Management of Aquatic Ecosystems through Community Husbandry

(MACH)

Final Report

Estimation of the Importance of Non Fish Aquatic Wetland Resource use by Socio-Economic Status (Hail Haor Wetland)

By Naushee Rahman*

* Naushee Rahman is a 3rd year Bachelor of Resource Economics student from the University of Sydney, Australia, completing professional work experience with the MACH Project c/o Winrock International Institute for Agricultural Development

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The MACH Project

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ACRONYMS and TERMS

AIG	:	Alternative Income Generation
BTRI	:	Bangladesh Tea Research Institute
CNRS	:	Centre for Natural Resource Studies
GoB	:	Government of Bangladesh
Hail Haor	:	A haor located near Sri Mangal in the Moulvibazar District.
Haor	:	A seasonal water body.
MACH	:	Management of Aquatic Ecosystems through Community Husbandry
NGO	:	Non Government Organisation
RRA	:	Rapid Rural Appraisal
USAID	:	United States Agency for International Development

EXECUTIVE SUMMARY

Background

Bangladesh is home to hundreds of species of unique plants, fish, birds and other wildlife. The floodplains of Bangladesh are some of the world's most important wetlands. These wetlands provide important habitats for thousands of migrating birds, and are a critical source of income and nutrition for Bangladesh's poorest people. Unfortunately, these habitats are in decline due to overuse, poor management, increasing rates of sedimentation and the rapid conversion of wetlands to agricultural use. This arises from the need to meet the demand of the swelling population.

The Study

The work for this report is derived from a recommendation from a draft of the *Haor Wetland: Estimation of Economic Value* study report by L. Colavito. The study results show that the Hail Haor wetland provides farmers with a wide variety of products, which have very significant economic value, accruing from diverse sources. Some of these benefits are not even fully recognized by the recipients (e.g. water charge of aquifers). Recommendations from the report include (1) assessing the distribution of wetland benefits by socio-economic status and (2) assessing the importance of groundwater charge by the wetland.

This report assesses the socio-economic benefits of the wetland through conducting an RRA with wetland product users and statistical analysis of the household survey conducted for Colavito (2001). A separate RRA was conducted to determine if there have been changes in the water table associated with decline in the wetland area. A review a literature was also conducted to assist the project in assessing the importance of groundwater charge. This study was undertaken as a part of the Professional Work Experience placement program from the University of Sydney, which took place over a 6-week period (24/11/01 to 7/01/02). The author is a 3rd year student of Resource Economics under the Faculty of Agriculture.

The Results

- **Wetland User RRA:** The RRA showed that there were a wide variety of products harvested. It indicated that larger farmers primarily harvested grass, and the smaller farmers collected a larger variety of products.
- **Statistical Analysis:** The T-test procedure was used to analyze the relative and absolute consumption of wetland resources by socio-economic status. The analysis showed that there was no significant difference in the level of non-fish wetland resource use between different socio-economic groups, by either absolute or relative levels of consumption. This contradicts expectations. Further examination of the data and survey procedures revealed that there might have been substantial underestimation of wetland product use. [1]
- **Ground Water RRA.** A number of farmers, particularly larger farmers, noted that the tube well water was drying up faster than it has in the past.

[1] This finding has resulted in the re-conducting of the survey.

1.0 Introduction

Wetland areas have a variety of economic benefits. Not all benefits are as readily identified or quantified than others[2]. Direct benefits, such as fisheries production, aquatic vegetation production and products are easier estimated than other benefits such as recreational value, water quality improvement, flood control value, pasture value, impacts on the water table and biodiversity. Although the latter have very real and significant economic value, they are more challenging to estimate. Failure to include the economic value of all wetland outputs will clearly bias development efforts in Bangladesh. It may lead to an increase of agricultural use and damage to wetlands.

The original study[3] was undertaken to develop a methodological framework and to calculate a preliminary conservative estimate of the economic value of the MACH Hail Haor wetland site. The estimated values in that study were conservative and should be considered a lower bound on the wetland's economic value. Such estimation of wetland value is an important and complex task, which has not yet been attempted in Bangladesh. To justify wetland preservation, it is important to establish the sustainable management of wetlands and to show they have an economic value that exceeds alternative production uses.

This study is a follow-up effort to assist the MACH project determine the impact of wetlands across socio-economic groups and provide some assistance on water recharge issues.

[2] The study referred to here is the *Hail Haor: Estimation of Economic Value* by Dr. Luke A. Colavito

[3] " " " " " "

1.1 MACH Project

The aim of the MACH Project is to promote the ecologically sound management of floodplain resources for the sustainable supply of food for the poor of Bangladesh. The MACH Project is an original integrated effort to develop approaches to demonstrate the sustainable productivity of water resources. These include water, fish, plants and wildlife over entire wetland ecosystems.

MACH takes a multi-disciplinary participatory approach to address wetland decline. MACH is pioneering a variety of activities to preserve and reduce the overuse of wetland resources by monitoring the degradation at selected project sites. Examples of these activities include development of fish sanctuaries, alternative income generation programs to reduce seasonal pressures, reforestation of tributaries to reduce sedimentation and reconnecting water bodies to preserve wetland productivity.

MACH is a GoB project that has been implemented by four NGOs. They are Winrock International, CNRS and CARITAS-Bangladesh supported by funding from USAID. Currently the program is working at three sites that are representative of the freshwater wetland ecotypes of Bangladesh. This study was conducted in the Hail Haor MACH site in the Moulvibazar District. The Hail Haor is an extensive wetland area that reaches a maximum size of 12 300 Ha (1999 measurements).

The project works with communities and local government, to restore wetland physical and biological functions through management and physical interventions that include re-vegetation, excavation of key beels and canals and establishing fish sanctuaries. Having the knowledge and technology accepted is essential to the success of the project.

1.2 Terms of Reference

Objective 1:

Examine the socioeconomic characteristics of the beneficiaries of non-fish aquatic products from the Hail Haor (HH) using the CNRS implemented HH Survey. A common assumption regarding the use of the Haor is that the poor benefit proportionately more from the diversity of the products available. A major aim of this report to test this assumption. Activities for this objective include:

(i) Describing the methodology for a recently conducted household resource use survey[4].

(ii) Conducting statistical tests, such as the t-test analysis to determine the relative and absolute importance of haor resources to the users of different socio-economic status's.

(iii) Conduct a narrowly focused RRA with various beneficiaries of the haor's resources to estimate their usage.

Objective 2:

Examine the issues affecting the Hail Haor wetland and the local water table.

