



# MACH-II

## Completion Report – Volume- 1

### MACH Achievement



June, 2007

**USAID**  
FROM THE AMERICAN PEOPLE

*A project of the Government of Bangladesh*

*Supported by USAID*

*Project Partners:*

*Winrock International*

*Bangladesh Centre for Advanced Studies (BCAS)*

*Center for Natural Resource Studies (CNRS)*

*CARITAS Bangladesh*



# MACH-II

## Completion Report

### Volume-I



June 2007

Winrock International  
Bangladesh Centre for Advanced Studies  
Center for Natural Resource Studies  
CARITAS Bangladesh



**WINROCK**  
INTERNATIONAL



**Table of Contents**

<b>Table of Contents.....</b>	<b>i</b>
<b>Acronyms.....</b>	<b>iii</b>
<b>1. Executive Summary.....</b>	<b>v</b>
<b>2. Project Overview .....</b>	<b>1</b>
A. BACKGROUND .....	1
B. ARRANGEMENT .....	1
C. PHYSICAL INTERVENTION SUPPORT FUND.....	2
D. STRATEGIC OBJECTIVE FRAMEWORK.....	3
E. PROGRAM MANAGEMENT .....	3
F. MAJOR FINDINGS OF THE MID-TERM REVIEW, THE GoB EVALUATION OF ISM AND THE USAID EVALUATION OF MACH.....	4
G. SYNERGIES WITH OTHER PROJECTS.....	5
H. PROJECT SITES .....	5
<b>3. Summary of Achievements and Impacts .....</b>	<b>10</b>
A. RESOURCE MANAGEMENT ACTIVITIES .....	10
B. MACH HABITAT RESTORATION.....	12
C. WETLAND AND RIPARIAN TREE PLANTING .....	14
D. INDUSTRIAL POLLUTION MITIGATION .....	16
E. RESOURCE MANAGEMENT ORGANIZATIONS.....	19
F. PUBLIC AWARENESS PROGRAM .....	24
G. CO-MANAGEMENT AND GOVERNANCE .....	26
H. FEDERATIONS OF RESOURCE USER GROUPS (FRUGs).....	30
I. LIVELIHOODS.....	32
J. WETLAND IMPACTS .....	35
K. OUTREACH PROGRAM .....	38
L. INFLUENCE AND UPTAKE .....	41
M. COMMUNICATION INITIATIVES FOR INFLUENCE AND UPTAKE .....	42
<b>4. Sustainability, policy impact and uptake.....</b>	<b>45</b>
A. SUSTAINABILITY THROUGH LOCAL INSTITUTIONS .....	45
B. SUSTAINABILITY THROUGH EXTERNAL INFLUENCES AND POLICY CHANGE.....	46
C. SUSTAINABILITY THROUGH EXPANSION BUILDING ON MACH .....	48
<b>5. Economic value of wetlands and estimated value of MACH impacts .....</b>	<b>50</b>
A. INTRODUCTION.....	50
B. ECONOMIC VALUE OF HAIL HAOR WETLAND.....	50
C. VALUE OF BENEFITS DERIVED FROM MACH .....	52
D. BENEFIT COST ASSESSMENT .....	55
<b>6. People's Empowerment.....</b>	<b>57</b>
A. INTRODUCTION.....	57
B. ANECDOTES ON EMPOWERMENT .....	58
<b>7. Financial Summary .....</b>	<b>64</b>
A. DURATION AND FUND ALLOCATION .....	64
B. IMPLEMENTING PARTNER ORGANIZATIONS.....	64
C. BUDGET AND EXPENDITURE.....	65
D. FINANCIAL REPORTING AND AUDIT .....	66
<b>8. MACH II Revised Exit Plan Milestone Log (Major Events/Activities November 2006- June 2007) .....</b>	<b>67</b>

**TABLES**

Table 1: Wetland sanctuaries existing in MACH sites in April 2007 by year of creation. ....	11
---	----

