sending her children to the primary school in the village.

Presently they have no food crisis and they can manage winter clothes and other amenities as required by the family.

Women are able to visit Upazila health centre and the nearest Upazila town by themselves. Presently about 75% of women go to the local health centre for their treatment especially the pregnant mothers. 10 years ago 100% of childbirths took place in the village attended by a mid wife. Many of the women are able to go to the district HQ alone. However, mobility is less for women compared to men.

4.5.9. Violence

Theft of fish does not occur in this village. People stated that violence is not a big factor in this area. Many women go outside the village, they even travel to the town to work in the garment factories. Presently the women are involved in income generating activities, so,

husbands understand the situation - the status of the wife has increased due to their contribution to the family income. The level of understanding has improved over the period- the harassment of women by their husbands has reduced.

Whatever conflict there is, the role of the village leader is still prominent. They try to solve problems at the village level through arbitration.

4.6. Key Informant Interviews

4.6.1. Brahmaputra Fish Hatchery

The land area of this fish hatchery is about 10 ha of which the water area is about 7.3 ha, there is 0.41 ha of owned land and 4.1 ha of leased in land. In total there are 41 ponds; 25 ponds are for nursery and 16 ponds are for brood fish. The hatchery includes 5 sheds, 30 jars, 4 circular and one shed for poultry on 20 decimal of land. Present land value is about Tk.1,000 per decimal. Lease of land costs about 500 Taka per decimal. Total cost for establishing the hatchery is about Tk.1,500,000.

With this establishment the hatchery produces about 4,000 Kg. of spawn (4,000 kg spawn at an average price of Tk 2,500/kg i.e. a total gross income of Tk. 10 million). Among the carp; Mrigel 50%, Rui 3%, Silver carp 25% other carps 22%. In addition they produce 500,000 fingerlings at Tk.2.4 each. The total gross profit is Tk.11.2 million.

They have 18 full time staff and a seasonal staff of 40.

Most of the staff are from this village and have experience on fish related activities but no female workers are engaged there due to many outsiders visiting the hatchery (though the scope is there for them to work). They do not engage any law consultant, accountant or any educated expert for the hatchery. All fulltime staff receive regular salary even in the flooding period. In fact more people are required during the flood period. During festival the full time staff receives Tk.700-800 as bonus. They also receive medical support during illness.

Table 4-1: Staff Costs - Brahmaputra Fish Hatchery

Type of Staff/job	Number	Paid months	Cost Taka
Expert (Skilled)	1		Owner
Assistant Expert (Technically skilled full time)	4	7	160,000
Non technical (semi skilled)	14	12	336,000
Seasonal staff	40	8	640,000
Maintenance of ponds			120,000

(Flood year increases 50% cost for maintenance, 4 floods in the last 10 years. Badly affected species are *Pabda* and *Magur* brood fish – escaped)

Table 4-2: Value of Production and Operating Costs

Description	Taka
Fish feed	700,000
Medicine cost	300,000
Telephone bill	36,000
Net to protect fish	50,000
Fish netting	32,000
Market value of 30 tons of brood fish @Tk. 200,000/ton*	6,000,000
Expenditure for replacement of brood fish in a year	200,000
Electricity cost (9 months)	30,000
Equipment value	500,000
Total production & operational cost	1,848,000
Total cost (staff, production & operation) is Tk. 3,104,000 which is 28% percent of gross profit	

* not included in the total production and operation cost.

Last year 100 nursery farmers visited their hatcheries on a weekly basis. On average 2-3 additional visitors accompanied each nurseryman. These visitors became customers and this is how business expanded. The hatchery people always sell on a priority basis to their regular customers. Each customer purchases about 1 to 1.5 Kg of spawn 2-3 times in a season. About 95% of the hatchery production has been sold to the nurseries and the rest to the *Farias*. 1 to 2 *Farias* come to their hatchery and they do not like to deal with *Farias*. They create many problems – very often, they want false money receipts or less quantity of spawn in standard bags. They usually want to cheat the farmers and in this process the hatchery people do not like to involve them in this business. This type of activity is harmful for the reputation of the hatchery. The hatchery does not sell on credit.

- They procure fish feed from the local automatic rice mill
- They procure brood fish from 7-8 sources and assure that male and female brood fish come from different sources.
- He provides advice/suggestion to the nursery people based on what he learned from the training and booklets available from different sources. He provides the photocopies from the training manual and booklets.
- He also delivers lectures to some groups of farmers.
- He suggests to the new nursery people that they bring samples of water in order to check their water quality

The people who are working in his hatchery, have developed their livelihood over the period. All of them have been able to put a tin roof on their houses. They can save cash money as they get their salary, in cash, regularly. They are sending their children to school. They recognize their work as a regular job the same as the educated people do in the office and social status has been upgraded.

There are about 70 hatcheries in greater Mymensingh of which 57 are in Mymensingh district.

4.6.2. Harvest Groups

Harvest groups are generally formed by like-minded people in the village and groups consist of 4-7 members. They invest for equipment, nets and others tools equally and share the income equally. The harvest groups operate together to catch fish in open water and in the

ponds. Usually they catch fish from late May to February but the peak period for pond harvest is August to mid October and mid December to January. The peak periods for open water fishery are May to mid June and mid October to December.

They have other livelihood strategies, apart from fish catching, which are listed on priority ranking:

- Earth cutting
- Paddy harvest
- Transplanting of paddy
- Weeding
- Poultry and livestock raising
- Vegetable selling
- Rickshaw pulling
- Working in brickfield

Along with fish harvesting activities they usually get involve in the above activities. However, the intensity of the above-mentioned activities* increases during their lean period especially from January to mid May. Harvest groups consider that their situation is better now because of the generation of diversified livelihood strategies over the period. Ten years previously the situation was bad because the pond fisheries were not there and other employment opportunities were very much limited to day labour– Ag. labouring and earth cutting and very often people had to migrate temporarily to towns or cities for work.

Generally, small ponds (up to 8-10 decimals) are harvested by the owner while the bigger pond owners engage harvest groups. The harvest groups are engaged under three different arrangements:

- (a) Contractual arrangement - minimum Tk. 250-300 for one harvest - depends on pond size.
- (b) Share harvest 10-25% of sale value of harvest. However, the share depends on fish species, size and production.
- (c) They rent out their net to the small pond owner (Tk. 100) for a one-time harvest.

Generally they catch fish in the same pond for a long time because some of them are relatives, are from the same community and some because they became familiar to the pond owner.

The major source of income for the harvest group is fish catching. It is estimated that 75% of their income comes from fish catching and 25% comes from other activities as indicated above. The harvest group is involved in fish catching on average 20 days/months in the good seasons and daily income is about Tk. 80 to Tk.130. During the average period they earn about Tk. 50 to 80 per day. Out of their total income from fish catching - they earn 60% from capture fishery and 40% from pond fish harvest. Each group (4-5 members) catches fish about 30-34 Kg per day

Gradually the number of harvest groups is increasing; 10 years ago only 2 groups were in the village, 5 years ago 4 groups existed and now there are 12 groups. The increased number of harvest groups is not a problem because fish culture in ponds, water bodies and in the rice fields is increasing.

4.6.3. Housing

- 10 years ago there were no tin houses
- 5 years ago 2 households had tin houses
- Now 4 households have tin houses

4.6.4. Crisis Coping

10-12 years ago they had a serious food crisis in the lean period of fish catching this has reduced drastically. Now they can catch fish about 9 months in a year and diversified employment opportunities are available during the other months of the year. Now they can afford to send their children to school

4.6.5. Fingerlings Sellers (*Pona Paiker*)

Fingerlings sellers are known as *Pona Paiker* in the villages and they like to introduce themselves as *Pona Paiker*. During the Focus Group Discussion 6 *Pona Paikers* were there. Out of 6 *Paikers*, 3 have been involved in this business for 17 years and the other 3 have been involved for 5/6 years. The new people joined in *Pona* business because they discovered that the senior people are making a good profit from the *Pona* business and it has improved the wealth of their families. Previously the young *Pona paikers* had hard times- it was difficult to mitigate the family needs by only doing day labouring. They had insufficient money to start *Pona* business. However, some nursery people helped them to buy the pots and getting *Pona* by partial credit.

Pona paikers usually procure *Pona* from several nurseries because one nursery cannot supply all of their *Pona* demands – in terms of species, size, quantity and quality. The *Pona paikers* used to sell *Pona* in their own *Thana* and in the nearby districts. Their market is not good if the nursery is not near or linked by a reasonable road network. The *Pona* sellers generally sell *Pona* from April to October but they sell most from April to June and one seller usually deals with an average of 150 fish farmers in a year. There is still demand of fingerlings in the market during lean months but the supply is on order only.

They received training from the project and they participated in further training 2 months ago offered by the project. *Pona Paiker* advises the pond farmers using their knowledge gained from training and farmer to farmer information. Demand of Grass carp, Silver carp, *Catla* and *Shar-puti* fingerlings is more popular because they grow faster. *Pona Paikers* prefer male customers to female customers because they bargain the price and are very choosy. According to their observation, the women understand the fish culture much better than the men do.

The major threats in their business are:

- Growth of nursery
- Increased price of fish feed
- Shortage of quality fingerlings

Pona Paikers earn income from fingerlings selling about Tk. 90 to 120 per day during the season. Their major source of income is selling of fingerlings; it is estimated that 50% of their income comes from fish selling and the other 50% comes from other activities as follows:

- Earth cutting
- Paddy harvest
- Transplanting of paddy
- Weeding
- Poultry and livestock raising
- Shop keeping
- Vegetable selling
- Rickshaw pulling
- Working in brickfield

In their village presently about 100 people are involved in *Pona* business, 5 years ago the number was about 22 and 10 years ago it was only 10 -12.

Their situation is much better now compare to the situation of 5 years ago. Out of 6 *Pona* sellers 5 persons improved their thatch house to tin made house.

4.6.6. Nursery Owner Interview

During the Focus Group Discussion 7 nursery owners were present. Ten years ago only 5-6 nurseries existed, 5 years ago it increased to 30 and presently there are about 80 nurseries in the area. The Average water area of a nursery is about an acre (0.46ha), which typically has about 3 ponds, and each pond is about 30 decimals (0.12 ha). 85% of nursery owners have developed their nurseries on their own land and 15% of nurseries are on leased land.

Table 4-3: Financial information - Nursery

Market value of land for nursery is about Tk. 2000/dec*100dec	200,000
(In case of lease land rent is about Tk. 100/dec*100dec	10,000
Excavation cost of nursery ponds Tk. 2000/pond*3nos	6,000
Purchase of pump set	25,000
Construction of one shed	200
Hired labour for nursery Tk. 1500/month*12months	18,000
Maintenance cost for 3 ponds about 35 day labourers	2,450
Fish fry 3Kg for one acre of nursery (15-20gm./decimal)	5,500
Diesel for pump operation	2,000
Fish feed	11,000
Medicine/chemical	2,000
Purchase of net	2,000
Pots and others	300
Total	274,450

The Annual profit of a nursery is about Tk. 35 thousand. They produce following fingerlings:

Sharputi	50%
Silver carp	25%
Grass carp	8%
Rui	8%
Catla	8%

(They sell at 28 Paisa per *pona*)

85% of *Pona* are sold to *paiker* and 15% are sold to pond farmers directly.