Activities for this objective include:

(i) Conducting a narrowly focused RRA to verify /examine the effects of the water table on wetland use.

(ii) Search the Internet for information on the effect of water tables on wetlands.

Activities

[4] The study referred to here is the *Hail Haor: Estimation of Economic Value* by Dr. Luke A. Colavito

Socio-Economic Study

(i) Work with CNRS experts to develop description of the methodology of the household survey conducted.

(ii) Work with CNRS database expert to carry out cross-tab analysis and t-tests of resource use by socio-economic groups.

(iii) Verify findings of study within Rapid Rural Appraisals (RRA) with beneficiary groups.

(iv) Write up short report on the socio-economics of non-fish wetland products.

Groundwater Research

(i) Internet / secondary source literature search. This search was to find out if there were any studies, which had addressed how wetland degradation impacted the groundwater level.

(ii) Conduct RRA concerning changes in the aquifer in Hail Haor during field visit.

Table 1: Schedule of Activities and Outputs.

Activity	**Date**
Gather information with CNRS on survey methodology	24/11/01 – 10/12/01
Create and carry out t-test analysis	24/11/01 – 10/12/01
Complete report on socio-economics of non-fish aquatic products	10/12/01
Internet searches	24/11/01 – 7/1/02
Contact key informants	7/12/01 – 7/1/02
Complete report on groundwater findings	7/1/02
Field Trip- Ask group farmers: 1. About the water level 2. Socio-economic RRA 3. Visit an income generation group 4. Visit pineapple growers 5. Other routine activities	10/12/01 – 12/12/01
Complete Trip Report	7/1/02
Prepare a seminar of the final report to the group of advisors involved with the report as a closing exercise	5/01/02

The time for this these activities to be completed will be within a 6-week time frame.

1.3 Approach and Implementation

The author was briefed at his arrival by Dr. M. A. Mannan, Country Coordinator, Winrock international and introduced to Dr. Luke A. Colavito who advised her on the MACH project and her primary task for the TOR and the background of the Hail Haor study. Dr. Colavito was selected as the advisor for the period of internship. The author was then introduced to Bill Collis who advised her on the secondary groundwater research for the TOR, and Sachin Halder who was to organise data collection from the CNRS office. The following is a summary of the author's approach to developing the assignment:

- Discussions with Dr. Colavito took place at the initial meeting. He instructed the author on the main objectives of the assignment and the methodology involved. The analysis of data from his recently conducted survey of non-fish wetland resources was to comprise the bulk of the report. A meeting with Mr. Collis took place regarding the groundwater research on the Internet.
- Meetings with CNRS for Hail Haor survey results (data collection) began before the trip to the Hail Haor took place. Follow-up visits took place several times after that to get more relevant data.
- Visit the Hail Haor wetland at Sri Mangal took place on the 10th to the 11th of December 2001. It was jointly organised by the MACH and the CNRS offices.
- Review the available documents concerning the MACH project
- Write report on findings and of the events that took place during he visit to the haor.

2.0 RRA Addressing Non-Fish Wetland Products

2.1 Introduction

At the Hail Haor site, a number of rapid rural appraisals (RRA)[5] were conducted with groups of haor beneficiaries in order to gauge the extent to which non-fish wetland aquatic resources were utilised from the Haor. The objective of the appraisal was to collect information about the relative importance of non-fish wetland products by socio-economic status.

As part of the RRA exercise, important issues affecting the haor were also assessed. They were conducted during the trip to Sri Mangal with beneficiary groups at the *Lalbagh* village (10/12/01 - 12/12-01) and other village locations. The memorandum sent to the co-ordinators of the field trip is shown in Annex 1. The site co-ordinator, Mr. Moloy Kumar Sarker, organised the itinerary for the field visit, which he presented at the initial briefing meeting (Annex 2). The findings of this investigative report should be treated as anecdotal. The findings from such RRAs can sometimes provide the basis for further study and analysis.

2.2 The Wetland user RRA

The review with the group of small fisherman and farmers was conducted in a group discussion format, with the respondents sitting together in a large group and would answer the questions that applied to them. The checklist presented to them is detailed in Annex 3.

[5] There are two types of rural appraisal that can be used to acquire information: the *rapid rural appraisal* (RRA) and the *participatory rural appraisal* (PRA). The RRA is a non-structured information-gathering tool used to uncover areas to be looked at in a PRA. A PRA is designed to directly and actively assist the participants.

RRA-1 **Poor Farmers on Non-Fish Wetland Products**

Name: *Abdul Muhid, Murtaz Ali, Abdul Bashar, Junaid Hussain, Abdul Hakim, Ali Assan, Md. Sofie, Billal, Jofur Mia, Maruf Mia, Allal Mia, Rual, Samin, Abdul Haddi, Azrahul Islam, Foriduzzaman, Ryce, Moqbul Hossain*

Location: *Lalbagh*

Date: *11/12/01*

Farmer Type: Fisherman

Distance from Haor: *Close (up to 1 km)*

NON-FISH PRODUCT USE

- The farmers collected *shaluk*, *tona* and *shapla* (all fruits of water or lotus/lily plants) during August-September. Grasses for fodder and *halanchashak* for human consumption were harvested all year from the haor. Birds were also hunted during the winter (November-February).
- Approximately 12.5% of the annual income of these participants came from non-fish wetland products.

FISHERIES ISSUES

- The major fear of the fisherman is that if the haor dries up then they will not be able to fish (i.e. they will have no way to support their family and earn money).
- The problems that these fishermen face are largely: siltation of the waterways, lack of fish varieties (there is over fishing of large fish are extinct and there are very few small fish species left). Weeds are destroying the fishing navigational routes, clogging the waterways. Their ideas for improving the situation are to re-excavate channels and set aside fish sanctuaries to give the fish the chance to regenerate.

OTHER ISSUES

- Other problems the fisherman have identified are: the leasers are willing to accept bribes from larger fishermen to allow them to over fish, rich landowners have near total control

over the land and water resources and this means that it is difficult for the poor fishermen to grow their fishing operations, and in some cases, even maintain them.

- Leaser's control the beels (water bodies) and have placed fishing restrictions fishing in those areas.