Table 2: Status of re-excavation of beels and canals up to April of 2007.....	12
Table 3: Number of fish protection devices installed up to April 2007.....	14
Table 4: Summary of other structural works up to April 2007.....	14
Table 5: Numbers of trees planted by habitat type and area.....	15
Table 6: Number of trees surviving in October 2006.....	16
Table 7: Median values of different parameters in water in seven locations of Mokesh Beel ecosystem in 2001. .....	17
Table 8: Results of 24-hour composite effluent samples from five textile factories.....	17
Table 9: Trainings conducted for RMO members (number of participants covered).....	19
Table 10: RMO organizational changes.....	20
Table 11: Summary of RMO assessments recorded as % of achievement of ideal for each indicator theme.....	23
Table 12: MACH awareness raising events and attendance up to April 2007.....	24
Table 13: Breakdown of endowment funds by UFC.....	28
Table 14: Summary of schemes and grants made to RMOs to trial endowment fund operation.....	29
Table 15: Summary of funds used for UFC costs under trial endowment fund operation.....	29
Table 16: Development of RUG/FRUG micro-credit program.....	30
Table 17: Status of FRUGs.....	31
Table 18: Results of FRUG assessments in August 2005 and October 2006 showing achievement against seven categories of indicator (as a percentage out of the possible maximum score for each category of indicator). .....	32
Table 19: Training provided by MACH-Caritas up to April 2007.....	33
Table 20: Changes in income for AIGA credit recipients by year of first loan in MACH-I.....	33
Table 21: Estimated increases in income of RUG members after receiving support for new income sources (training and credit) in MACH-II.....	34
Table 22: Definitions of reporting years.....	36
Table 23: Catch Per Unit Area (kg/ha) by year in three sites.....	36
Table 24: Number of fish species recorded in sample catches in monitoring areas.....	37
Table 25: Biodiversity indices for fish catch (Shannon indices).....	38
Table 26: Summary of outreach schemes.....	39
Table 27: Outreach support provided by MACH (all sites were formerly under Fourth Fisheries Project).....	40
Table 28: Examples of economic wetland benefits.....	50
Table 29: Summary of potential benefits of wetlands and the valuation estimation approaches used in Hail Haor .....	51
Table 30: Estimated value of Hail Haor economic outputs in 1999-2000.....	52
Table 31: Valuation of impacts of MACH project, actual benefits to 2006 and projection for 15 years. Valuation at 2006 prices.....	53
Table 32: Expenditure of MACH projects and benefit- cost analysis.....	55
Table 33: Summary of Benefit-cost assessment.....	56
Table 34: MACH II budget and Expenditure as on 30 April 2007.....	65
Table 35: ISMP budget and Expenditure as on 30 April 2007.....	65
Table 36: Details of progress against milestones set for the no-cost extension of MACH-II.....	67

## Figures

Figure 1: Cumulative total of trees planted by MACH.....	15
Figure 2: BOD levels of factory effluent in Kaliakoir.....	17
Figure 3: Trends in dissolved oxygen levels in three sections of Turag River December 05-March 07.....	18
Figure 4: Co-management arrangements and links between organizations established through MACH.....	26
Figure 5: Micro-credit support through MACH.....	33
Figure 6: Fish consumption- mean with 95% confidence interval (g/person/day) from monitoring.....	35
Figure 7: Composition of fish catch per hectare.....	37
Figure 8: Baikka Beel mid-winter waterbird census.....	38
Figure 9: Components of the MACH exit strategy.....	45

## Appendices

Annex 1: Summary List of MACH-I & MACH-II Reports.....	70
Annex 2: Extracts from the current Bangladesh Poverty Reduction Strategy Paper Relevant to MACH.....	74
Annex 3: Trends in Fish Catch.....	80
Annex 4: Impacts of fish production trends on fish consumption and household livelihoods.....	97
Annex 5: Project Maps.....	115