Initially most of the Nurserymen were dependant on agriculture, gradually started pond culture and rice-fish and later as nurserymen. Most of the nurserymen were marginal (40%) and small farmers (60%), later some middle class farmers joined the business. Presently most nurserymen are solvent and established in their community.

Nazimuddin - Case Study

Initially Nazimuddin was a share cropper in agricultural farming and during the crisis periods he sometimes undertook laboring for his relatives. He had no agricultural land and stayed at his uncle's house. He started a Nursery with 20 decimals of pond and now he operates 6 ponds which cover a land area of about 360 decimals. Out of the 360 decimals, 320 decimals is water area. About 40 people are engaged from time to time but 4 people work regularly with a fixed monthly salary; 3 people receive Tk.1,500 and the other one receives Tk.2,000. Last year he sold fingerlings for about Tk. 300,000. There are still fingerlings in his nursery, the value of which would be about Tk. 200,000 to Tk. 250,000.

He has now purchased 35 decimals of land and has constructed his own house there. The house is made of tin and its floor is concrete. He has purchased one TV, Music system and good quality furniture and has installed a hand tube well for drinking and domestic purposes.

He has 4 children; 2 daughters and 2 sons. The elder daughter is now an adult, she has completed primary education. One son and one daughter are studying in the primary school and the youngest is an infant. His wife is responsible for looking after the children and all other domestic work; in addition, she looks after the nursery pond located behind the house.

His wife does not participate in fingerling selling. She has received training from her husband and learned further by looking after the nursery pond herself.

4.6.7. Visit to a prawn farm

Abdul Hakim is a diploma holder in agriculture and working in BADC. He started fish culture in 1981 and received training from government institute. In 1993 he received training in prawn farming since then he has started prawn culture. However, at the same time, he also remains engaged in fish culture.

He was making good profit out of prawn culture but this year the local and international market is bad because of 11th September, 2001 incident in the USA. The present selling rate is about Tk.200 per Kg, which does not even cover the production costs. Therefore, he did not sell any prawn this year. Initially he was procuring PL from *Mash Kanda* Danida supported hatchery. Presently he collects PL from Gazipur BRAC hatchery.

He usually checks the market price before selling. In this process, he also checks Dhaka market and sometimes he communicates with the extended market using a mobile phone. Sometimes Dhaka market people suggest that he brings prawn to Dhaka but he does not do this because without a confirmed deal the traders will not honour the agreed rate.

4.6.8. Wholesale market

A Focus Group Discussion was held in *Mymensingh* New Market with 4 *Aratders*. 10 -12 *Aratders* and about 65 fish vendors are active in New Market. In addition, 25 fish vendors come from different small markets and sell at their respective markets.

About 25-30 *Beparies* generally bring their fish to sell in this market and the *Aratder* sells fish by auction on behalf of them. *Aratders* earn a certain percentage of commission on the

Nuru Bepary (Aratder) - Case Study

Nuru *Bepary* started his carrier as a Tea Stall Boy, later he became involved in ice cream selling then worked as a rickshaw puller. In 1980 he entered the fish business as a helper through a friend of a fish *Aratder*, after 5-6 years his boss discontinued his fish business. From that time Nuru started the *Aratdary* business with one of his friend under partnership arrangement. Since 1995-96 he is doing business independently.

Presently he earns about Tk 8 – 10 thousand per month. Now he is residing in a rented house but he purchased a small plot in *Mymensingh* town for building a house in the near future. He has a small family; wife, 3 children and a mother. One son is studying in a famous public school, one daughter is studying in a good kindergarten school, the youngest child is only 18 months old. His wife does the domestic work and looks after the children.

Danida introduced them with the pond farmers and they were acting as an information center. Following their information they were contacting the farmer and purchasing fish from them on credit under the informal guarantee of Danida people. In this process the fish farmers could joined in the extended market and they could established themselves. However, after certain period Danida was not there and the relationship developed with the fish farmers. From that period many fish farmers bring their fishes directly to us.

The major threats of fish business are:

- Bad weather
- Power Failure

sale value of fish. The fish vendors purchase fish from the *Aratders* and sell them to individuals. On an average each *Bepary* brings about 50 to 70 Kg. of fish per day. Each *Aratder* sells 50 -70 Kg. of fish per day. Each fish vendor sells about 20 to 25 Kg fish per day. Each *Aratder* has their fixed or semi fixed *Beparies*. Generally each *Aratder* deals with 1 to 2 *Beparies* per day. More fish are available in February and March from *Beel* and in June to August from ponds. However, the fish business of *Beparies*, *Aratders* and vender is very dependent upon supply, market demand and the weather.

Initially most of the present *Aratders* purchased fish directly from the harvest site. Now that the market has been expanded many people (*Beparies*) are involved in the marketing process. The *Beparies* usually purchase open water fish directly from the harvesters. Pond fish are also purchased from the pond site, sometimes they purchase through middlemen and/ or from small *Arats* for open water and pond fish. *Beparies* bring their fish by bus (on the roof), pickup, train and rickshaw/van.

One *Aratder* sells on average 60 Kg per day

10 *Aratders* * 60 Kg = 600 Kg/ day

In order to maintain the market 8 labourers are engaged and the same labourers help the *Aratders* in the process of fish sales. In addition 2 more people are involved in selling ice for fish preservation purposes only and, 8 male/female workers are involved in water selling in

buckets. The fish vendors preserve their unsold fishes in an icebox to sell the following day. There is no incidence of fish theft because there are two guards in the market who are paid a monthly salary. In the whole market there is a *Bazaar Samity* (society) where all the fixed shop owners are the general members of the *Samity* and they elect an executive committee for their day-to-day activities. This committee is responsible for employing the guards and the management of the market. The fixed shop owners pay Tk. 20 per day to cover their various expenditures and from this fund they pay the guards.

5. Economic Impact

5.1. Methodology of Economic/Financial Analysis

Development expenditures such as the investment in the MAEP program is an investment that affects future productivity, income growth, environmental quality, food and farmer safety and the quality of rural life. Increased productivity means that more output can be produced with the same amount of total inputs or the same amount of output can be produced with a smaller quantity of inputs. At the industry level, a productivity-improving technical change typically results in both an increase in output and an increase in output per unit of input, while total inputs may fluctuate (Alston and Pardey, 1996). Productivity improvements lead to a reduction in costs per unit of output.

Economic evaluations of development expenditures increase our understanding of the payoffs to investing in alternative public or private investments. All investments have “opportunity costs” in terms of what those same resources could have earned in alternative uses. Economic evaluations can quantify net benefits in order to help funding agencies decide if they are making the correct decisions with respect to their investments.

For this study four types of economic impact are estimated:

- Household level income returns based on partial budget analysis (5.2 - Household: Costs and Returns)
- Economic Linkages: estimation of secondary jobs directly linked to pond aquaculture (5.3)
- Economic Surplus Generated (5.4)
- Project Returns as measured by Internal Rate of Return (IRR), Benefit-Cost Ratio (B/C), and Net Present Value (5.5).

5.1.1. Economic Surplus

For this study, the economic surplus method is used. This methodology is preferred because the economic surplus concept underlies the conventional economic rationale for development investments. This approach estimates returns on investments by:

Calculating the change in consumer and producer surpluses that result from technological change brought about through research and extension of results, and

The theory underlying the economic surplus approach is based on the material benefits to society from technological change. The adoption of new technology reduces the unit cost of production, shifting the supply curve to the right and increasing consumer and producer surpluses.

Consumers gain from the new technology because they can consume more at a lower price, and producers gain because their unit costs of production fall. The distribution of benefits between the two groups depends on the elasticity of demand and supply curves and on the nature and magnitude of the supply shift. The combined total benefit to consumers and producers, measured in monetary units, is the change in economic surplus. The basic formula for estimating the change in economic surplus in year t (ΔES_t) is:

$$\Delta ES_t = K_t P_t Q_t \frac{(1 + 0.5 k_t \epsilon \gamma)}{\epsilon + \gamma}$$

where: P_t is the price of a commodity affected by activity in year t ;
 Q_t is the quantity of production in year t of the commodity affected by the activity;
 ϵ is the elasticity of supply;
 γ is the elasticity of demand; and
 K_t is the proportionate downward shift in the supply curve in year t due to investment.

A basic economic framework can be used to measure the economic effects of productivity changes and of certain other types of induced changes. That framework includes:

A supply and demand model of a commodity market to measure economic benefits at each of several points in time and

The basic supply and demand model, as described in Alston and Pardey (1996), is represented in **Figure 3**. In this model, S_0 represents the supply curve before induced technical change, and D represents the demand curve. The initial price and quantity are P_0 and Q_0 . Suppose program activity leads to savings of R per unit in the average and marginal cost of production, reflected as a shift down in the supply curve to S_1 . This induced supply shift leads to an increase in production and consumption to Q_1 (by $\Delta Q = Q_1 - Q_0$) and the market price falls to P_1 (by $\Delta P = P_0 - P_1$).

Consumers are better off because the research enables them to consume more of the commodity at a lower price. Consumer's benefit from the lower price by an amount equal to his cost savings on the original quantity ($Q_0 \times \Delta P$) plus their net benefits from the increment in consumption. Although they receive a lower price per unit, producers are better off too, because their cost have fallen by R per unit, an amount greater than the fall in price.

Producers gain the increase in profits on the original quantity – i.e., $Q_0 \times (R - \Delta P)$ – plus the profits earned on the additional output. Total benefits are obtained as the sum of producer and consumer benefits. As an approximation, the cost savings per unit multiplied by the initial quantity, $R \times Q_0$, is often used.

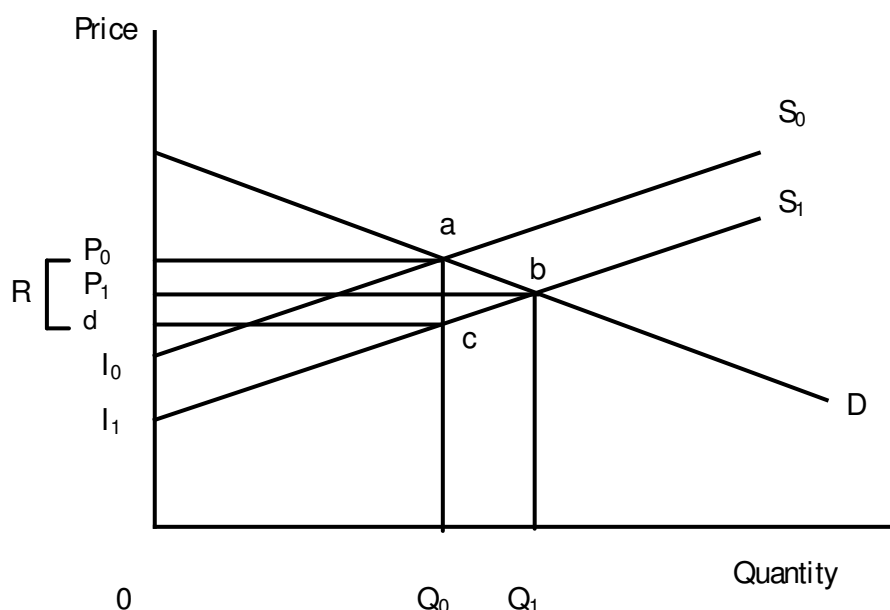


Figure 3: Basic Supply and Demand Model for Development Benefits

The areas in the figures above that represent economic benefits can be measured by simple equations provided in Alston, Norton, and Pardey, 1995. These areas (called economic surpluses) are measured on a year-by-year basis.