RRA-2

Name: *not given*
Location: *West Varaura*
Date: *11/12/01*
Farmer Type: *Poultry (AIG) [off seasonal fishermen]*
Distance from Haor: *Far (2-3 km)*

NON-FISH PRODUCT USE

- Collecting fodder from the haor saves the fishermen 1500 taka per month. It takes 6 hours a day to collect enough fodder for 4 cows. 50% of the houses here have cows. They all collect fodder from the haor.
- In the dry season, about 200-250 Taka value per day from non-fish aquatic wetland products is utilized by these fishermen.
- Now that there is virtually no fish left in the haor, these once-fisherman harvest the leaves of the *shapla* to eat and the grasses as fodder for cattle. They also eat the *shamuk*, which is a type of snail, and the *dona*, a type of lotus fruit.
- The poor fishermen earn about 30 600 taka per year (approx. A$874) and 12 500 taka of this total comes from non-fish resources from the haor. Therefore, about 40% of their income comes from the haor's non-fish aquatic wetland resources.
- They sell the *makhua*, a type of water fruit at the market.

FISHERIES ISSUES

- These farmers have identified that the lack fish species and the siltation are major causes for concern.
- Generally, these farmers/fishermen have very little to do, as the amount of fish in the haor is not enough for full time fishing. If they were not farming poultry, they would be idle labour.
- They consume small amounts of non-fish products for personal consumption, but they do not count this as harvesting for selling purposes. They consider any products sold from the haor as a bonus to their income, not the sole source, or a major source.
- Those who can't fish, lease fishing gear, collect grasses for fodder and supply it to others.
- These farmers are breeding poultry as an alternative means of income whilst they refrain from fishing. The locals realize that the fish need time to regenerate, an as such, have moved into poultry as a means of income in the meantime.

OTHER ISSUES

- In a 30-45 day period, it costs 4000-5000 taka to feed the chickens. The farmers can sell them for a total of 10 000 taka, and therefore, make a profit of 5000 taka each 30-45 day cycle (approx. A$145). The chickens sell for 60-70 taka per kilogram and the chickens can grow up to 1.4 kg each (approx. A$2.40-2.80 per chicken).
- The MACH project trained them (four of the local fishing families) for a month, and now the farmers are into their 3rd batch.
- The poultry farm has a capacity of 300 chickens, but currently has 100.
- Other AIG activities include tending cattle, making fishing equipment (nets, gears etc.) and fish trading (they sell and trade the fish, but do not catch it themselves).

RRA-3 Larger Farmers Non-Fish Wetland Products

Name: *Orun Kanta Roy*

Location: *Bhimlsi*

Date: 11/12/01

Farmer Type: *Agricultural Farmer (Rice/other side crops)*

Distance from Haor: Far (2-3 km)

NON-FISH PRODUCT USE

- Non-fish resources: he uses a lot of grass from the haor as fodder for his cattle. He has to buy 600 Tk. Per month of fodder to supplement his cattle's haor grass intake. If not for the grass from the haor, there would not be enough grass available on the market for him feed his cattle.
- Hill-streams provide water for irrigation. If he could get more water he would produce more crops.

RRA-4

Name: Diponkar Dash

Location: *Bhimlsi*

Date: *11/12/01*

Farmer Type: *Agricultural Farmer (Rice/other side crops)*

Distance from Haor: *Far (2-3 km)*

NON-FISH PRODUCT USE

- Both the farmers collect grasses from the haor as well as purchase fodder for their cattle.
- On average, the larger farmers earn 77 099 taka per year (approx. A$2202.83) and 18 750 taka of this comes from haor support (value of fodder collected from the haor plus the actual amount spent on resources from the haor) annually. Therefore, about 24% of the total income of the larger farmers comes from the haor (15% of their total income is saved by haor resources that he would have spent on fodder).
- They grow different crops during the seasons (*aush*, *amon* and *boro*) on their land. The winter season, *aush*, sees the water level fall as the monsoon leaves. If the haor were to shrink, the farmers would not be able to produce their rice crops during this season. On the same token, they would be able to produce more rice if they were able to access more water from the haor.

3.0 Groundwater Issues

3.1 Introduction

The rapid rural appraisal (RRA) concerning groundwater issues was conducted alongside the RRA on non-fish products. It was a short survey only intended to gain an introductory insight into the possibility of groundwater concerns. It was mainly trying to ascertain whether a fall in the water level of the haor would (negatively) affect the groundwater table. Information on the consequences changing water table levels had on farmers, such as tube-wells or if water access is becoming unavailable was noted. An Internet search was also conducted to examine the relationship between wetland degradation and groundwater levels.

3.2 The Ground Water RRA

The survey presented to the small and large farmers is presented in Annex 3 and was conducted simultaneously with the non-fish product RRA.

RRA-1 Small Farmers on Ground Water Issues

Name: *Abdul Muhid, Murtaz Ali, Abdul Bashar, Junaid Hussain, Abdul Hakim, Ali Assan, Md. Sofie, Billal, Jofur Mia, Maruf Mia, Allal Mia, Rual, Samin, Abdul Haddi, Azrahul Islam, Ryce. Foriduzzaman, Moqbul Hossain*

Location: *Lalbagh*

Date: *11/12/01*

Farmer Type: *Fisherman*

Distance from Haor: *Close (up to 1 km)*

TUBE WELLS

- These fishermen have not noticed any changes in the level of water supply (rise/fall) in recent years.

- They feel that the water availability from the haor is the same, and that it dries up during the same time as it always had (February and March). De-watering from leaves.
- The fishermen have not notices that the tube well is drying up faster than it previously did. The water is unavailable during the winter months.

GROUNDWATER ISSUES

- The amount of water used for drinking has increased for the fishermen, but the amount of water for agriculture has not. The fisherman do not have any system for using the water e.g. irrigation and are landless, so they cannot grow crops.

RRA-2

Name: *not given*
Location: *West Varaura*
Date: *11/12/01*
Farmer Type: *Poultry (AIG)*
Distance from Haor: *Far (2-3 km)*

GROUNDWATER

- The lack of water in the dry winter season is cause for concern for the poultry farmers.
- The rapid floods increase the water level without giving the weeds a chance to catch up and block the waterways. However, when the water level increase gradually, it means that the weeds are able to grow at the same rate, taking oxygen out of the water, blocking sunlight and fishing paths.
- In the drier months (October to April) means less income for these fishermen (50-80 taka per day, compared with 200-300 taka per day in the wet season), which is why they need AIG activities in these periods.

RRA-3 Large Farmers on Ground Water Issues

Name: *Orun Kanta Roy and Diponkar Dash*

Location: *Bhimsli*

Date: *11/12/01*

Farmer Type: *Agricultural Farmer (Rice/other side crops)*

Distance from Haor: *Far (2-3 km)*

TUBE WELLS

- The farmers are noticing the tube well drying up any earlier than usual after monsoon. They insist that water is always available from the haor. Problems only arise if the tube well is made too shallow.
- The use of the tube wells has increased. But is seldom used for agriculture by these farmers, because there is difficulty with the filtration, the wells get clogged from too much sand and prefer to use surface water.