**Acronyms**

AGM	Annual General Meeting
AIGA	Alternative Income-Generating Activity
BCAS	Bangladesh Center for Advanced Studies
BELA	Bangladesh Environmental Lawyers Association
BOD	Biological Oxygen Demand
CA	Cooperative Agreement
CBO	Community Based Organization
CIDA	Canadian International Development Agency
CNRS	Center for Natural Resource Studies
COD	Chemical Oxygen Demand
DANIDA	Danish Agency for Development Assistance
DFID	Department for International Development (of the UK)
DoE	Department of Environment
DoF	Department of Fisheries
EC	Executive Committee
ERD	External Relations Division (Ministry of Finance)
ETP	Effluent Treatment Plant
FAD	Fish Aggregating Device
FFP	Fourth Fisheries Project
FGD	Focus Group Discussion
FMC	Fisheries Management Committee
FTF	Farmer-To-Farmer Program
FRUG	Federation of Resource Users Group
GB	General Body
GIS	Geographic Information System
GoB	Government of Bangladesh
HH	Hail Haor
IFB	Islamic Foundation Bangladesh
IMED	Implementation Monitoring and Evaluation Division (Ministry of Finance)
IR	Intermediate Results
ISMP	Investment Support to MACH Project
IUCN	International Union for the Conservation of Nature
KM	Kangsha-Malijhee
LCG	Local Consultative Group
LGC	Local Government Committee
LOI	Leaders Outreach Initiatives
MACH	Management of Aquatic Ecosystems through Community Husbandry
MoU	Memorandum of Understanding
MoEF	Ministry of Environment and Forest
MoFL	Ministry of Fisheries and Livestock
MoL	Ministry of Land
NGO	Non-Governmental Organization
NRM	Natural Resource Management
NSC	National Steering Committee
PIL	Project Implementation Letter
PMU	Project Management Unit

RMO	Resource Management Organization
RPT	Results Package Team
RRA	Rapid Rural Appraisal
RUG	Resource User Group
SEI	Stockholm Environment Institute
SO	Strategic Objective
SUFO	Senior Upazila Fisheries Officer
TB	Turag-Bangshi
UDCC	Upazila Development Coordination Committee
UFC	Upazila Fisheries Committee
UFO	Upazila Fisheries Officer
UNO	Upazila Nirbahi Officer
UP	Union Parishad
USAID	U.S. Agency For International Development

## 1. Executive Summary

The floodplains of Bangladesh form one of the world's important wetlands - home to hundreds of species of fish, plants and other wildlife including thousands of migratory birds. The annual catch of almost 500,000 metric tons of fish and prawns from floodplains and wetlands is a source of income and a critical supply of nutrition for millions of Bangladesh's poorest rural households. The people and government of Bangladesh have long recognized that these habitats as well as the fish that depend on them are in decline, but little had been done to reverse this trend.

The Management of Aquatic Ecosystems through Community Husbandry (MACH) projects supported by USAID and the Government of Bangladesh have run from late September 1998 to the end of June 2007, although the local currency component will continue to June 2008. The projects have been implemented by Winrock International, Centre for Natural Resource Studies, Caritas Bangladesh, and Bangladesh Centre for Advanced Studies, working closely with the Department of Fisheries and Ministry of Fisheries and Livestock. The projects have worked in three large wetland systems: Hail Haor (Moulvi Bazar District, wet season extent 12,490 ha) and Turag-Bangshi floodplain (Gazipur District, wet season extent 4,370 ha) from April 1999 onwards, and Kangsha-Malijhee floodplain (Sherpur District, wet season extent 8,210 ha) since August 2000.

MACH has established what is best described as community based co-management of these three large wetland systems covering in total about 25,000 ha of wet season wetlands (about 4,600 ha of water in the dry season). The key elements of the MACH approach have been establishing community organizations and then embedding within them institutions for sustainable wise use of wetland resources, formally linking these with the existing local government system, and through this making interventions to restore wetland habitats and their productivity and to improve the livelihoods of poor people dependent on these wetlands. Where possible it has also addressed poor land use practices in the watersheds of these wetlands that adversely affect the downstream wetland ecosystems.

The organizations involved comprise: 16 Resource Management Organizations (RMOs) representing all local people with interests in wetlands and fisheries and 13 Federations of Resource User Groups (FRUGs) comprising of poor fishers and other poor wetland users. Both RMOs and FRUGs are registered as social welfare organizations and follow good governance practices including elections of office bearers, transparent decision making and accounting, they have demonstrated an ability to handle funds effectively whether raised from local people through fishing fees, or provided from the project. The RMOs incorporate all types of local stakeholders – fishers, farmers, landless, local opinion leaders, men and women, and work to represent the whole community in protecting, managing and restoring productivity of their area of wetland and ensuring fair access for local poor fishers. The FRUGs comprise only of poor men and women who previously made use of these wetlands, and operate savings and credit functions for their members, who have all received training to adopt economic activities that are intended to enhance their incomes and diversify their livelihoods so that they are less dependent on fishing and are able to comply with restrictions on wetland use set by the RMOs without suffering economic hardship. In addition 25 Union Parishads, and the administrations of five Upazilas are involved. The RMOs are now invited to their respective UP meetings. Co-management is formalized through five Upazila Fisheries Committees where representatives of all these bodies sit to coordinate and oversee management of the three wetland systems. All of these organizations have been recognized by government and are expected to continue to function and maintain and enhance these wetlands and the lives of poor resource users in the long term.