Using estimates of the annual flows of economic benefits and costs a variety of performance indicators can be developed.

5.1.2. Financial Analysis

The other part is the cost of public expenditure. The performance indicators used in the literature and in this report include:

1. Internal Rate Of Return (IRR),
2. Net Present Value (NPV), and
3. Benefit Cost Ratio (B/C).

In practice given a stream of benefits and costs spreadsheet programs such as excel can directly estimate these financial parameters. The actual formulas/methods for estimation are provided below.

The IRR is the interest rate, which makes the sum of the discounted net returns exactly equal to zero. The IRR can be interpreted to mean that on average, each Taka invested in research will return R percent annually from the date of the initial investment until the expiration of research impact. In other words if you received a bank interest rate equal to the IRR you would be indifferent in choosing between putting your money in the bank or the research. This is why if the IRR exceeds the “normal” interest rate then the investment is “recommended.

The formula for the IRR is presented below where: B_t = the annual benefits from t years into the future, C_t = the annual cost extended t years into the future, and r = the interest rate of return. The following equation when solved for r yields the IRR.

$$0 = \sum_{t=0}^{\infty} \frac{(B_t - C_t)}{(1 + r)^t}$$

The formula for the NPV is presented below where B_t = the annual benefits t years into the future, C_t = the annual cost extended t years into the future and, r = the discount rate.

$$NPV = \sum_{t=0}^{\infty} \frac{(B_t - C_t)}{(1 + r)^t}$$

The NPV is an amount of money that represents the current value of the research benefit stream. Again an individual would be indifferent between taking the stream of benefits or the NPV of that stream of benefits.

Given the projected benefits and costs can be calculated for each year. The benefit cost ratio can then be calculated as the NPV of benefits divided by the NPV of costs. The benefit cost ratio is calculated as follows:

NPV Total Benefit/NPV of public cost

5.2. Household: Costs and Returns

The carp polyculture technology extended by the MAEP requires limited input cost and is highly profitable. Table 5-1 shows that across the eight strata per decimal costs vary only from Tk 80 up to Tk 104. The table also shows that the cost per decimal between the Danida

target group (Tk 83) and non-target group (Tk 85) is essentially the same. This indicates that wealthier and poorer groups have adopted a similar set of low input high profit practices.

Table 5-1: Comparison of Average Cost/Decimal by Sample Strata

Strata	Average cost./dec.		Sample Type	Average cost./dec.
1 FNFMM	80		Pond Target	83
2 FNFNMM	104		Pond Non-target	85
3 NFNFM	82			
4 FNFNM	94			
5 FNFNMNM	62			
6 NFNMN	47			
7 NFNMN	72			
8 NFNMN	98			

Table 5-2 summarizes the returns or profitability of MAEP extended carp polyculture.¹¹ Profits range from Tk 282 per decimal up to 747 per decimal. This shows that the technology is highly profitable but is also dependent on local conditions, low returns are in more remote areas and areas subject to flooding. The simple average profitability is Tk 475 per decimal.

Table 5-2: Summary of Carp Polyculture Profitability by Sample Strata

Strata	Harvested during last one year			Profitability	
	Average Nos./dec.	Average harvest (in kg)/dec.	Average T. value (in Tk.)/dec.	Average T. Cost (in Tk.)/dec.	Average T. Profit (in Tk.)/dec.
1 FNFMM	39	12	536	80	456
2 FNFNMM	99	14	625	105	520
3 NFNFM	63	14	572	82	490
4 FNFNM	61	15	593	94	498
5 FNFNMNM	184	23	809	62	747
6 NFNMN	46	8	329	47	282
7 NFNMN	45	10	447	72	374
8 NFNMN	57	13	531	98	433
Simple Average	74	14	555	80	475

5.3. Economic Linkages: Job Creation

The scale of the MAEP impact has also resulted in the direct generation of substantial numbers of jobs linked to the production and marketing of fish. Table 5-3 details the types and numbers of direct jobs generated (excluding the pond owner/operators). The approaches for estimation of each job category are detailed in the table. The approaches used were conservative and represent an underestimation of the jobs linked to the fishery sector.

Conservatively over 225,000 jobs are directly linked to the fishery sector in the seven greater Mymensingh area districts. The vast majority of these jobs are of a type that the Danida target group will benefit. The largest single categories of jobs are *Faria* (small trader), *Beparies*

¹¹ It should be noted that these returns represent returns to labor and management. Only cash costs have been calculated.

(medium trader), retailers, and labor hired for fish production. The anecdotal evidence from the study PRA and key informant interviews indicate that many poor households have taken advantage of jobs that have become available in the fishery sector, moving above the poverty line.

Table 5-3: MAEP direct job creation

Job Type	Number of labor days per year	Number of full time equivalent Jobs per year	Calculation approach
Hired Labor for Production	5,054,555	16,849	Survey data from households for hired labor
Netting Groups	1,544,447	5,148	Survey data from households for hired labor
Marketing (Faria)	23,419,333	73,185	Key informant surveys in markets
Marketing (Beparies)	11,709,667	36,593	Key informant surveys in markets
Marketing (Aratder)	5,854,833	18,296	Key informant surveys in markets
Marketing (Retailer)	17,564,500	54,889	Key informant surveys in markets
Marketing (Labor)	4,160,000	13,000	Key informant surveys in markets
Hatcheries Full Time	212,800	665	Key informant interviews based on number of hatcheries and numbers of staff
Hatcheries Seasonal	336,000	1,050	Key informant interviews based on number of hatcheries and numbers of staff
Nurseries	896,000	2,800	Key informant interviews based on estimate per district, likely an underestimation.
Fry Traders	988,446	3,089	Based on key informant interview with a ration of 150 farmers per fry trader and active during 1/3 year
Total	71,740,582	225,564	

Assuming a conservative yearly wage of 22,500 per average fishery sector worker this implies that total yearly wages generated from fishery sector jobs is over five billion Taka (USD 89 million).

5.4. Economic Surplus Generated

Table 5-4 presents the key variables and results of economic surplus calculation. Annual surpluses generated are compared from before the MAEP efforts to the current market situation.

Table 5-4: Economic Surplus Calculation Variables

Description	1989	2001	Change in %
Price (Tk/MT)	32,979	42,320	28.3%
Quantity (MT)	85,465	351,290	311.0%
Demand Elasticity	1.00	0.70	-30.0%
Supply Elasticity	0.50	0.50	0.0%
Producer Surplus (Tk/Year)	2,805,000,000	14,700,000,000	424.1%
Consumer Surplus (Tk/year)	1,402,500,000	1,052,000,000	-25.0%
Total Surplus (Tk/year)	4,207,500,000	15,752,000,000	274.4%

Notes: Elasticity and price information from Fisheries Sector Review study. All prices are in current Taka.

The results show a dramatic increase in societal welfare as measured by total economic surplus. Economic surplus rises from Tk 4.2 billion in 1989 to 15.8 billion in 2001 or in USD

terms from 74 million in 1989 to 276 million in 2001. It should be noted that this dramatic increase in welfare came from producer surplus as consumer surplus decreased by about 40% because of the increase in fish price.

5.5. Project Returns

The returns the GOB/Danida investments are summarised in Table 5-5 and detailed in Table 5-6. The costs estimated are approximate and include investment in BFRI before the MAEP project (as a lump sum), the direct project costs, the advisor costs, and the GoB/DoF costs.

Table 5-5: Summary of MAEP returns in USD

	Cost	Benefit	Net Benefit
Total	28,668,000	1,408,000,000	1,379,000,000
NPV*	14,101,000	386,000,000	372,000,000
BCR=27.4		IRR=242%	

* NPV is calculated using an interest rate of 15%

The returns to the project are extremely high. The net present value (NPV)¹² of the project investment is USD 386 million, the Benefit cost ratio is 27:1, and the internal rate of return is 242%.¹³

Table 5-6: Project returns in USD

	Cost	Benefit	Net Benefit
1989	8,689,033	-	-8,689,033
1990	713,688	15,478,827	14,765,139
1991	1,286,785	30,957,654	29,670,869
1992	943,210	46,436,482	45,493,272
1993	1,071,409	61,915,309	60,843,900
1994	1,259,029	77,394,136	76,135,107
1995	1,737,958	92,872,963	91,135,006
1996	1,827,966	108,351,791	106,523,825
1997	1,662,231	123,830,618	122,168,386
1998	2,076,212	139,309,445	137,233,233
1999	1,766,609	154,788,272	153,021,663
2000	1,981,678	170,267,100	168,285,422
2001	1,940,296	185,745,927	183,805,630
2002	1,712,857	201,224,754	199,511,897
Total	28,668,962	1,408,573,278	1,379,904,316
NPV*	14,101,874	386,544,951	372,443,077
BCR=27.41		IRR=242%	

* NPV is calculated using an interest rate of 15%

It should be noted that the results presented here do not include the indirect benefits generated in input supply and marketing operations. These benefits include extensive employment for poorer members of society that DoF/Danida defines as its target group. These indirect impacts will be estimated in the main report. It should be noted that MAEP is not solely responsible for extension of polyculture in the project districts. Other projects,

¹² The NPV represents the present value that would be equivalent to the income stream.

¹³ The rate of return calculated by IRR is the interest rate corresponding to a 0 (zero) net present value. This is the level of interest for the initial investment equal to the project income stream.

DoF, and BFRI have contributed. However, DoF/Danida through MAEP and support to the BFRI¹⁴ has supported the vast amount of technology refinement and extension activities

¹⁴ The facility currently named the Bangladesh Fishery Research Institute (BFRI) was built by Danida in the 1980ies.

6. Conclusions and Recommendations

Currently, 396,000 poor rural families (the target population of the project), earn significant incomes from pond aquaculture resulting from project activities. These families now earn Tk. 3,600 (USD 63) on average per year from pond aquaculture, representing approximately 13% of their annual income. In addition, over 418,870 greater Mymensingh households (1.8 million people) would be below the Danida target group poverty threshold of Tk 40,000 in income per year if they were not engaged in MAEP promoted pond aquaculture.

The MAEP is one of the most successful development programs in Bangladesh and stands as an international development achievement of the first order.

Denmark has a long history of cooperation with Bangladesh in the fisheries sector. Danida's cooperation with the Department of Fisheries in Mymensingh started in 1977 with the construction of the Aquaculture Experiment Station (AES) and continues to this day in the form of Agricultural Sector Programme Support (ASPS).