GROUNDWATER

- Both farmers have noticed no change in the level of water supply (rise or fall) over recent years.
- They are always able to get water from the haor, every month

RRA-4

Name: *not given*

Location: Tea Gardens

Date: *11/12/01*

Farmer Type: *Agricultural Farmer (pineapples/lemons/chilies)*

Distance from *Haor: Far (2-3 km)*

TUBE WELLS

- The tube wells need to draw water from a depth of 80-10 metres. There is no problem getting the water, and the water level has not changed as far as the farmers have noticed.

GROUNDWATER

- Lemons need a constant water supply.
- The lemon farmers irrigate their crops with water from hill-streams, which they get by using pumps.
- One of the three lemon farmers surveyed said that tube wells were occasionally used for watering their crops, but they mainly used the water from the hill-streams. This farmer noted that the level of water from the tube wells has fallen over the last few years. The water from the tube wells doesn't meet his requirements, so he must use the surface water (hill-streams) instead.
- There are a lot of hill-streams in the area as the farming land is near the catchment boundary. The farmers prefer to farm lemons as growing pineapples incurs a loss for them. Also, the farmers tend to plant the rows of pineapples vertically down the slope and not horizontally along the contour. This has caused serious erosion in some areas.

OTHER ISSUES

- During the wet season, when there is plenty of water, the price of lemons falls to 200 taka per 1000 lemons, due to the excess supply of lemons in the market.
- In the off-season, pineapples fetch 15-20 taka each, but in the peak season, they can sell for as low a 3-4 taka each.
- Some of the farmers use hormones to increase the size of the lemons.
- The lemon trees need to be sprayed every 15 days with pesticide. The pesticide is sprayed with different types every cycle, so that the insects do not become immune.
- Lemons need fertiliser twice a year (the farmers use urea and potash).
- Medium sized lemon fetch 1100 taka per 1000 lemons at the markets (approx. A$31 for 1000 lemons).
- The lemons from the Sri Mangal area supply the local market as well as the Dhaka market.

- The farmers grow three varieties of lemons: Jarrah (large), Chinese (large, fragrant variety that can fetch up to 20 taka per lemon) and the Kubuji variety (oval shaped. Small and medium sized). The Jarrah and the Chinese varieties are exported to the UK and the US.
- As an aside, these farmers also grow some chilies.

3.3 Internet and Secondary Literature Source Search

The objective was to find information on studies conducted elsewhere (but as close to Bangladesh as possible), which studied and analysed the socio-economic effect of varying ground water levels. In particular, information on a wetland that had water levels falling and the effect that this had on the wetland, the people and the economy.

An Internet search was conducted using many keywords associated with this topic (wetlands, water levels, aquifers, groundwater, measuring groundwater, measuring aquifer, and others). Journal databases were searched on he Internet for articles relating to the subject. This was conducted at several science journal publication sites.

The search had limited success.[6] Some of the articles found were inaccessible from the Internet and hard copies were required. Other articles could only be accessed if the user had a subscription to use the site and some articles, which did not need payment to be accessed, and were available, were not relevant.

The some relevant articles found were from the International Water Management Institute (IWMI).

The first report, *Research Report 49: Basin Level Use and Productivity of Water: Examples from South Asia*[7]. This report examined a water accounting procedure to four sub-basins in South Asia: the Bhakra in India, Chishtian in Pakistan, Huruluwewa in northern Sri Lanka and the Kirindi Oya in southern Sri Lanka. The accounting procedure identifies the quantities and

[6] There was limited time for the activity, limited access to the Internet, and other tasks were given higher priority.

[7] The authors of this report were: David Molden, R. Sakthivadivel and Zaigham Habib.

the productiveness of various water uses within a basin. In all four cases, the productivity of water currently being depleted by agriculture can be improved. This methodology can be used on the Hail Haor to see if the water productivity can be improved.

The second report was *Research Report 50: Modeling Scenarios for Water Allocation in the Gediz Basin, Turkey*[8]. This report was designed to describe the use of a distributed hydrological model to evaluate different data scenarios for the Gediz basin in Turkey. It was found that a (positive) climate change would have the largest impact on the basin. Average stream flows would decrease to about 2/3 of their current levels in a wet year and almost half on a dry year. This has an opposite implication to Bangladesh as the risk of climate change will have a pronounced effect, including flooding, not drying up of the basin.
The irrigation scenario showed that an increase in the climate would reduce the volume of surface water and increase the dependence on groundwater supplies.
This report had instructions detailing how further scenarios may be modeled for different basins. This approach may be applied to the Hail Haor if further more detailed analysis was desired.

[8] The authors of this report were: Geoff Kite, Peter Droogers, Hammond Murray-Rust and Koos de Voogt.

4.0 Hail Haor Household Survey of Non-Fish Aquatic Wetland Products

4.1 Introduction

The survey was conducted for a report (Colavito, 2001). The objective of the report was to develop a methodology to determine a lower limit on the economic value of the Hail Haor MACH project wetland site. Currently, the Hail Haor is in a degraded state and its condition is continuing to decline due to siltation (caused by man-made erosion of the surrounding hills) and over exploitation of common resources.

Establishment of the economic value of the wetlands is crucial to justify their preservation and the allocation of resources for their management.

4.2 Survey Methodology for Estimation of Hail Haor Non-Fish Products

A. Summary of Methodology

In this section, the methodology and implementation of the survey are detailed
There were two major objectives of this activity:

(1) Estimate the total non-fish[9] product output value[10] for Hail Haor.

(2) Estimate the value of output from Haor land of different types and conditions.[11]

B. Sample selection procedure

Calculations:

[9] Non-fish products include all biological economic outputs that are not included in the catch monitoring survey. The produets would include specific aquatie vegetation, snails/mollusks, and grasses grown on Haor periphery

[10] As part of the economic value calculation total physical output will also be estimated

[11] At this point MACH does not have a classification that clearly incorporates measurement of the level of degradation from overuse. Land types analyzed will be based on land use pattern, water depth and subjective assessment of ecosystem quality.

The calculations for the overall number of villages to be surveyed and the number of villages per stratification layer are outlined below. Note the principal is that each population unit within each stratification layer will have an equal chance of selection. Note some stratification units have too few households to justify a survey.