MACH has supported excavation of about 57 ha of beels and 32 km of canals to expand dry season water holding in the RMO managed areas; the RMOs established 63 sanctuaries covering an area of 194 ha (within which 25,000 concrete fish protection devices have been placed) and setting closed seasons; planting of 644,000 trees linked with RMOs, local landowners, and public lands; and release of about 1.19 million native fishes of 15 species as part of native fish restoration initiatives.

Collectively these activities have resulted in increases in fish catches of 2-5 times over the 1999 baselines of 58-171kg/ha, reaching an average of 278-362 kg/ha in the last two years in the three sites, or an overall average of 327 kg/ha compared with 144 kg/ha when the project started. Fish consumption of households living in villages around these wetlands has shown statistically significant increases in all three sites, and on average increased by about 45% over the same period (25-36% in Hail Haor), and detailed household monitoring showed that the landless have in general benefited as much as larger landowners. Fish species diversity also increased, particularly in Hail Haor. Here the largest sanctuary covering about 100 ha was created in “Baikka Beel”, in this sanctuary wintering water bird populations rose dramatically from 300-900 of 18 species in 2003 and 2004 to over 7,000 of 35 species in 2006 and 2007. This is the first large wetland sanctuary run by a community organization in Bangladesh, a visitor tower has been constructed, and recognizing the significance of both this sanctuary and the whole of Hail Haor the Ministry of Fisheries and Livestock plans to propose designating the haor as a wetland of international importance (Ramsar site).

Revolving loan funds worth US\$ 0.42 million (Tk.29.1 million) have been transferred to the FRUGs, and training was provided to the group members, this has helped about 5,200 poor households (group members) increase their supplemental incomes by about 50% while also reducing their dependence on fishing by about two-thirds. The FRUGs now operate as independent organizations employing their own staff. For sustainability the Upazila Fisheries Committees are endowed with a total of US\$ 0.53 million (Tk 36 million), the interest from which will primarily be used for continued restoration of wetland habitat by the Resource Management Organizations, but also to cover the costs of meetings and visits by UFC members to the wetlands. These systems have been successfully trialed for two years by providing grants to the UFCs equivalent to the funds they will receive from endowment interest. The principal amount of the endowment will remain and will be slight enhanced yearly so that interest can be expected forever.

A catchment and wetland ecosystem approach has been vital – for example tree planting along streams flowing into the wetlands, and the promotion of contour cultivation on over 90 ha of hills where previously pineapple was grown in rows aligned with the slope – and aimed at reducing soil erosion which is causing siltation of parts of these wetlands by up to 5 cm a year in Hail Haor. Ability of communities and local institutions to address threats has been enhanced, for example in Kaliakoir the number of textile related industries increased from 20 in 2003 to 166 in late 2005, most are involved in dieing and as a result of discharging untreated effluent into local water channels the surface water in the beels and Turag River is now far below national standards in the dry season. MACH has helped local college student volunteers set up a water quality monitoring program reporting to the RMOs and UFC which has generated evidence of the problem. The RMOs of Turag-Bangshi site have also cooperated with one another to hold mass meetings and events to lobby for cleaner water, and were part of delegations from the UFC that met with senior officials of the Department of Environment and Ministry of Environment and Forests. As a result the Upazila Fisheries Committee and Department of Environment have agreed to sign an agreement to cooperate to enforce existing anti-pollution laws as a priority, and polluting industries in general have been instructed by government to comply with existing legislation by installing effluent treatment plants.

These cases illustrate several themes that run through the MACH projects. The project team sought a greater impact by working with other projects and programs: research on pollution and cleaner production options for textile dieing was co-funded by DFID and the European Union, several volunteer experts were brought in under the Farmer-to-Farmer program of USAID including a pineapple expert, and the project collaborated with Nishorgo Support Project to promote co-management of natural resources and with other fisheries projects to promote strategic uptake of good practices in Department of Fisheries. This has been supported by targeted communications initiatives, for example films broadcast on TV on co-management, wetland conservation and water pollution. The project has also sought to strengthen links among the community based organizations – at the site level, and exchanging lessons and experience with those supported by other projects, and with other bodies, including local service providers (government and NGOs) so they know what supports they are entitled to and have contacts that they can turn to after the project ends.