Winrock International was engaged by Danida to assess technical, social and economic impact of the MAEP as well as to address the sustainability issues after completion of the project. Several intermediate impact studies have been conducted during the implementation phases of the project. These studies primarily focused on impact on the trainees. This study focuses on the impact on the Greater Mymensingh area, including Danida's target population.

The results clearly show a very impressive project impact:

6.1. General

The MAEP Programme has had a very positive impact and has achieved broad penetration of carp polyculture in the seven target districts. The number of adopting households (1.4 million) far exceeds the number of directly trained households through MAEP efforts (100,000). Currently, 396,000 poor rural families (the target population of the project), earn significant incomes from pond aquaculture resulting from project activities. These families now earn Tk. 3,600 (USD 63) on average per year from pond aquaculture, representing approximately 13% of their annual income. In addition, over 418,870 greater Mymensingh households (1.8 million people) would be below the Danida target group poverty threshold of Tk 40,000 in income per year if they were not engaged in MAEP promoted pond aquaculture.

Important impacts can be summarized as follows:

- In all, 1.4 million households have adopted pond aquaculture and are earning on average Tk, 8,283 per year (USD 145).
- Over 418,870 greater Mymensingh households (1.8 million people) would be below the Danida target group poverty threshold of Tk 40,000 in income per year if they were not engaged in MAEP promoted pond aquaculture.
- Average yield has risen from 4kg/Dec (1mt/ha) to 13.5kg/Dec (3.3mt/ha).
- Total yield has risen from 85 thousand metric tons (MT) in 1989 to 351 thousand MT in 2002.
- Danida target group households reported a higher yield than non-target, wealthier pond owners indicating the suitability of the MAEP approach for smallholders.

- 40% of Bangladesh's aquaculture production comes now from 10% of country's area
- Annual revenue from fish cultivation has risen from USD 48 million in 1989 to USD 252 million in 2001
- At least 68% of respondents use manure, 72% use fertilizer and 72% use lime.
- 61% of respondents were stocking 4 or more of the recommended species
- The Net Present Value (NPV) of the project investment is USD 386 million,
- The Benefit to Cost Ratio is 27:1, and
- The Internal Rate of Return is 242%.
- Economic surplus rises from Tk 4.2 billion in 1989 to 15.8 billion in 2001.
- Consumer surplus decreased by about 25%.

Furthermore, PRAs conducted among the target population have shown:

- Improved housing, education, and productive investments.
- That aquaculture income is critical to crisis coping strategies.
- Widespread involvement of the private sector.
- Women are positive to pond aquaculture.
- Poor families are able to adopt new practices.

6.2. Sustainability

The above impacts clearly show that farmer-to-farmer transmission and the role of input suppliers (hatcheries, nurseries, and fry traders) have been very important in the wider dissemination of carp polyculture. It also shows that carp polyculture is sustainable because:

- The general cultivation practices are well known in rural communities,
- The inputs needed for carp polyculture are widely available from a vibrant private sector input supply chain and
- The demand for fish continues to grow and local outlets are available for the rural poor to sell their production.

An extension of the program, in its current form, is not needed for the sustainability of MAEP induced changes/impacts. MAEP has achieved sustainability through the widespread adoption and knowledge of carp polyculture technology and the establishment of a private sector input supply chain including hatcheries, nursery operations, and fry traders.

Presently there is consideration of continuing MAEP activities by national NGOs under the supervision of the DoF. National NGOs would provide credit and training to Danida target group households, the training cost would be covered by the interest rate charged. The DoF would have a supervisory role, conducting adoption/knowledge tests to ensure that the program is being run effectively.

However the additional 7,000 poor households reached by means of the continued DoF/NGO partnership and use of the Tk. 40 million micro-credit fund will obviously make a continued positive contribution to poverty reduction in the 7-district area.

It is essential that emphasis should be placed on pro-poor aquaculture activities targeted at the poorest section of the rural community with access to a water source.

6.3. Recommendations

- **Implementation of the NGO Fishery Credit/Training Follow-up Program.** The NGO implemented fishery credit/training program should be highly focused on reaching rural poor households that have not adopted carp polyculture. The program should have very strong mechanisms to ensure that Danida target group beneficiaries are selected for training.
- **Monitoring of the NGO Credit Program.** It is recommended that the joint NGO/DoF monitoring of the program should be based on a random sample survey of trainee groups. The survey should include aquaculture adoption questions. The survey should also include an assessment of whether the households are new to carp polyculture production.
- **Application of MAEP Approaches.** The MAEP program has proven profoundly effective. The lessons of MAEP should be assessed and applied to fishery development programs across Bangladesh. While this impact study has not assessed the nature of activities undertaken by MAEP, it is clear that a strong technical focus in training and the development of a vibrant private sector input supply and marketing system are crucial to MAEP success.
- MAEP training materials and programs should be field tested in other Danida fishery programs and made available via the DoF extension Wing in Dhaka (Danida promoted information centre in the DoF entrance foyer). MAEP staff should also be utilized as resource people to assist other fishery programs learn from the MAEP experience and where possible engaged to work under new programs.

7. Annexes

Annex A

Table A - 1: Sample locations and sample strata.

S.N.	District	Upazila	Union	Mouza	HH	Popu.	Urban	Favoured	Flooding	MAEP I-II	MAEP Con.	Name	Strata	Use
1	Kishoregonj	Hossainpur	Sahedal	Sahedal	947	4,959	R	F	NF	M	M	FNFMM	3	1
2	Kishoregonj	K. Sadar	Chauddasata	Chauddasata	972	5,273	R	F	NF	M	M	FNFMM	3	1
3	Kishoregonj	K. Sadar	Jasodal	Salpa Jasodal	1,303	6,852	R	F	NF	M	M	FNFMM	3	1
4	Tangail	Madhupur	Madhupur	Tuniabari	61	365	U	F	NF	M	M	FNFMM	3	1
5	Gazipur	Sripur	Sripur H.Q	Sripur	1,830	10,271	U	F	NF	NM	M	FNFNMM	4	2
6	Tangail	T.Sadar	Paurashava		13,659	84,942	U	F	NF	NM	M	FNFNMM	4	2
7	Gazipur	Kaliakair	Fulbaria	Mothajuri	1,500	8,097	R	NF	NF	M	M	NFNMM	7	3
8	Gazipur	Kapasias	Torgaon	Chinaduli	242	1,377	R	NF	NF	M	M	NFNMM	7	3
9	Mymensingh	Fulbaria	Bakta	Kayerchala	1,186	6,417	U	F	NF	M	NM	FNFNMNM	11	4
10	Mymensingh	Trishal	Rampur	Darila	368	2,009	R	F	NF	NM	NM	FNFNMNM	12	5
11	Kishoregonj	Katiadi	Kargaon	Pachlipara	583	2,492	R	NF	F	NM	NM	NFFNMNM	14	6
12	Mymensingh	Bhaluka	Rajai	Sajangaon	87	442	R	NF	F	NM	NM	NFFNMNM	14	6
13	Tangail	Nagarpur	WB Duptiair	Bade Bhugolhat	138	629		NF	F	NM	NM	NFFNMNM	14	6
14	Mymensingh	Phulbari	Enayetpur	Kalagaon	569	3,282	R	NF	NF	M	NM	NFNFMNM	15	7
15	Mymensingh	M. Sadar	Kustia	Kushtia	1,007	5,658	R	NF	NF	M	NM	NFNFMNM	15	7
16	Gazipur	Kaliganj	Jamalpur	Jamalpur	1,547	8,717	R	NF	NF	NM	NM	NFNFMNM	16	8
17	Kishoregonj	Bajitpur	Baliardi	Yousuf darbar	804	4,236	R	NF	NF	NM	NM	NFNFMNM	16	8
18	Netrakona	Khaliajuri	Krishnapur	Jabadpur	43	228	R	NF	NF	NM	NM	NFNFMNM	16	8
19	Tangail	Delduar	Pazilhati	Fazilhati	793	4,952	R	NF	NF	NM	NM	NFNFMNM	16	8
20	Tangail	Kalihati	Paikara	Golora	256	1,431		NF	NF	NM	NM	NFNFMNM	16	8

Note that in each selected mouza / site 30 households were selected for a total of 600 households for the survey.

Annex B: Additional Tables and Information

Table B - 1 summarizes the relationship between the survey strata (summarized earlier) and measures of productivity and income. There was not a strong correlation between productive pond area, yield, and pond income per decimal or total family income except for the strata with the largest productive pond area, which also had the highest average total family income.

Table B - 1: Production Parameters by Survey Strata

	Survey Strata	Productive Pond Area in dec	Yield/Dec in KG	Pond Income/dec	Family Income
1	FNFMM	13.5	12.3	536	53,776
2	FNFNMM	17.9	13.9	625	55,102
3	NFNFMM	41.1	14.0	572	76,451
4	FNFMNM	8.4	15.1	593	63,388
5	FNFNMNM	7.3	22.8	809	45,455
6	NFFNMNM	10.7	8.0	329	42,689
7	NFNFNM	18.7	10.3	447	55,530
8	NFNFNMNM	25.7	12.8	531	52,342

Table B - 2 summarizes the same data by surveyed target and non-target farmers. The summary data indicate that target farmers, relative to than non-target farmers, had much smaller productive pond areas, about the same average yields and income per pond, and much lower total family incomes.

Table B - 2: Production Parameters by Sample Type

Sample Type	Number of Cases	Pond Area in dec.	Yield/Dec in kg	Pond Income/dec.	Family Income
Target Farmer Ponds	57	8.0	13.8	566	27,345
Non Target Farmer Ponds	145	22.7	13.4	557	99,476

The next set of tables (3-9) is based on a breakdown of parameters by sample type where the samples are target producers or non-target producers.

Table B - 3 and Table B - 4 summarize the breakdown between production of seed fish (fingerlings) and table fish. In general, non-target producers are more involved in table fish production.

Table B - 3: Fish Production by Sample Type

Sample Type	No. of cases	Fish Seed Production				Table fish production			
		<i>Dhani</i>	<i>Angule pona</i>	<i>Nola Pona</i>	Other	<i>Nola Mach</i> 100gm	Small fish 300gm	Big fish 1Kg+	Other
Pond-target	57	1		2		10	31	13	
Pond Non-target	145	1	2	3		22	101	53	1
Total	202	2	2	5		32	132	66	1

Table B - 4: Fish Production by Sample Type in %

Sample Type	Fish Seed Production				Table fish production			
	<i>Dhani</i>	<i>Angule pona</i>	<i>Nola Pona</i>	Other	<i>Nola Mach</i> 100gm	Small fish 300gm	Big fish 1Kg+	Other
Pond-target	1.8%		3.5%		17.5%	54.4%	22.8%	
Pond Non-target	0.7%	1.4%	2.1%		15.2%	69.7%	36.6%	0.7%
Total	1.0%	1.0%	2.5%		15.8%	65.4%	32.7%	0.5%

Table B - 5 and Table B - 6 set out a statistical summary of fish feeding practices classified between the two different samples of farmers. In general, target farmers used less of the recommended inputs than the target farmers. The key to increasing yields is to use a combination of these inputs.