Sample-draw:

This will identify the villages to be included in the household survey. Selection is done by village with a weighted for population. The mechanical selection is done through keeping a cumulative village population number and the generation of a random number between 0 to the stratification population total. The number generated is then matched to the corresponding village.

The following are the factors for stratification at the village level:[12]

Village type stratifications:

1. Fisherman village
2. Agricultural village

Haor Proximity

1. Close (according to discussion within road about 1 km)
2. Far (according to discussion outside road 1+km up to 2-3 km)

Habitat characteristics[13]

1. "Good" quality
2. "Poor" quality

Within the selected village the following stratifications will be used:

Profession:

[12] If it is determined that village household size vary substantially than for each stratification layer, household number of population should be a weighting factor.

[13] Issue for discussion where this stratification should be used.

Farmer

Fisherman

Land holdings:

Large/medium

Landless/small

The procedure for sampling was as follows:

Identify population villages and their population from available government records
Characterize village as farmer and fisherman from local expert knowledge
Characterize village by proximity
Characterize village as close or far using map/GIS and local expert knowledge
Draw sample from the sample frame 1-4
At selected village level compile list of voters and stratify by profession, and farm size by local expert opinion and draw sample

Village sample size and household survey sample size is based on definition of the population and estimation of variation in measuring variables. However, expectations that major parameters didn't vary substantially with stratifications should justify a smaller village and household sample size in line with project resources

Village selection: 1 Villages per stratification total 6 villages[14]
Household survey: 4 farmers per stratification, 16 per village, total 64 HOUSEHOLDS

Final decision on sample size is determined after sample population is identified (steps 1-4)

Level of effort: one interview took about 20-30 minutes to complete

C. Household Survey Methodology

[14] Note all fisherman villages should be considered close eliminating a number a stratifieation cells

The instructions given for the implementation of this survey were given to the surveyors as.

> *"The interviewer should proceed carefully to determine all the products that the respondent harvests and carefully document the amounts and values of products. The ability of the interviewer to determine all the products being extracted from the Haor is critical to estimating Haor economic value. The interviewer should compile a list of potential products and quiz the respondents about each of the products to jog memory."*[15]

Three CNRS staff (two from CNRS Dhaka and one from CNRS Sri Mangal) implemented the survey. Two locals were hired to collect the sample village names. Mr. Sachin Halder (of CNRS Dhaka) trained the other two CNRS staff in implementing the survey and the two locals in collecting the village names.

After training, it took more than 25 days to collect the data from all the villages. The respondents were very cordial in their reception of the data collectors and were very willing to provide information. As this survey was collecting data on non-fish wetland products rather than the volume of fish caught, there was no rivalry or competitiveness that might otherwise have been there. The liked the questions and gave as much information as they could supply from memory. They named products they harvested, but were not prompted for specific products they may have harvested.

4.3 Analysis

Descriptive information on the survey data including farm size, product type and usage will be presented in tabular form in **Section 4.3.1** and in **Annex 5**. This will then be described and analyzed in the next sections.

[15] Colavito 2001 draft report.

4.3.1 Description of the Data

Tables 2 and 3 and **Figure 2** present descriptive data on income/consumption derived from non-fish wetland resources.

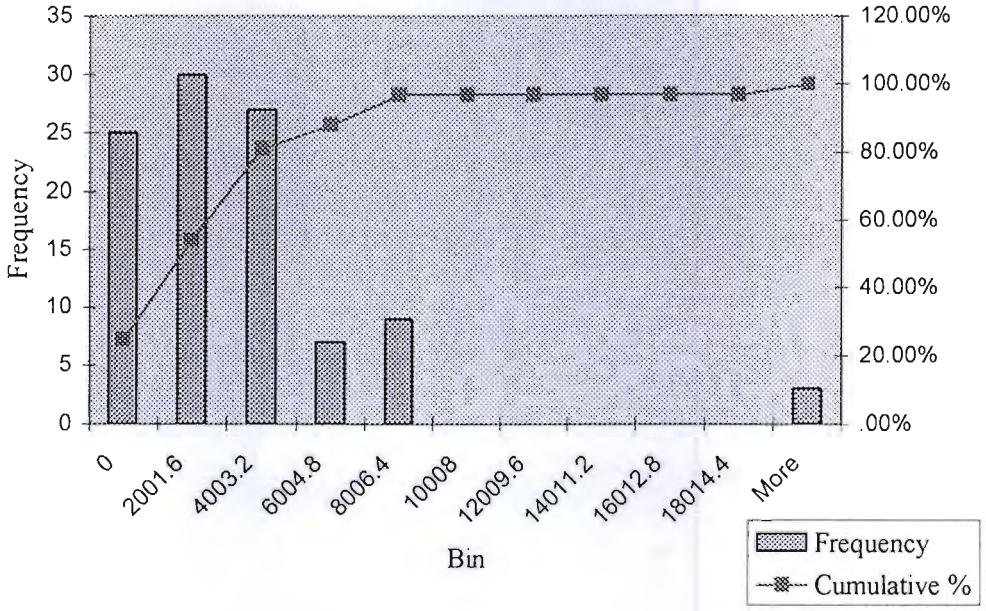
Table 2. Descriptive statistics on non-fish income.

Item	Value
Sample size	64
Mean	2592.574257
Standard Error	377.4392418
Median	1360
Mode	0
Standard Deviation	3793.217435
Sample Variance	14388498.51
Skewness	3.045926582
Range	20016
Minimum	0
Maximum	20016
Sum	261850
Confidence Level (95%)	748.8287902

Table 3. Aggregate Product Value Histogram.

Bin	Frequency	Cumulative %
0	25	0.2475248
2001.6	30	0.5445545
4003.2	27	0.8118812
6004.8	7	0.8811881
8006.4	9	0.970297
10008	0	0.970297
12009.6	0	0.970297
14011.2	0	0.970297
16012.8	0	0.970297
18014.4	0	0.970297
More	3	1

Figure 2. Income Histogram



It is observed that the Aggregate Product Value Data is not normally distributed.

4.3.2 T-tests

Three t-tests were conducted on the data collected from the household survey. The first test was to determine if there was a significant difference between the absolute value of the income gained from the haor between socio-economic groups (defined by land size). The results are shown in **Table 4**.

Table 4: T-test for absolute non-fish product income by land size group.