A study in the early stage of the project highlighted the economic value of wetlands in Bangladesh: the economic value of Hail Haor as a wetland in 1999-2000 was estimated largely from use values at US\$ 8 million or Tk 37,000 per hectare per year, much more than single crop agricultural land. By 2006 there had been a 24% increase in this value solely as a result of increased fish catches. Moreover an economic assessment of just the directly attributable impacts of MACH on fish catches, alternative income generating activities, trees, pineapple growing estimated a present value of benefits up to 2022 of Tk 2,970 million or US\$ 44 million at a 6% discount rate. Compared with a present value of total costs equivalent to US\$ 9.57 million, this gives an internal rate of return of 56%, and a benefit cost ratio of 4.7. Moreover, most of these benefits have put more income in the hands and more fish in the stomachs of poor people.

The seeds have been sown to expand this impact. MACH supported the Department of Fisheries (DoF) to take up similar activities in ten former Fourth Fisheries Project water bodies where community organizations already existed, through this nine new sanctuaries were created and 11 existing ones were improved. MACH also has assisted the new inland capture fisheries team of the DoF to develop a program proposal that would see a more national uptake of key elements of the MACH approach and lessons from a series of projects. MACH cooperated with Fourth Fisheries Project, Community Based Fisheries Management phase 2 project and Danida to influence policy in DoF and Ministry of Fisheries and Livestock. Consequently the Inland Capture Fisheries Strategy of the DoF and road map of the ministry include the aim of establishing Upazila Fisheries Committees nationally to incorporate and work with an expanding network of community based organizations, and also place the spread of permanent sanctuaries and efforts to restore and sustain major wetlands as high priorities nationally. Additionally the Government of Bangladesh in their Poverty Reduction Strategy Paper have mentioned MACH as the approach to be considered for management of open inland capture fisheries.

## **2. Project Overview**

### **A. Background**

The floodplains of Bangladesh form one of the world's important wetlands-- home to hundreds of species of unique fish, plants and wildlife and critical habitat for thousands of migrating birds. Equally important, with an annual catch of almost 500,000 metric tons of fish and prawn, the floodplains and wetland habitats serve as a source of income and a critical supply of nutrition for millions of Bangladesh's poorest rural households. The people and government of Bangladesh have long recognized that these habitats as well as the fish that depend on them are in decline.

Recognizing the need for new approaches to floodplain and wetland resource conservation and management, the Governments of Bangladesh and the United States of America jointly developed a program called Management of Aquatic Ecosystems through Community Husbandry (MACH). An agreement to implement this program was signed by the two governments in May 1998. Winrock International and its partners were selected in July 1998 and work began in late September of 1998. Program sites were selected by the Project Steering Committee in March of 1999 and field activities at the Hail Haor and Turag-Bangshi sites began in April 1999. This agreement provided for a 5 year program ending in July of 2003. In July 2000 the MACH program was amended adding an additional work site, the Kangsha-Malijhee site (in Sherpur) with work beginning at this new site in August of 2000.

### **B. Arrangement**

MACH is a Government of Bangladesh (GoB) project supported by the United States Agency for International Development (USAID). Winrock International and its three partners, the Bangladesh Center for Advanced Studies (BCAS), Center for Natural Resource Studies (CNRS), and CARITAS Bangladesh, implemented the project. The original agreement between USAID and the Government of Bangladesh was established through a Results Package Teaming Agreement signed by the two countries. The actual money for the project did not pass through the GoB annual budgets. The mechanism for reporting to government was through the steering committee mechanism, which has remained throughout the project. The project steering committee is chaired by the Secretary, Ministry of Fisheries and Livestock with the Vice Chair being the Joint Secretary of the Ministry of Land (see later for details of its composition).

MACH had its Mid-term review in November and December of 2001. This review recommended that MACH be extended for three years beyond its originally designed completion date. On January 15, 2003, it was agreed that the Strategic Objective Grant Agreement or SOAG signed between the governments of the US and Bangladesh would also extend MACH for a further 3 years. MACH was extended and the phase II is aptly entitled MACH II. MACH II, essentially an extension of MACH, began on October 30, 2003 and ended on October 29, 2006. There was a no cost extension of the project from July, 2003 through October 29, 2003. The MACH II program was then given a further 8 month no cost extension from October 29, 2006 through June 30, 2007.