Table B - 5: Fish Feeding Practices by Sample Type

Sample Type	Manure		Fertilizer		Green Feed		Dry Feed			Balanced Feed		Lime	
	Cow	Poultry	Urea	TSP	Aquatic Plant	Leaves / Grasses	Rice Bran	Oil cake	Other	Factory made	Home made	Before stock	After stock
Pond target													
Non-response	6	6	6	6	6	6	6	6	6	6	6	6	6
No use	21	41	25	25	40	33	7	24	48	50	49	19	24
Irregular use	25	10	25	25	11	17	37	24	3	1	2	23	20
Regular use	5		1	1		1	7	3				9	7
Total	57	57	57	57	57	57	57	57	57	57	57	57	57
Pond Non-target													
Non-response	16	16	16	16	16	16	16	16	16	16	16	16	16
No use	37	97	26	35	86	68	14	44	123	127	126	31	43
Irregular use	62	28	80	71	33	49	72	59	2		1	52	51
Regular use	30	4	23	23	10	12	43	26	4	2	2	46	35
Total	145	145	145	145	145	145	145	145	145	145	145	145	145
Total	202	202	202	202	202	202	202	202	202	202	202	202	202

Table B - 6: Fish Feeding Practices by Sample Type in %

Sample Type	Manure		Fertilizer		Green Feed		Dry Feed			Balanced Feed		Lime	
	Cow	Poultry	Urea	TSP	Aquatic Plant	Leaves / Grasses	Rice Bran	Oil cake	Other	Factory made	Home made	Before stock	After stock
Pond target													
Non-response	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%
No use	36.8%	71.9%	43.9%	43.9%	70.2%	57.9%	12.3%	42.1%	84.2%	87.7%	86.0%	33.3%	42.1%
Irregular use	43.9%	17.5%	43.9%	43.9%	19.3%	29.8%	64.9%	42.1%	5.3%	1.8%	3.5%	40.4%	35.1%
Regular use	8.8%		1.8%	1.8%		1.8%	12.3%	5.3%				15.8%	12.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Pond Non-target													
Non-response	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%
No use	25.5%	66.9%	17.9%	24.1%	59.3%	46.9%	9.7%	30.3%	84.8%	87.6%	86.9%	21.4%	29.7%
Irregular use	42.8%	19.3%	55.2%	49.0%	22.8%	33.8%	49.7%	40.7%	1.4%			35.9%	35.2%
Regular use	20.7%	2.8%	15.9%	15.9%	6.9%	8.3%	29.7%	17.9%	2.8%	1.4%	1.4%	31.7%	24.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.3%	100.0%	100.0%

Table B - 7 summarizes inputs and sources of inputs for producers as well as the numbers using each input by target and non-target producers

Table B - 7: Summary of Input Use by Sample Type

Name of items used	Numbers possessing ponds	Numbers using the item	Total amount used in kg/dec.		Average No. of days/dec.		Cash cost for the work/dec.
			Own source	Purchased	Own source	Purchased	
Lime							
Pond target	57	29		2.09			10.96
Pond Non-target	145	101		1.28			7.86
Urea							
Pond target		28		1.30			8.75
Pond Non-target		97		1.18			7.74
TSP							
Pond target		25		1.73			24.17
Pond Non-target		88		1.44			17.93
Cow dung							
Pond target		14	26.10	2.56			0.57
Pond Non-target		60	18.32	0.51			0.40
Poultry litter							
Pond target		6	4.46				
Pond Non-target		22	8.18	0.94			1.64
Green feed							
Pond target		14	27.83	1.79	0.36		1.79
Pond Non-target		40	20.98	2.36			2.29
Rice bran							
Pond target		33	7.57	20.26	0.08	1.21	54.12
Pond Non-target		107	7.17	7.62			19.25
Oil Cake							
Pond target		22		3.98			39.60
Pond Non-target		79	0.06	4.46			49.91
Factory made balanced feed							
Pond target							
Pond Non-target		2		2.58			35.17
Other types of feed							
Pond target							
Pond Non-target		1	1.11				
Netting for harvest							
Pond target		16					72.64
Pond Non-target		81					40.59

Table B - 8 shows differences between stocking and harvesting practices and costs for target and non-target farmers. There are relatively small differences between the variables with the exception of average cost per decimal and average numbers harvested per decimal.

Table B - 8: Stocking and Harvesting Practices by Sample Type

Sample Type	Stocked during last year		Harvested during last year		
	Average Nos./dec.	Average cost (in Tk) /dec.	Average Nos/dec.	Average harvest (in kg)/dec.	Average T. value (in Tk.)/dec.
Pond target	162.70	75.85	60.69	13.78	565.59
Pond Non-target	155.91	64.50	70.44	13.44	556.91

Table B - 9 summarizes the judgment of the interviewers about selected variables influencing fish productivity and adoption of recommended practices promoted by the project. Response of feeding practices is also included.

Table B - 9: Interviewers' Judgment about Fish Status and Feeding Methods by Sample Type

Observations	Pond Target		Pond non-target		Total	
	No.	%	No.	%	No.	%
Visibility						
No sign of fish	2	3.5%	2	1.4%	4	2.0%
Some fish seen occasionally	29	50.9%	84	57.9%	113	55.9%
Fish seen here & there	17	29.8%	34	23.5%	51	25.3%
Fish seen everywhere	1	1.8%	9	6.2%	10	5.0%
Non-response	8	14.0%	16	11.0%	24	11.9%
Response to Green Feed						
No response of fish	22	38.6%	43	29.7%	65	32.2%
Within 6-10 min.	18	31.6%	38	26.2%	56	27.7%
Within 2-5 min.	6	10.5%	28	19.3%	34	16.8%
Within 1 min.	1	1.8%	3	2.1%	4	2.0%
Non-response	10	17.5%	33	22.8%	43	21.3%
Response to Dry Feed						
No response of fish	4	7.0%	5	3.5%	9	4.5%
Within 6-10 min.	28	49.1%	77	53.1%	105	52.0%
Within 2-5 min.	9	15.8%	36	24.8%	45	22.3%
Within 1 min.	6	10.5%	8	5.5%	14	6.9%
Non-response	10	17.5%	19	13.1%	29	14.4%
Relative Quantity						
Very much less	3	5.3%	2	1.4%	5	2.5%
Less	11	19.3%	24	16.6%	35	17.3%
Sufficient	8	14.0%	33	22.8%	41	20.3%
Much	23	40.4%	62	42.8%	85	42.1%
Too much	4	7.0%	8	5.5%	12	5.9%
Non-response	8	14.0%	16	11.0%	24	11.9%
Relative Size						
Very small	3	5.3%	2	1.4%	5	2.5%
Small	33	57.9%	75	51.7%	108	53.5%
As big as it should be	10	17.5%	45	31.0%	55	27.2%
Big	3	5.3%	7	4.8%	10	5.0%
Very big		0.0%		0.0%	0	0.0%
Non-response	8	14.0%	16	11.0%	24	11.9%
Body Condition						
Head, skin & bone	4	7.0%	7	4.8%	11	5.5%
Thin	21	36.8%	39	26.9%	60	29.7%
Good	22	38.6%	74	51.0%	96	47.5%
Very good	2	3.5%	9	6.2%	11	5.5%
Non-response	8	14.0%	16	11.0%	24	11.9%
Health						
Sick	12	21.1%	15	10.3%	27	13.4%
Slightly sick	22	38.6%	55	37.9%	77	38.1%
Healthy	15	26.3%	59	40.7%	74	36.6%
Non-response	8	14.0%	16	11.0%	24	11.9%

Table B - 10 shows variation between target and non-target producers concerning the interviewers judgment about the observed catch and fishing methods used.

Table B - 10: Interviewers' Judgment about Observed Catch and Fishing Methods by Sample Type

Observations	Pond Target		Pond non-target		Total	
	No.	%	No.	%	No.	%
Average Number of fish/dec.						
No. of species						
0	33	57.9%	76	52.4%	109	54.0%
2	4	7.0%	8	5.5%	12	5.9%
3	8	14.0%	16	11.0%	24	11.9%
4	10	17.5%	33	22.8%	43	21.3%
5	1	1.8%	8	5.5%	9	4.5%
6	1	1.8%	3	2.1%	4	2.0%
7				0.7%	1	0.5%
Relative Size						
Very small		0.0%	1	0.7%	1	0.5%
Small	16	28.1%	40	27.6%	56	27.7%
As big as it should be	5	8.8%	26	17.9%	31	15.4%
Big	3	5.3%	2	1.4%	5	2.5%
Very big		0.0%		0.0%	0	0.0%
Non-response	33	57.9%	76	52.4%	109	54.0%
Body Condition						
Head, skin & bone	2	3.5%	3	2.1%	5	2.5%
Thin	13	22.8%	28	19.3%	41	20.3%
Good	8	14.0%	36	24.8%	44	21.8%
Very good	1	1.8%	2	1.4%	3	1.5%
Non-response	33	57.9%	76	52.4%	109	54.0%
Health						
Very sick	1	1.8%		0.0%	1	0.5%
Sick	6	10.5%	13	9.0%	19	9.4%
Slightly sick	9	15.8%	31	21.4%	40	19.8%
Healthy	8	14.0%	25	17.2%	33	16.3%
Non-response	33	57.9%	76	52.4%	109	54.0%
No. of Net Throws						
0	33	57.9%	76	52.4%	109	54.0%
1	4	7.0%	22	15.2%	26	12.9%
2	19	33.3%	38	26.2%	57	28.2%
3	1	1.8%	8	5.5%	9	4.5%
4		0.0%	1	0.7%	1	0.5%

The next set of tables (11-20) is based on a breakdown of parameters by sample strata as defined earlier. The parameters reported upon are the same set as reported in tables 2-10 by sample type.