T-Test: Paired Two Sample for Means		
	Small Farmer Household Income	Large Farmer Household Income
Mean	1608.25	1398.938
Variance	13802391.4	3416371
Observations	32	32
Pearson Correlation	0.08257171	
Hypothesized Mean Difference	0	
Df	31	
t Stat	0.29523178	
P(T<=t) one-tail	0.3848926	
t Critical one-tail	1.69551868	
P(T<=t) two-tail	0.7697852	
t Critical two-tail	2.03951458	

Note: Sample was divided in half by land size

The results here show that there is no statistical difference between large and small farmers in non-fish product use.

The second test was to test if there was a significant difference between the relative value of the income gained from the haor between socio-economic groups. The results are shown in **Table 5**.

Table 5: T-test for relative non-fish product income by land size group.

T-Test: Paired Two Sample for Means		
	% of Small Farmer HH Income	*% of Large Farmer HH Income*
Mean	0.040011	0.033038
Variance	0.011287	0.002224
Observations	32	32
Pearson Correlation	-0.04927	
Hypothesized Mean Difference	0	
Df	31	
t Stat	0.33331	
P(T<=t) one-tail	0.370572	
t Critical one-tail	1.695519	
P(T<=t) two-tail	0.741145	
t Critical two-tail	2.039515	

Note: Sample was divided in half by land size

The results here show that there is no statistical evidence to say that there is any difference of relative income gained from the haor between socioeconomic groups.

The third test was to test if there was a significant difference between the relative (by standard land sizes) value of the income gained from the haor between socio-economic groups. The results are shown in **Table 6**.

Table 6: T-test for relative non-fish product income by standard land size group.

T-Test: Two-Sample Assuming Equal Variances		
	% of Small Farmer HH Income	*% of Large Farmer HH Income*
Mean	0.04375	0.027234
Variance	0.011053	0.001054
Observations	36	28
Pooled Variance	0.006698	
Hypothesized Mean Difference	0	
Df	62	
t Stat	0.80088	
P(T<=t) one-tail	0.21313	
t Critical one-tail	1.669805	
P(T<=t) two-tail	0.42626	
t Critical two-tail	1.998969	

Note: Sample land size was 2.5 acres and is used as the break point

Again, the results here show that there is no statistical evidence to say that there is any difference of relative income (by standard size) gained from the haor between socioeconomic groups.

5.0 Conclusion

5.1 RRA with Farmers about Non-Fish Wetland Aquatic Products

The RRA showed that there were a wide variety of products harvested. It indicated that larger farmers primarily harvested grass, and the smaller farmers collected a larger variety of products.

5.2 Rapid Rural Appraisal (RRA) with Farmers about Groundwater Issues

A number of farmers, particularly larger farmers, noted that the tube well water was drying up faster than it has in the past.

5.3 Hail Haor Household Survey of Non-Fish Aquatic Wetland Products

The analysis of the data showed that there was no significant difference in the level of non-fish wetland resource use between different socio-economic groups, by either absolute or relative[16] levels of consumption. This contradicts expectation that the poor and marginal will make more use of and be more dependent on the wetland.

[16] Relative consumption refers to the percentage of income from the haor

Annexes

Annex 1: Field Trip Memorandum

The following memorandum was sent to the co-ordinators of the field trip to Hail Haor in Dhaka and Sri Mangal.

To:	**Mr. Sachin Halder (CNRS)**
	Md. Shabuddin (MACH)
	Mr. Bill Collis (MACH)
	Dr. Luke A. Colavito
From:	Naushee Rahman
Date:	December 6, 2001

RE: **Field Trip to Sri Mongol**

Travel to the Site

Departure (Dhaka):	10/12/01 at 7 AM on the Parabat Train
Arrival (Sri Mangal):	10/12/01 at 11:50 AM

Activities (11/12/01)

Visit group of farmers to survey regarding:

(a) Changes in the water level

(b) Socio-economic RRA

Visit an income generation group

Visit pineapple growers

Other routine activities

Travel Back From Site

Departure (Sri Mangal):	12/12/01 at 9:30 AM on the Joyintika Train.
Arrival (Dhaka):	12/12/01 at 2:30 PM

Requirements

Accommodation:

Reservations at the MACH Guesthouse from the 10/12/01 to the 12/12/01.

Travel:

Vehicle for pick-up from Sri Mangal Station to the MACH guesthouse at 11:50 AM, on the 10/12/01.

Vehicle for travel between sites for the Activities on the 11/12/01.

Vehicle for drop-off to the Sri Mangal Station at 8:30 AM on the 12/12/01.

Activities:

Organisation of Activities for the 11/12/01, that is:

1. Organise a group of farmers from around the Haor for surveying.
2. Visit an income generation group.
3. Visit Pineapple Growers.
4. Other routine activities for Hail Haor visits

Annex 2: Field Trip Itinerary

Upon arrival at Sri Mangal, a meeting was held at the MACH office where the participants were briefed on the activities at the MACH site and following day's activities. The itinerary for the field visit to the Hail Haor is shown below.

MACH Project
Hail Haor Site

Visit Program for Naushee Rahman and Dr. M. A. Mannan
Date: 10-11 December 2001

10-12-01	15:00	Project Briefing
	15:30	Start for visit to BTRI
11-12-01	8:00	Start for visit to Poultry Farm at *West Varaura* (AIG).
	8:30	Start for meeting with beneficiary group at *Lalbagh*. Discuss tube-well related issues (groundwater) as well as non-fish wetland resources with small fishermen.
	9:30	Start for visit to riparian plantation and swamp nursery.
	10:30	Start for visit to haor (wetlands) at *Vunbir Point*.
	11:30	Start for visit to a pineapple demonstration plot for discussion with farmers.
	13:00	Visit larger agricultural farmers at *Bhimsli*.
	14:00	Return to MACH office.
	15:30	Debriefing.
	16:15	Leave Sri Mangal by Parabat.

Annex 3: The RRA Survey Checklist

The following checklist from Colavito (2001) was utilized. Basic questions on water table issues were conducted informally.

Household Survey Form: Hail Haor non-Fish Products

Location: _____

Family and Respondent Name: _____

Date of Interview _____

Distance to Haor _____

Socio-economic status

Major Profession: _____(Farmer, Fisherman, Part-time fisherman, other specify)

Land holdings:

Land type*	**Amount (Ha/Dec/Acres)**
(Specify by irrigation and cropping pattern)	Specify units

*Also include access to particular Beels by payment of a fee.