The main purpose of MACH has remained demonstration to communities, local government, and policymakers of the viability of and need for community- and ecosystem-based approaches to natural resource management (NRM) and habitat conservation in Bangladesh. MACH has been concerned with the sustainable productivity of wetlands and equitable access to those resources for the community as a whole. The MACH approach considers all factors affecting communities and their wetlands. MACH has used a multidisciplinary, multi-sectoral, participatory process of planning and implementation for reviving wetland function including fisheries.

The main purpose of the MACH and MACH II projects has been to demonstrate to communities, local government and policy-makers the viability of a community approach to natural resource management and habitat conservation in Bangladesh over an entire wetland. The MACH 'community' included those people dependent either economically or nutritionally on the wetland and its products. The program has emphasized and worked with poorer individuals and groups, particularly fisher communities who are generally the poorest members of rural communities. MACH also included

local government as well as the local elite so that the institutions and approach could be truly sustainable.

MACH has supported local communities in forming their own organizations for overall management of physical and biological components of selected ecosystems. The project has emphasized conservation and rehabilitation of degraded or lost aquatic habitats. Major habitat restoration activities have included reestablishment of dry season refuges for fish and other organisms dependent on aquatic habitat (i.e., permanent *beels* and deep riverine *kums* or scour holes).<sup>1</sup> The project has also included work with local industries to reduce pollution; work to reestablish watershed functions through re-vegetation and re-forestation, where feasible; and work to reduce soil erosion by introducing and demonstrating to farmer's suitable agricultural systems in parts of the watershed.

### C. Physical Intervention Support Fund

MACH, from its inception, planned to access outside funds to conduct larger scale physical interventions/habitat restoration that were being recommended by the communities and the fisher folk. The understanding was that large-scale physical works, if required to improve wetland and floodplain fisheries habitat, would be completed with external funds and that MACH Partners would identify where those funds could come from. In 1999 and 2000, MACH-Winrock held discussions for the funding of these works with Local Government Engineering Department, World Food Programme, and the Fourth Fisheries Project of the World Bank.

In early 2000 after detailed discussion with USAID, MACH-Winrock was requested to prepare a proposal for the use of GoB-USG 416b funds. In July 2000, MACH submitted a proposal and USAID agreed, in principle, to the use of local (416b) currency funds. The original agreement/ understanding was that resources could be made available through a simple agreement between the GoB (Economic Relations Division - ERD) and USAID. MACH was informed that the funds would be directly provided, through Winrock, to support MACH area communities' habitat restoration works. Delays and complications in securing funding caused MACH to scale down physical intervention plans during the two years following. It was originally expected that 416b funds would be available for release to MACH in December 2000. This did not materialize, the Government of Bangladesh, through the offices of ERD, insisted that the money go through the normal government approval and spending channels which was not required for previous organizations receiving 416b local currency funds (i.e. one example was Grameen Shakti that received the funds directly as stipulated in the PIL), details are described below.

MACH first submitted a proposal to the DOF/MOFL who approved and forwarded the request for the local currency funds to ERD. ERD agreed in principle but requested that standard government procedures be followed. MACH and the MOFL complied by preparing a Technical Assistance Project Proforma (TAPP) as requested. After many meetings and site visits by senior MOFL, DOF and Planning Commission personnel, the TAPP was submitted in June 2001. A SPEC meeting was held in August of 2001, where a decision was made that the proposal should be submitted as a PCP/PP rather than a TAPP. Once again, a high level government committee was formed to look into MACH and determine the need for the fund. This, again, involved a series of site visits and other activities. Again, additional meetings occurred to review the proposed PP. A final agreement between the Project/MOFL and SPEC committee came in November 2001. Following usual GOB procedure, the PCP/PP had then to be submitted to a pre-ECNEC and then the ECNEC committee before final approval. Because of the decision that a PCP/ PP had to be prepared and the various required approvals, funds did not become available until April of 2003. The original start date shown in the PP document was June of 2002 (for 3 years). Because of the loss of a year (due to the process described above) the PP had to then be revised later in 2005 and it was revised to end with the ending date of MACH II on October 29, 2006. During the MACH project steering committee meeting of August 2006, a decision of the meeting recommended that the PP of the ISM project be further extended to

---

<sup>1</sup> *Doha* or *kum* is the local term for river scour holes in Kaliakor, whereas *kur* is used in Sherpur area and *duar* in Sreemangal.