Table B - 11: Fish Production by Sample Strata

Strata	No. of cases		Fish Seed Production								Table fish production							
			Dhani		Angule pona		Nola Pona		Other		Nola Mach-100gm		Fish 300gm		Big fish 1 Kg+		Other	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 FNFMM	52	25.74%					1	1.92%			4	7.69%	31	59.62%	22	42.31%	1	1.92%
2 FNFNMM	23	11.39%			1	4.35%	1	4.35%			6	26.09%	11	47.83%	5	21.74%		
3 NFNFM	23	11.39%	1	4.35%							7	30.43%	18	78.26%	8	34.78%		
4 FNFNM	20	9.90%										18	90.00%	6	30.00%			
5 FNFNMNM	18	8.91%			1		2				4	22.22%	10	55.56%	4	22.22%		
6 NFNFMNM	10	4.95%									3	30.00%	4	40.00%	2	20.00%		
7 NFNFMNM	22	10.89%									3	13.64%	15	68.18%	8	36.36%		
8 NFNFMNM	34	16.83%	1	2.94%			1				5	14.71%	25	73.53%	11	32.35%		
Total	202	100.00%	2	0.99%	2	0.99%	5	2.48%			32	15.84%	132	65.35%	66	32.67%	1	0.50%

Table B - 12: Fish Feeding Practices by Sample Strata

	Manure		Fertilizer		Green Feed		Dry Feed			Balanced Feed		Lime	
	Cow	Poultry	Urea	TSP	Aquatic Plant	Leaves Grasses	Rice Bran	Oil cake	Other	Factory made	Home made	Before stock	After stock
1 FNFMM													
Non-response	10	10	10	10	10	10	10	10	10	10	10	10	10
No use	12	30	17	19	25	19	6	18	40	41	41	15	18
Irregular use	24	12	21	19	14	19	31	20	2	1	1	18	18
Regular use	6		4	4	3	4	5	4				9	6
Total	52	52	52	52	52	52	52	52	52	52	52	52	52
2 FNFMM													
Non-response	4	4	4	4	4	4	4	4	4	4	4	4	4
No use	7	11	4	4	15	13	1	5	19	19	19	2	4
Irregular use	7	7	10	10	3	5	10	7				8	9
Regular use	5	1	5	5	1	1	8	7				9	6
Total	23	23	23	23	23	23	23	23	23	23	23	23	23
3 FNFMM													
Non-response													
No use	4	17	7	10	15	12	4	7	18	21	19	6	9
Irregular use	14	4	12	9	6	7	14	11	2		2	11	9
Regular use	5	2	4	4	2	4	5	5	3	2	2	6	5
Total	23	23	23	23	23	23	23	23	23	23	23	23	23
4 FNFMM													
Non-response	1	1	1	1	1	1	1	1	1	1	1	1	1
No use	7	15	5	5	16	9	3	6	19	19	19	6	6
Irregular use	5	4	12	12	2	8	7	8				6	6
Regular use	7		2	2	1	2	9	5				7	7
Total	20	20	20	20	20	20	20	20	20	20	20	20	20
5 FNFMM													
Non-response	1	1	1	1	1	1	1	1	1	1	1	1	1
No use	10	17	9	9	16	16	2	8	17	17	17	10	10
Irregular use	7		8	8	1	1	14	9				6	6
Regular use							1					1	1
Total	18	18	18	18	18	18	18	18	18	18	18	18	18
6 FNFMM													
Non-response	2	2	2	2	2	2	2	2	2	2	2	2	2
No use	3	7	5	5	7	6	2	3	8	8	8	3	3
Irregular use	5	1	3	3	1	2	4	4				4	4
Regular use							2	1				1	1
Total	10	10	10	10	10	10	10	10	10	10	10	10	10
7 FNFMM													
Non-response	3	3	3	3	3	3	3	3	3	3	3	3	3
No use	6	16	2	3	9	10		8	19	19	19	5	5
Irregular use	9	2	14	13	9	9	12	9				7	10
Regular use	4	1	3	3	1		7	2				7	4
Total	22	22	22	22	22	22	22	22	22	22	22	22	22
8 FNFMM													
Non-response	1	1	1	1	1	1	1	1	1	1	1	1	2
No use	9	25	2	5	23	16	3	13	31	33	33	3	11
Irregular use	16	8	25	22	8	15	17	15	1			18	9
Regular use	8		6	6	2	2	13	5	1			12	12
Total	34	34	34	34	34	34	34	34	34	34	34	34	34
Total	202	202	202	202	202	202	202	202	202	202	202	202	202

Table B - 13: Fish Feeding Practices by Sample Strata in %

	Manure		Fertilizer		Green Feed		Dry Feed			Balanced Feed		Lime	
	Cow	Poultry	Urea	TSP	Aquatic Plant	Leaves Grasses	Rice Bran	Oil cake	Other	Factory made	Home made	Before stock	After stock
1 FNFMM													
Non-response	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
No use	23.1	57.7	32.7	36.5	48.1	36.5	11.5	34.6	76.9	78.9	78.9	28.9	34.6
Irregular use	46.2	23.1	40.4	36.5	26.9	36.5	59.6	38.5	3.9	1.9	1.9	34.6	34.6
Regular use	11.5	0.0	7.7	7.7	5.8	7.7	9.6	7.7	0.0	0.0	0.0	17.3	11.5
2 FNFMM													
Non-response	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
No use	30.4	47.8	17.4	17.4	65.2	56.5	4.4	21.7	82.6	82.6	82.6	8.7	17.4
Irregular use	30.4	30.4	43.5	43.5	13.0	21.7	43.5	30.4	0.0	0.0	0.0	34.8	39.1
Regular use	21.7	4.4	21.7	21.7	4.4	4.4	34.8	30.4	0.0	0.0	0.0	39.1	26.1
3 FNFMM													
Non-response	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No use	17.4	73.9	30.4	43.5	65.2	52.2	17.4	30.4	78.3	91.3	82.6	26.1	39.1
Irregular use	60.9	17.4	52.2	39.1	26.1	30.4	60.9	47.8	8.7	0.0	8.7	47.8	39.1
Regular use	21.7	8.7	17.4	17.4	8.7	17.4	21.7	21.7	13.0	8.7	8.7	26.1	21.7
4 FNFMM													
Non-response	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
No use	35.0	75.0	25.0	25.0	80.0	45.0	15.0	30.0	95.0	95.0	95.0	30.0	30.0
Irregular use	25.0	20.0	60.0	60.0	10.0	40.0	35.0	40.0	0.0	0.0	0.0	30.0	30.0
Regular use	35.0	0.0	10.0	10.0	5.0	10.0	45.0	25.0	0.0	0.0	0.0	35.0	35.0
5 FNFMM													
Non-response	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
No use	55.6	94.4	50.0	50.0	88.9	88.9	11.1	44.4	94.4	94.4	94.4	55.6	55.6
Irregular use	38.9	0.0	44.4	44.4	5.6	5.6	77.8	50.0	0.0	0.0	0.0	33.3	33.3
Regular use	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	5.6	5.6
6 FNFMM													
Non-response	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
No use	30.0	70.0	50.0	50.0	70.0	60.0	20.0	30.0	80.0	80.0	80.0	30.0	30.0
Irregular use	50.0	10.0	30.0	30.0	10.0	20.0	40.0	40.0	0.0	0.0	0.0	40.0	40.0
Regular use	0.0	0.0	0.0	0.0	0.0	0.0	20.0	10.0	0.0	0.0	0.0	10.0	10.0
7 FNFMM													
Non-response	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
No use	27.3	72.7	9.1	13.6	40.9	45.5	0.0	36.4	86.4	86.4	86.4	22.7	22.7
Irregular use	40.9	9.1	63.6	59.1	40.9	40.9	54.6	40.9	0.0	0.0	0.0	31.8	45.5
Regular use	18.2	0.0	13.6	13.6	4.6	0.0	31.8	9.1	0.0	0.0	0.0	31.8	18.2
8 FNFMM													
Non-response	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
No use	26.5	73.5	5.9	14.7	67.7	47.1	8.8	38.2	91.2	97.1	97.1	8.8	32.4
Irregular use	47.1	23.5	73.5	64.7	23.5	44.1	50.0	44.1	2.9	0.0	0.0	52.9	26.5
Regular use	23.5	0.0	17.7	17.7	5.9	5.9	38.2	14.7	2.9	0.0	0.0	35.3	35.3

Table B - 14: Comparison of Average Cost/Decimal by Sample Strata

Strata	Average cost./dec.	Sample Type	Average cost./dec.
1 FNFMM	80.05	Pond Target	83.39
2 FNFNMM	104.55	Pond Non-target	84.60
3 NFNFM	81.71		
4 FNFNM	94.48		
5 FNFNMNM	62.01		
6 NFNFMNM	47.45		
7 NFNFMNM	72.43		
8 NFNFMNM	97.97		

Table B - 15: Summary of Input Use by Sample Strata

Strata	Stocked during last one year		Harvested during last one year		
	Average Nos./dec.	Average cost (in Tk.)/dec.	Average Nos./dec.	Average harvest (in kg)/dec.	Average T. value (in Tk.)/dec.
1 FNFMM	86.62	50.92	39.08	12.26	536.26
2 FNFNMM	249.68	71.71	99.25	13.88	624.63
3 NFNFM	126.53	68.94	62.53	13.99	572.10
4 FNFNM	108.29	59.34	60.88	15.11	592.94
5 FNFNMNM	369.44	123.68	184.21	22.80	809.07
6 NFNFMNM	123.52	52.61	46.32	8.04	328.96
7 NFNFMNM	106.15	58.49	45.02	10.33	446.64
8 NFNFMNM	186.41	75.52	56.88	12.80	530.67

Table B - 16: Stocking and Harvesting Practices by Sample Strata

Strata	Stocked during last one year		Harvested during last one year		
	Average Nos./dec.	Average cost (in Tk.)/dec.	Average Nos./dec.	Average harvest (in kg)/dec.	Average T. value (in Tk.)/dec.
1 FNFMM	86.62	50.92	39.08	12.26	536.26
2 FNFNMM	249.68	71.71	99.25	13.88	624.63
3 NFNFM	126.53	68.94	62.53	13.99	572.10
4 FNFNM	108.29	59.34	60.88	15.11	592.94
5 FNFNMNM	369.44	123.68	184.21	22.80	809.07
6 NFNFMNM	123.52	52.61	46.32	8.04	328.96
7 NFNFMNM	106.15	58.49	45.02	10.33	446.64
8 NFNFMNM	186.41	75.52	56.88	12.80	530.67

Table B - 17: Interviewers Judgment about Fish Status and Feeding Methods by Sample Strata