Harvesting of non-Fish Products:

Fill in the following table:

Harvesting Non-Fish Products

Product name	Beel Source	Season Harvested (list by month and week number)	Harvest effort (no of days per period)	Amount harvest per harvest effort	Value of Product (market price or labor value)	Source of Valuation (local market, farm gate price, value of labor to collect)	Total value (Multiply and recheck with farmer)	Product use(s): Home use for consumption or other production activity or sale	Percent of production change from 5 years ago	Comments
1.	Name of Beel, include line for each Beel	Example: May 1st week to End May 4th week	1 day per week	10 kg	3	From list above or other	4*10*3=120	From list above or other	Farmer assessment of percent decline	
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										

Annex 4: Field Trip Report

A brief log of events of the day's events at the haor is detailed in the following diary.

Monday, 10th December, 2001

15:00 I arrived at the MACH office in Sri Mangal where I was introduced to Mr. Moloy Sarker and Mr. Darrel Deppert. I was briefed on the project's aims, goals, past and current activities and what I was to do the next day.

15:30 Dr Mannan took me to the Bangladesh Tea Research Institute where I was able to see the tea gardens get a better idea of the hilly environment.

Tuesday, 11th December, 2001

8:00 I met Mr. Sarker and Dr Mannan and we went to see the first of the sites, an alternative income generation group of poultry farmers at *West Varaura*. These farmers were part time fishermen who were relaxing their intensive fishing practices in the hopes it would give the fish time to regenerate. In the meantime, they farmed poultry for alternative income. These fishermen were very aware of their dependency on the haor and knew that it was necessary to preserve the wetland.

8:30 We went to *Lalbagh* to meet a beneficiary group of the MACH activities. The fishermen had restricted their fishing in order to give the fish a chance to regenerate. They were very dependent on the haor for both fish and non-fish resources. They were able to identify the problems the haor had, and how it could be fixed. Even so, they were unhappy about cutting back on fishing as this meant a cut in income.

9:30 The next stop was a riparian plantation. This plantation was supplying the vegetation for planting in eroded and denuded wetland areas. Many of the plants would be of economic or medicinal use to the villagers once they were mature. Next to the plantation was a riverbank, which had been re-vegetated using the plants from the nursery. Further upstream, there was a sand mining operation where sand brought down from the Gopla River. The sand was filling up the waterways and causing other sedimentation problems. The benefit of this sand mining is two-fold. The miners have a source of

income selling the sand for constructional use in the city and they are removing the sand from the waterways.

10:30 As it is winter now, the haor is in its 'dry' period. There is still evidence of the how extensive the wetlands were during the monsoon, and people are still fishing in the shallow waters. Now, there were *boro* rice crops grown in the areas where the water level has receded.

11:30 The pineapple farmers were fairly convinced that the horizontal planting technique along the contour was a better way to cultivate, but they considered it a 'loss item'. They would rather concentrate on their primary crop, lemons. All the large farmers here grew lemons. The volume of lemons produced here (in the Sri Mangal district) can supply the Dhaka market, as well as the local and some of the export markets.

13:00 I met with two larger agricultural farmers who were not reliant on the haor for any of their requirements other than for cattle fodder. They did not need it for income, food (although they ate fish) or their livelihoods. They used a large quantity of grass collected from the haor as fodder for their cattle the market would not be able to supply the amount of cattle fodder required by even one of the farmers if the haor ceased providing free grass. If the water from the haor readily available during the *boro* season, both farmers would be able to produce much more rice than they were currently producing, but they weren't adversely affected by the water level.

15:30 The debriefing meeting took place back at the Sri Mangal MACH office with Mr. Sarker. Details about the day's events were discussed, and points reiterated.

Annex 5: Household survey raw data.

Serial No.	Farmer Size	Farmer Type	Farmer Distance	Aggregate value (for all products) for one year.	Product Name	Annual value for each product List Below
1	Small(Landless)	Fisherman	Close	0		
2	Small(Landless)	Fisherman	Close	0		
3	Small(Landless)	Fisherman	Close	0		
4	Small(Landless)	Fisherman	Close	800	Shaluk	800
5	Small(Landless)	Fisherman	Close	0		
6	Medium(Upto 2.5 acre)	Fisherman	Close	1320	Grass	1200
6	Medium(Upto 2.5 acre)	Fisherman	Close	1320	Snails	120
7	Small(Landless)	Fisherman	Close	0		
8	Medium(Upto 2.5 acre)	Fisherman	Close	0		
9	Small(Landless)	Other	Far	0		
10	Large(Greater than 2.5 acre)	Farmer	Far	0		
11	Large(Greater than 2.5 acre)	Farmer	Far	0		
12	Medium(Upto 2.5 acre)	Farmer	Far	0		
13	Medium(Upto 2.5 acre)	Farmer	Far	0		
14	Medium(Upto 2.5 acre)	Farmer	Far	0		
15	Medium(Upto 2.5 acre)	Farmer	Far	0		
16	Medium(Upto 2.5 acre)	Farmer	Far	0		
17	Small(Landless)	Fisherman	Close	1890	Grass	1800
17	Small(Landless)	Fisherman	Close	1890	Pokol	90
18	Small(Landless)	Fisherman	Close	1232	Grass	1200
18	Small(Landless)	Fisherman	Close	1232	Snails	32
19	Small(Landless)	Fisherman	Close	0		
20	Small(Landless)	Fisherman	Close	96	Snails	96
21	Small(Landless)	Fisherman	Close	2120	Shaluk	240
21	Small(Landless)	Fisherman	Close	2120	Grass	1800
21	Small(Landless)	Fisherman	Close	2120	Snails	80
22	Small(Landless)	Fisherman	Close	768	Snails	768
23	Small(Landless)	Fisherman	Close	1280	Grass	1280
24	Medium(Upto 2.5 acre)	Fisherman	Close	2720	Shaluk	160
24	Medium(Upto 2.5 acre)	Fisherman	Close	2720	Grass	2400
24	Medium(Upto 2.5 acre)	Fisherman	Close	2720	Pokol	160
25	Medium(Upto 2.5 acre)	Farmer	Far	4480	Grass	1920
25	Medium(Upto 2.5 acre)	Farmer	Far	4480	Grass	1280
25	Medium(Upto 2.5 acre)	Farmer	Far	4480	Grass	1280
26	Large(Greater than 2.5 acre)	Farmer	Far	510	Dolkolmi/Khulum	480
26	Large(Greater than 2.5 acre)	Farmer	Far	510	Halanchashak	12
26	Large(Greater than 2.5 acre)	Farmer	Far	510	Dunuman Kanpata	12