June 30<sup>th</sup>, 2008 to ensure sustainability of the project institutions and to continue to support the DoF/MoFL in its scaling up of the community-based co-management approaches.

#### **D. Strategic Objective Framework**

The strategic objective framework established by the environment team for MACH was modified in November of 2001 (see Strategic Objective file). After the mid-term review and during the development of MACH II, a slightly revised version of the indicators was established and the intermediate results and indicators modified. These are found in volume 2 of this completion report.

#### **E. Program Management**

*National Steering Committee.* A National Steering Committee has provided guidance and advice to MACH on management of programs and has been chaired by the Secretary of the MOFL. The Ministry of Land (MOL) representative has been the vice-chairperson, and the Department of Fisheries (DOF), Department of Environment (DOE), External Relations Division (ERD), Ministry of Environment and Forestry (MOEF), Implementation Monitoring and Evaluation Division (IMED), Planning Commission, USAID, and Winrock International have all been represented by members. The committee met at least once a year or as often as required.

*Results Package Team/Project Management Unit.* A Results Package Team (RPT)/Project Management Unit (PMU) consisting of a USAID-Bangladesh chairperson and members from GOB (DOF and MOFL), Winrock International, and its partner organizations BCAS, CNRS, and CARITAS directed efforts of the project. This team met monthly throughout the year and guided MACH operations and management. The team/Unit had the authority and responsibility to guide and monitor implementation of decisions. The self-directing and self-monitoring RPT/PMU has worked to formulate implementation strategies and monitor and review progress.

*Local Government Committee/Upazila Fisheries Committee.* The local Government Committees (LGCs) were MACH's most important committees at the site or local level. They reviewed and approved program activities and offered recommendations and assistance when required. The sites' union and upazila officials established these upazila-level committees in early participatory project meetings. The respective Upazila Nirbahi Officer (UNOs), the senior-most administrator in an Upazila, chairs the LGC at each of the respective MACH sites. The Upazila Fisheries Officer serves as the member secretary of the committee with support from MACH's site coordinators. Other members of the committees are the union parishad (UP) chairpersons, nearly all the main upazila officials, the Resource Management Organization (RMO) representatives, representatives of Federations of Resource User Groups, other stakeholders, and MACH representatives. The LGCs have been the apex committee at the upazila level for integrating the key community-based organizations (i.e. RMOs) with all other nation-building departments. The committee has had a positive impact as a local-level planning body and has been responsible for many of MACH's successes in resource management of critical wetlands. The government has converted them into Upazilla Fisheries Committee which will continue after MACH ends.

*Partners.* WINROCK International, the grantee, is a world leader in sustainable agriculture and NRM. The organization has considerable experience in management and execution of USAID-funded projects worldwide. Winrock is a nonprofit, nongovernmental organization (NGO). The organization has been working in some 40 countries, including the United States, on more than 100 projects and programs. In Bangladesh, Winrock was responsible for overall program management and provision of specific technical inputs in geographic information systems (GIS), fisheries biology, and watershed management. Winrock's headquarters in the United States provided overall program and financial support.

*CARITAS.* CARITAS in Bangladesh, a large national NGO that has worked in Bangladesh since 1972, was established by the Catholic Bishops Conference of Bangladesh as a nonprofit organization. Through its activities, CARITAS works for integrated human development and welfare that contributes to national development. For MACH they have been responsible for community development and alternative income-generating activities (AIGAs). For the latter, and for socioeconomic development of poor wetland resource users, CARITAS has undertaken and

successfully implemented such activities as an awareness campaign, formation and mobilization of resource user groups (RUGs), training and skills development for groups, credit support for AIGAs, agricultural demonstrations, education, health care, and nutritional activities.

*Center for Natural Resource Studies.* CNRS is a nongovernmental development organization formed in 1993 that focuses on ecological management of floodplain ecosystems through community-based management approaches with a mission to restore, conserve, enhance, and wisely use natural resources supporting and influencing government strategies and initiatives. The center has demonstrated a variety of field interventions toward developing sustainable wetland and fisheries management approaches with due consideration to environmental and socioeconomic issues. For MACH, CNRS was responsible for management of wetland resources through forming community-based RMOs, helping them to determine biological, physical, and social areas for development. CNRS was also responsible for generating environmental awareness and monitoring impacts of project activities.