Observations	1 FNFM		2 FNFM		3 FNFM		4 FNFM		5 FNFM		6 FNFM		7 FNFM		8 FNFM		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Visibility																		
No sign of fish	1	1.92%	2	8.70%	0	0.00%	0	0.00%	1	5.56%	0	0.00%	0	0.00%	0	0.00%	4	1.98%
Some fish seen occasionally.	23	44.23%	11	47.83%	14	60.87%	12	60.00%	11	61.11%	7	70.00%	13	59.09%	22	64.71%	113	55.94%
Fish seen here & there	15	28.85%	3	13.04%	8	34.78%	7	35.00%	4	22.22%	1	10.00%	5	22.73%	8	23.53%	51	25.25%
Fish seen everywhere	5	9.62%	2	8.70%	1	4.35%	0	0.00%	0	0.00%	1	10.00%	1	4.55%	0	0.00%	10	4.95%
Non-response	8	15.38%	5	21.74%	0	0.00%	1	5.00%	2	11.11%	1	10.00%	3	13.64%	4	11.76%	24	11.88%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
Response to Green Feed																		
No response of fish	14	26.92%	6	26.09%	10	43.48%	3	15.00%	16	88.89%	6	60.00%	3	13.64%	7	20.59%	65	32.18%
Within 6-10 min.	15	28.85%	3	13.04%	8	34.78%	9	45.00%	0	0.00%	1	10.00%	8	36.36%	12	35.29%	56	27.72%
Within 2-5 min.	12	23.08%	4	17.39%	4	17.39%	2	10.00%	0	0.00%	1	10.00%	4	18.18%	7	20.59%	34	16.83%
Within 1 min.	1	1.92%	1	4.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	5.88%	4	1.98%
Non-response	10	19.23%	9	39.13%	1	4.35%	6	30.00%	2	11.11%	2	20.00%	7	31.82%	6	17.65%	43	21.29%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
Response to Dry Feed																		
No response of fish	3	5.77%	0	0.00%	0	0.00%	0	0.00%	2	11.11%	4	40.00%	0	0.00%	0	0.00%	9	4.46%
Within 6-10 min.	25	48.08%	6	26.09%	15	65.22%	13	65.00%	12	66.67%	1	10.00%	12	54.55%	21	61.76%	105	51.98%
Within 2-5 min.	11	21.15%	5	21.74%	6	26.09%	5	25.00%	1	5.56%	2	20.00%	7	31.82%	8	23.53%	45	22.28%
Within 1 min.	4	7.69%	5	21.74%	2	8.70%	0	0.00%	1	5.56%	1	10.00%	0	0.00%	1	2.94%	14	6.93%
Non-response	9	17.31%	7	30.43%	0	0.00%	2	10.00%	2	11.11%	2	20.00%	3	13.64%	4	11.76%	29	14.36%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
Relative Quantity																		
Very much less	4	7.69%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	2.94%	5	2.48%
Less	9	17.31%	1	4.35%	4	17.39%	4	20.00%	3	16.67%	3	30.00%	5	22.73%	6	17.65%	35	17.33%
Sufficient	9	17.31%	7	30.43%	2	8.70%	7	35.00%	1	5.56%	1	10.00%	8	36.36%	6	17.65%	41	20.30%
Much	21	40.38%	9	39.13%	16	69.57%	8	40.00%	8	44.44%	2	20.00%	5	22.73%	16	47.06%	85	42.08%
Too much	1	1.92%	1	4.35%	1	4.35%	0	0.00%	4	22.22%	3	30.00%	1	4.55%	1	2.94%	12	5.94%
Non-response	8	15.38%	5	21.74%	0	0.00%	1	5.00%	2	11.11%	1	10.00%	3	13.64%	4	11.76%	24	11.88%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%

Observations	1 FNFMM		2 FNFNM		3 NFNFMM		4 FNFNM		5 FNFNMNM		6 NFFNMNM		7 NFNFNM		8 NFNFNMNM		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Relative Size																		
Very small	2	3.85%	1	4.35%	0	0.00%	0	0.00%	0	0.00%	2	20.00%	0	0.00%	0	0.00%	5	2.48%
Small	25	48.08%	8	34.78%	17	73.91%	9	45.00%	13	72.22%	5	50.00%	10	45.45%	21	61.76%	108	53.47%
As big as it should be	15	28.85%	6	26.09%	6	26.09%	8	40.00%	3	16.67%	2	20.00%	9	40.91%	6	17.65%	55	27.23%
Big	2	3.85%	3	13.04%	0	0.00%	2	10.00%	0	0.00%	0	0.00%	0	0.00%	3	8.82%	10	4.95%
Very big		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Non-response	8	15.38%	5	21.74%	0	0.00%	1	5.00%	2	11.11%	1	10.00%	3	13.64%	4	11.76%	24	11.88%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
Body Condition																		
Head, skin & bone	3	5.77%	0	0.00%	2	8.70%	0	0.00%	1	5.56%	2	20.00%	1	4.55%	2	5.88%	11	5.45%
Thin	12	23.08%	5	21.74%	7	30.43%	6	30.00%	8	44.44%	5	50.00%	5	22.73%	12	35.29%	60	29.70%
Good	25	48.08%	12	52.17%	13	56.52%	12	60.00%	7	38.89%	1	10.00%	12	54.55%	13	38.24%	95	47.03%
Very good	4	7.69%	1	4.35%	1	4.35%	1	5.00%	0	0.00%	1	10.00%	1	4.55%	3	8.82%	12	5.94%
Non-response	8	15.38%	5	21.74%	0	0.00%	1	5.00%	2	11.11%	1	10.00%	3	13.64%	4	11.76%	24	11.88%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
Health																		
Very sick	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Sick	6	11.54%	3	13.04%	3	13.04%	1	5.00%	1	5.56%	4	40.00%	3	13.64%	6	17.65%	27	13.37%
Slightly sick	14	26.92%	7	30.43%	11	47.83%	12	60.00%	13	72.22%	3	30.00%	5	22.73%	12	35.29%	77	38.12%
Healthy	24	46.15%	8	34.78%	9	39.13%	6	30.00%	2	11.11%	2	20.00%	11	50.00%	12	35.29%	74	36.63%
Non-response	8	15.38%	5	21.74%	0	0.00%	1	5.00%	2	11.11%	1	10.00%	3	13.64%	4	11.76%	24	11.88%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%

Table B - 18: Interviewers Judgment about Observed Catch and Fishing Methods by Sample Strata

Observations	1 FNEMM		2 FNFNMM		3 NFNEMM		4 FNEMNM		5 FNFNMM		6 NFFNMM		7 NFNEMNM		8 NFNFNMM		Total			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
No. of species																				
0	38	73.08%	8	34.78%	10	43.48%	6	30.00%	10	55.56%	8	80.00%	6	27.27%	23	67.65%	109	53.96%		
2	2	3.85%	0	0.00%	1	4.35%	3	15.00%	0	0.00%	0	0.00%	5	22.73%	1	2.94%	12	5.94%		
3	2	3.85%	8	34.78%	2	8.70%	1	5.00%	1	5.56%	0	0.00%	5	22.73%	5	14.71%	24	11.88%		
4	8	15.38%	4	17.39%	8	34.78%	9	45.00%	4	22.22%	2	20.00%	5	22.73%	3	8.82%	43	21.29%		
5	1	1.92%	2	8.70%	1	4.35%	1	5.00%	2	11.11%	0	0.00%	1	4.55%	1	2.94%	9	4.46%		
6	1	1.92%	1	4.35%	0	0.00%	0	0.00%	1	5.56%	0	0.00%	0	0.00%	1	2.94%	4	1.98%		
7	0		0	0.00%	1	4.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.50%		
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%		
Relative Size																				
Very small	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	5.56%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.50%
Small	8	15.38%	6	26.09%	8	34.78%	9	45.00%	6	33.33%	1	10.00%	8	36.36%	10	29.41%	56	27.72%		
As big as it should be	5	9.62%	7	30.43%	5	21.74%	5	25.00%	1	5.56%	0	0.00%	8	36.36%	0	0.00%	31	15.35%		
Big	1	1.92%	2	8.70%	0	0.00%	0	0.00%	0	0.00%	1	10.00%	0	0.00%	1	2.94%	5	2.48%		
Very big		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%		
Non-response	38	73.08%	8	34.78%	10	43.48%	6	30.00%	10	55.56%	8	80.00%	6	27.27%	23	67.65%	109	53.96%		
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%		
Body Condition																				
Head, skin & bone	2	3.85%	0	0.00%	1	4.35%	0	0.00%	0	0.00%	1	10.00%	1	4.55%	0	0.00%	5	2.48%		
Thin	4	7.69%	6	26.09%	2	8.70%	8	40.00%	6	33.33%	0	0.00%	7	31.82%	8	23.53%	41	20.30%		
Good	7	13.46%	9	39.13%	10	43.48%	6	30.00%	2	11.11%	0	0.00%	8	36.36%	2	5.88%	44	21.78%		
Very good	1	1.92%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	10.00%	0	0.00%	1	2.94%	3	1.49%		
Non-response	38	73.08%	8	34.78%	10	43.48%	6	30.00%	10	55.56%	8	80.00%	6	27.27%	23	67.65%	109	53.96%		
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%		
Health																				
Very sick	1	1.92%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.50%
Sick	5	9.62%	2	8.70%	2	8.70%	2	10.00%	2	11.11%	1	10.00%	3	13.64%	2	5.88%	19	9.41%		
Slightly sick	2	3.85%	7	30.43%	6	26.09%	7	35.00%	4	22.22%	0	0.00%	8	36.36%	6	17.65%	40	19.80%		

Observations	1 FNFMM		2 FNFNMM		3 NFNFM		4 FNFNM		5 FNFNMNM		6 NFNMN		7 NFNFMNM		8 NFNFMNM		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Healthy	6	11.54%	6	26.09%	5	21.74%	5	25.00%	2	11.11%	1	10.00%	5	22.73%	3	8.82%	33	16.34%
Non-response	38	73.08%	8	34.78%	10	43.48%	6	30.00%	10	55.56%	8	80.00%	6	27.27%	23	67.65%	109	53.96%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%
No. of Net Throws																		
0	38	73.08%	8	34.78%	10	43.48%	6	30.00%	10	55.56%	8	80.00%	6	27.27%	23	67.65%	109	53.96%
1	6	11.54%	5	21.74%	2	8.70%	3	15.00%	0	0.00%	0	0.00%	8	36.36%	2	5.88%	26	12.87%
2	8	15.38%	6	26.09%	10	43.48%	9	45.00%	8	44.44%	2	20.00%	7	31.82%	7	20.59%	57	28.22%
3	0	0.00%	4	17.39%	0	0.00%	2	10.00%	0	0.00%	0	0.00%	1	4.55%	2	5.88%	9	4.46%
4	0	0.00%	0	0.00%	1	4.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.50%
Total	52	100.00%	23	100.00%	23	100.00%	20	100.00%	18	100.00%	10	100.00%	22	100.00%	34	100.00%	202	100.00%

Table B - 19: Connectivity of the Village with Upazila HQ and Nearest Growth Centre by Strata

Strata		Village connected with Upazila HQ					Total No. of Samples	Nearest major growth centre				
		Pucca Road	HBB road	Kutch Road	River	Total Responses		Pucca Road	HBB road	Kutch Road	River	Total
Pond Target	N	56	8	48	11	123	57	52	7	50	6	115
	%	98.25%	14.04%	84.21%	19.30%	215.79%		91.23%	12.28%	87.72%	10.53%	201.75%
Pond Non-target	N	129	54	124	36	343	145	124	42	128	11	305
	%	89%	37%	86%	25%	237%		85.52%	28.97%	88.28%	7.59%	210.34%
Non-pond Target	N	226	84	250	118	678	268	180	63	236	66	545
	%	84.33%	31.34%	93.28%	44.03%	252.99%		67.16%	23.51%	88.06%	24.63%	203.36%
Non-pond Non-target	N	113	39	112	53	317	130	91	25	112	24	252
	%	86.92%	30.00%	86.15%	40.77%	243.85%		70.00%	19.23%	86.15%	18.46%	193.85%
Entire PoP	N	524	185	534	218	1461	600	447	137	526	107	1217
	%	87.33%	30.83%	89.00%	36.33%	243.50%		74.50%	22.83%	87.67%	17.83%	202.83%

Note : The total % becomes more than 100% as because of multiple responses

Table B - 20: Means of transportation to visit the Zila town by Strata (rainy season)