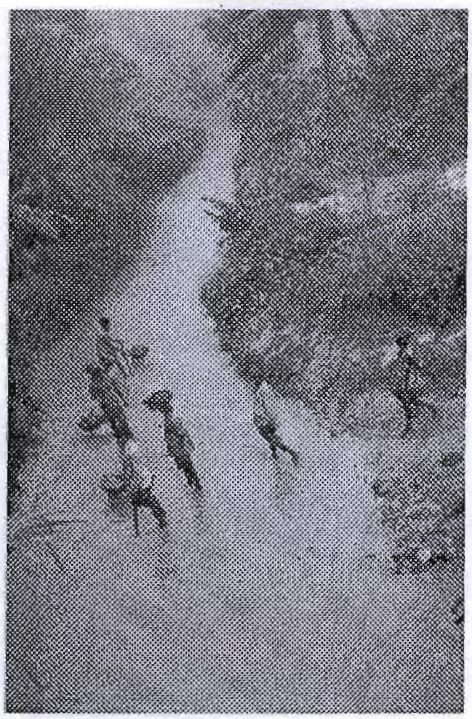
Serial No.	Farmer Size	Farmer Type	Farmer Distance	Aggregate value (for all products) for one year.	Product Name	Annual value for each product List Below
26	Large(Greater than 2.5 acre)	Farmer	Far	510	Kolmishak	6
27	Small(Landless)	Other	Far	0		
28	Small(Landless)	Farmer	Far	7540	Shaluk	600
28	Small(Landless)	Farmer	Far	7540	Grass	2400
28	Small(Landless)	Farmer	Far	7540	Snails	100
28	Small(Landless)	Farmer	Far	7540	Dolkolmi/Khulum	3840
28	Small(Landless)	Farmer	Far	7540	Kolmishak	300
28	Small(Landless)	Farmer	Far	7540	Shapla	300
29	Small(Landless)	Other	Far	3816	Shaluk	1200
29	Small(Landless)	Other	Far	3816	Snails	48
29	Small(Landless)	Other	Far	3816	Dolkolmi/Khulum	1920
29	Small(Landless)	Other	Far	3816	Kolmishak	360
29	Small(Landless)	Other	Far	3816	Shapla	144
29	Small(Landless)	Other	Far	3816	Lota	144
30	Small(Landless)	Other	Far	24	Shapla	24
31	Small(Landless)	Other	Far	376	Kolmishak	216
31	Small(Landless)	Other	Far	376	Shapla	160
32	Medium(Upto 2.5 acre)	Fisherman	Far	3770	Grass	3650
32	Medium(Upto 2.5 acre)	Fisherman	Far	3770	Shapla	120
33	Medium(Upto 2.5 acre)	Farmer	Close	0		
34	Small(Landless)	Other	Close	320	Dolkolmi/Khulum	320
35	Small(Landless)	Fisherman	Close	1200	Dolkolmi/Khulum	1200
36	Small(Landless)	Fisherman	Close	2640	Shaluk	80
36	Small(Landless)	Fisherman	Close	2640	Ugolgrass	2400
36	Small(Landless)	Fisherman	Close	2640	Gangra	160
37	Small(Landless)	Farmer	Close	0		
38	Small(Landless)	Fisherman	Close	20016	Pokol	18000
38	Small(Landless)	Fisherman	Close	20016	Snails	96
38	Small(Landless)	Fisherman	Close	20016	Dolkolmi/Khulum	1920
39	Medium(Upto 2.5 acre)	Farmer	Close	3000	Grass	1200
39	Medium(Upto 2.5 acre)	Farmer	Close	3000	Ugolgrass	1800
40	Small(Landless)	Other	Close	72	Snails	72
41	Small(Landless)	Fisherman	Close	32	Snails	32
42	Small(Landless)	Fisherman	Close	1200	Grass	1200
43	Small(Landless)	Fisherman	Close	0		
44	Small(Landless)	Fisherman	Close	0		
45	Large(Greater than 2.5 acre)	Fisherman	Close	3650	Grass	3650
46	Small(Landless)	Fisherman	Close	82	Shapla	50

Serial No.	Farmer Size	Farmer Type	Farmer Distance	Aggregate value (for all products) for one year.	Product Name	Annual value for each product List Below
46	Small(Landless)	Fisherman	Close	82	Gangra	32
47	Small(Landless)	Fisherman	Close	184	Shapla	144
47	Small(Landless)	Fisherman	Close	184	Gangra	40
48	Small(Landless)	Fisherman	Close	0		
49	Large(Greater than 2.5 acre)	Other	Far	0		
50	Medium(Upto 2.5 acre)	Farmer	Far	0		
51	Medium(Upto 2.5 acre)	Other	Far	0		
52	Large(Greater than 2.5 acre)	Farmer	Far	7312	Shaluk	96
52	Large(Greater than 2.5 acre)	Farmer	Far	7312	Grass	7200
52	Large(Greater than 2.5 acre)	Farmer	Far	7312	Dona	16
53	Medium(Upto 2.5 acre)	Other	Far	2700	Grass	2700
54	Small(Landless)	Other	Far	3000	Grass	3000
55	Large(Greater than 2.5 acre)	Farmer	Far	640	Grass	640
56	Small(Landless)	Other	Far	0		
57	Small(Landless)	Farmer	Close	1360	Shaluk	400
57	Small(Landless)	Farmer	Close	1360	Dolkolmi/Khulum	960
58	Medium(Upto 2.5 acre)	Farmer	Close	2560	Grass	2400
58	Medium(Upto 2.5 acre)	Farmer	Close	2560	Snails	160
59	Medium(Upto 2.5 acre)	Farmer	Close	4320	Shaluk	800
59	Medium(Upto 2.5 acre)	Farmer	Close	4320	Grass	1200
59	Medium(Upto 2.5 acre)	Farmer	Close	4320	Dolkolmi/Khulum	1920
59	Medium(Upto 2.5 acre)	Farmer	Close	4320	Shapla	400
60	Medium(Upto 2.5 acre)	Farmer	Close	2400	Grass	2400
61	Small(Landless)	Farmer	Close	2400	Grass	2400
62	Large(Greater than 2.5 acre)	Farmer	Close	2400	Grass	2400
63	Medium(Upto 2.5 acre)	Farmer	Close	2000	Grass	2000
64	Large(Greater than 2.5 acre)	Farmer	Close	0		

Annex 6: Photographs

This is the RRA in *Lalbagh*. The author can be seen taking down the responses to the surveys.

This is a riparian plantation that provides the plants for re-vegetating the denuded neighbouring riverbanks.



This is sand mining operation at *Vunbir Point* that serves two purposes: remove the sand that clogs the water paths for the fish and their harvesters; as well as provide the local with income