Strata		Total No. of Samples	Means of transportation to visit the Zila town						Total
			Rickshaw /Van	Baby taxi. /Tempo	Bus	Boat/ Engine boat	Launch	On foot	
Pond Target	N	57	44	40	41	8		15	148
	%		77.19%	70.18%	71.93%	14.04%		26.32%	259.65%
Pond Non-target	N	145	107	101	123	24		32	387
	%		73.79%	69.66%	84.83%	16.55%		22.07%	266.90%
Non-pond Target	N	268	156	162	213	94		91	716
	%		58.21%	60.45%	79.48%	35.07%		33.96%	267.16%
Non-pond Non-target	N	130	70	76	116	37		33	332
	%		53.85%	58.46%	89.23%	28.46%		25.38%	255.38%
Entire PoP	N	600	377	379	493	163		171	1583
	%		62.83%	63.17%	82.17%	27.17%		28.50%	263.83%

Note : The total % becomes more than 100% as because of multiple responses

Table B - 21: Means of transportation to visit the Upazila town by Strata (rainy season)

Strata		Total No. of Samples	Means of transportation to visit the Upazila town						Total
			Rickshaw /Van	Baby taxi/Tempo	Bus	Boat/ Engine boat	Launch	On foot	
Pond Target	N	57	49	38	22	12		27	148
	%		85.96%	66.67%	38.60%	21.05%		47.37%	259.65%
Pond Non-target	N	145	125	94	71	31	1	63	385
	%		86.21%	64.83%	48.97%		0.69%	43.45%	265.52%
Non-pond Target	N	268	196	187	79	108		131	701
	%		73.13%	69.78%	29.48%	40.30%		48.88%	261.57%
Non-pond Non-target	N	130	89	80	55	45		65	334
	%		68.46%	61.54%	42.31%			50.00%	256.92%
Entire PoP	N	600	459	399	227	196	1	286	1568
	%		76.50%	66.50%	37.83%	42.70%	0.17%	47.67%	261.33%

Note : The total % becomes more than 100% as because of multiple responses

Table B - 22: Means of transportation to visit the major growth centre by Strata (rainy season)

Strata		Total No. of Samples	Means of transportation to visit the Upazila town						Total
			Rickshaw /Van	Baby taxi /Tempo	Bus	Boat/ Engine boat	Launch	On foot	
Pond Target	N	57	51	9	4	5		51	120
	%		89.47%	15.79%	7.02%	8.77%		89.47%	210.53%
Pond Non-target	N	145	127	14	11	15	2	128	297
	%		87.59%	9.66%	7.59%	10.34%	1.38%	88.28%	204.83%
Non-pond Target	N	268	224	17	7	84		246	578
	%		83.58%	6.34%	2.61%	31.34%		91.79%	215.67%
Non-pond Non-target	N	130	110	10	6	35		123	284
	%		84.62%	7.69%	4.62%	26.92%		94.62%	218.46%
Entire PoP	N	600	512	50	28	139	2	548	1279
	%		85.33%	8.33%	4.67%	27.15%	0.33%	91.33%	213.17%

Note : The total % becomes more than 100% as because of multiple responses

Table B - 23: Secondary Occupation of Household Heads by Strata

Strata		Farming	Day labourer	Business	Other	Total
Pond Target	N	1	4	2	4	11
	%	9.10%	36.40%	18.20%	36.40%	100.00%
Pond Non-target	N	23	2	11	7	43
	%	53.50%	4.70%	25.60%	16.30%	100.00%
Non-pond Target	N	23	20	5	18	66
	%	34.80%	30.30%	7.60%	27.30%	100.00%
Non-pond Non-target	N	12	5	6	1	24
	%	50.00%	20.80%	25.00%	4.20%	100.00%
Entire PoP	N	59	31	24	30	144
	%	41.00%	21.50%	16.70%	20.80%	100.00%

Table B - 24: Health Status of Household Head by Strata

Strata		Disabled	Almost always sick	Sometimes sick	Hardly ever sick	Total
Pond Target	N	1	4	27	25	57
	%	1.80%	7.00%	47.40%	43.90%	100.00%
Pond Non-target	N	1	3	70	72	146
	%	0.70%	2.10%	47.90%	49.30%	100.00%
Non-pond Target	N	1	5	139	123	268
	%	0.40%	1.90%	51.90%	45.90%	100.00%
Non-pond Non-target	N	4	2	64	59	129
	%	3.10%	1.60%	49.60%	45.70%	100.00%
Entire PoP.	N	7	14	300	279	600
	%	1.20%	2.30%	50.00%	46.50%	100.00%

Table B - 25: Winter Clothes owned by Household Head by Strata

Strata	Pieces of clothes
Pond Target	1.47
Pond Non-target	1.92
Non-pond Target	1.48
Non-pond Non-target	1.61
Entire PoP.	1.61

Table B - 26: Roof Condition of First Room by Strata

Strata		Thatched/light materials	Tin/tiles	Concrete	Total
Pond Target	N	2	55		57
	%	3.50%	96.50%		100.00%
Pond Non-target	N	4	140	1	145
	%	2.80%	96.60%	0.70%	100.00%
Non-pond Target	N	32	233	3	268
	%	11.90%	86.90%	1.10%	100.00%
Non-pond Non-target	N	7	122	1	130
	%	5.40%	93.80%	0.80%	100.00%
Entire PoP	N	45	550	5	600
	%	7.50%	91.70%	0.80%	100.00%

N means number of samples

Table B - 27: Wall Condition First Room by Strata

Strata		Thatched/ light materials	Tin/ bamboo/ wood	Comb. of brick/tin/ bamboo	Brick/ concrete	Mud	No Wall	Total
Pond Target	N	8	31	1	2	15		57
	%	14.00%	54.40%	1.80%	3.50%	26.30%		100.00%
Pond Non-target	N	11	68	4	8	53	1	145
	%	7.60%	46.90%	2.80%	5.50%	36.60%	0.70%	100.00%
Non-pond Target	N	64	120	3	2	79		268
	%	23.90%	44.80%	1.10%	0.70%	29.50%		100.00%
Non-pond Non-target	N	9	70	1	5	45		130
	%	6.90%	53.80%	0.80%	3.80%	34.60%		100.00%
Entire PoP	N	92	289	9	17	192	1	600
	%	15.30%	48.20%	1.50%	2.80%	32.00%	0.20%	100.00%

N means number of samples

Table B - 28: Floor Condition of First Room by Strata

Strata		Kutchra	Semi-Pucca	Pucca	Total
Pond Target	N	53		4	57
	%	93.00%		7.00%	100.00%
Pond Non-target	N	133		12	145
	%	91.70%		8.30%	100.00%
Non-pond Target	N	263	2	3	268
	%	98.10%	0.70%	1.10%	100.00%
Non-pond Non-target	N	121		9	130
	%	93.10%		6.90%	100.00%
Entire PoP	N	569	2	28	600
	%	95.00%	0.30%	4.70%	100.00%

Table B - 29: Average Value in Taka of First Room by Strata

Strata	First Room	
	Avg. value(Tk)	Number
Pond Target	20,658	57
Pond Non-target	40,523	145
Non-pond Target	17,872	268
Non-pond Non-target	36,046	130
Entire PoP	27,549	600

Table B - 30: HH Connected with Electric Power Supply by Strata

Strata		Yes	No	Total
Pond Target	N	16	41	57
	%	28.10%	71.90%	100.00%
Pond Non-target	N	74	71	145
	%	51.00%	49.00%	100.00%
Non-pond Target	N	76	192	268
	%	28.40%	71.60%	100.00%
Non-pond Non-target	N	54	76	130
	%	41.50%	58.50%	100.00%
Entire PoP	N	220	380	600
	%	36.70%	63.30%	100.00%

Table B - 31: Households Possessing Valuable Equipment by Strata

Name of the Equipment	Pond Target	Pond Non-target	Non-pond Target	Non-pond Non-target
TV	9	59	22	37
Radio	10	80	57	57
Fishing net	6	58	20	17
Sewing machine	1	10	3	4
Power pumps for irrig./dewatering		21	5	10
Power-tiller/tractor		5	5	4
Husking machine		4		2
Threshing machine		1		
Sprayer		11		1
Bullock cart	1	1		
Boat		2	17	5
Rickshaw/van	4	8	16	7
Sugarcane crusher		2		
Agri. Tools	26	77	93	62
Motor cycle		10	1	7
Bi-cycle	13	66	35	30
Other non agricultural equipment	2	3	12	2

Table B - 32: Ownership of Cattle

Strata	Yes	No	Total
Pond Target	1	56	57
	1.75%	98.25%	100.00%
Pond Non-target	109	36	145
	75.17%	24.83%	100.00%
Non-pond Target	129	139	268
	48.13%	51.87%	100.00%
Non-pond Non-target	84	46	130
	64.62%	35.38%	100.00%
Entire PoP	354	246	600
	59.00%	41.00%	100.00%

Table B - 33: Type of Cattle and Income

	Livestock	Qty.	Annual income	Present Value	Qty. Sold	Sold Value
Pond Target	Buffalo	2.0	0	15,000	0.0	0
	Ox	1.1	0	5,429	0.3	1,500
	Cow	1.3	1,152	6,660	0.0	0
	Cow (<4 years)	1.0	182	2,636	0.4	1,273
	Goat/sheep	1.7	0	1,270	0.6	820
	Total	1.3	447	4,748	0.3	771
Pond Non-target	Buffalo	2.0	0	16,000	0.0	0
	Ox	1.5	6	8,851	0.5	3,129
	Cow	1.5	2,960	11,057	0.4	2,814
	Cow (<4 years)	1.4	81	3,537	0.1	319
	Goat/sheep	2.5	15	1,903	0.3	354
	Total	1.7	1,102	7,143	0.3	1,808
Non-pond Target	Buffalo	2.0	0	135,000	0.0	0
	Ox	1.0	5	5,919	0.4	2,035
	Cow	1.2	2,048	7,776	0.1	263
	Cow (<4 years)	1.3	0	2,984	0.0	18
	Goat/sheep	1.9	0	1,302	0.3	260
	Total	1.4	723	5,349	0.1	436
Non-pond Non-target	Buffalo	0.0	0	0	2.0	17,000
	Ox	1.1	0	6,859	0.3	2,204
	Cow	1.5	3,368	9,863	0.2	1,145
	Cow (<4 years)	1.5	30	3,509	0.1	323
	Goat/sheep	3.1	23	2,109	1.5	621
	Total	1.6	1,241	6,176	0.4	1,069

Table B - 34: Poultry Ownership

Strata		Yes	No	Total
Pond Target	N	50	7	57
	%	87.72%	12.28%	100.00%
Pond Non-target	N	120	25	145
	%	82.76%	17.24%	100.00%
Non-pond Target	N	194	74	268
	%	72.39%	27.61%	100.00%
Non-pond Non-target	N	111	19	130
	%	85.38%	14.62%	100.00%
Entire PoP	N	475	125	600
	%	79.17%	20.83%	100.00%

Table B - 35: Poultry - Quantities, Value and Income

Strata	Qty.	Annual income	Present Value	Qty. Sold	Sold Value
Pond Target	6.4	182	384.6	1.7	118.6
Pond Non-target	14.4	315	954.8	14.1	1155.0
Non-pond Target	6.8	196	416.6	2.5	168.0
Non-pond Non-target	10.8	1565	714.9	3.5	244.1
Entire PoP	9.6	545	618.9	5.6	430.0