*Bangladesh Center for Advanced Studies.* BCAS, a nonprofit research NGO, is one of Bangladesh's leading environmental research and policy institutes. Formed in 1984, BCAS has many years of experience contributing to establishing community-based open-water fisheries management. The center was among the major contributors to the current National Environmental Management Plan, which forms the basis for environmental regulation in Bangladesh. It has provided local coordination for MACH, short-term specialists in policy reform as needed, and support services for GIS, hydrology, fishery biology, and other specialist areas.

#### **F. Major Findings of the Mid-term Review, the GoB evaluation of ISM and the USAID evaluation of MACH**

As required by the Project Steering Committee and USAID, a mid-term review of MACH was conducted by a team consisting of a representative from the MOFL, one international expert in resource and participatory management and two national experts in fisheries. The review was conducted in November 2001 with a final report presented in early December 2001. The main findings of the review are summarized here.

The concept of MACH is still valid. MACH is implementing a broad range of activities many of which are innovative and complex. Program activities are already having positive impacts on ecosystems at the program sites including fish production. Program activities are also resulting in increased incomes for beneficiary group members. MACH is on course to meet the targets set for the Strategic Objective and the Intermediate Results, although more time will be required to ensure sustainability of the MACH approach.

MACH has developed considerable understanding of the requirements of improving the productivity and management of wetlands, and has responded to unforeseen local requirements by developing solutions acceptable to stakeholders. The present geographical coverage provides sufficient variety of ecosystems to fully test the MACH approach. The main issue that needs to be addressed is the sustainability of the MACH approach particularly with respect to local institution building and the time required to consolidate the environmental changes implemented by communities with program support.

In addition to this 2001 review, there was a mid term review of the program by the government of Bangladesh prior to the extension of the ISM fund. This review was conducted by a 6 member team from all branches of government (IMED, ERD, Planning Commission, Ministry of Finance, MoFL, and DoF) represented in the MACH steering committee. The evaluation was conducted in October 2004 and completed in January 2005. The results again validated the MACH approach and approved of the extension of the ISM fund.

Further MACH was evaluated finally during the evaluation of the USAID/Bangladesh environment program in April and May of 2006. Findings of this evaluation were that MACH is highly consistent with both USAID and government policies and strategies for natural resource management. That the co-management model in MACH was working well and appeared to have distinct advantages over previous approaches in the sector. That nearly all the targets had been achieved and some exceeded

and that wetland productivity was substantially enhanced by the project. The evaluation team also stated that one of the big achievement of the project has been the empowerment of women and the poor.

### **G. Synergies with other projects**

To boost MACH impacts the project developed cooperative relationships with other programs both within and without Bangladesh. MACH has actively sought cooperation with other USAID projects and USAID supported organizations throughout its life. Some of these relationships were with ATDP, AVRDC, DSAP (WorldFish), JOBS, CIMMYT, and particularly during MACH II with Nishorgo and the Governance programs of the mission. Furthermore the USDA funded Farmer-to-Farmer (FTF) Program managed by Winrock International has provided support to MACH. Numerous volunteers have provided assistance in the areas of Tilapia Culture, Pineapple and Lemon Farming, Watershed Management, Poultry Waste Management, Improved Poultry Management and Fisheries Monitoring.

Additional MACH has capitalized on bringing together other donor funded program of a similar nature and working with them to create a united front in addressing the issues of the sector as well as push for policy reforms. MACH worked very closely with the Fourth Fisheries Project of the Department of Fisheries funded by the World Bank as well as the CBFM project funded by DFID. MACH helped facilitate and participated in the design of the government's Inland Capture Fisheries Strategy. In addition MACH through its outreach program has supported communities managing more than 10 waterbodies under the Fourth Fisheries Project of DoF through support in sanctuary establishment and restoration of wetlands.

CARE Bangladesh (through a DFID-funded project) helped provide training and support for MACH cage-culture experiments. MACH has also cooperated with the Center for Environmental Geographic Information Systems (CEGIS) that evolved from the USAID funded ISPAN program.

Throughout MACH II the project has collaborated with both a DFID funded and an EU funded pollution mitigation project. The design and the work were part of the MACH program at the Kaliakor site where pollution reduction measures and monitoring have been put in place linked with the local RMOs formed by MACH.

### **H. Project sites**

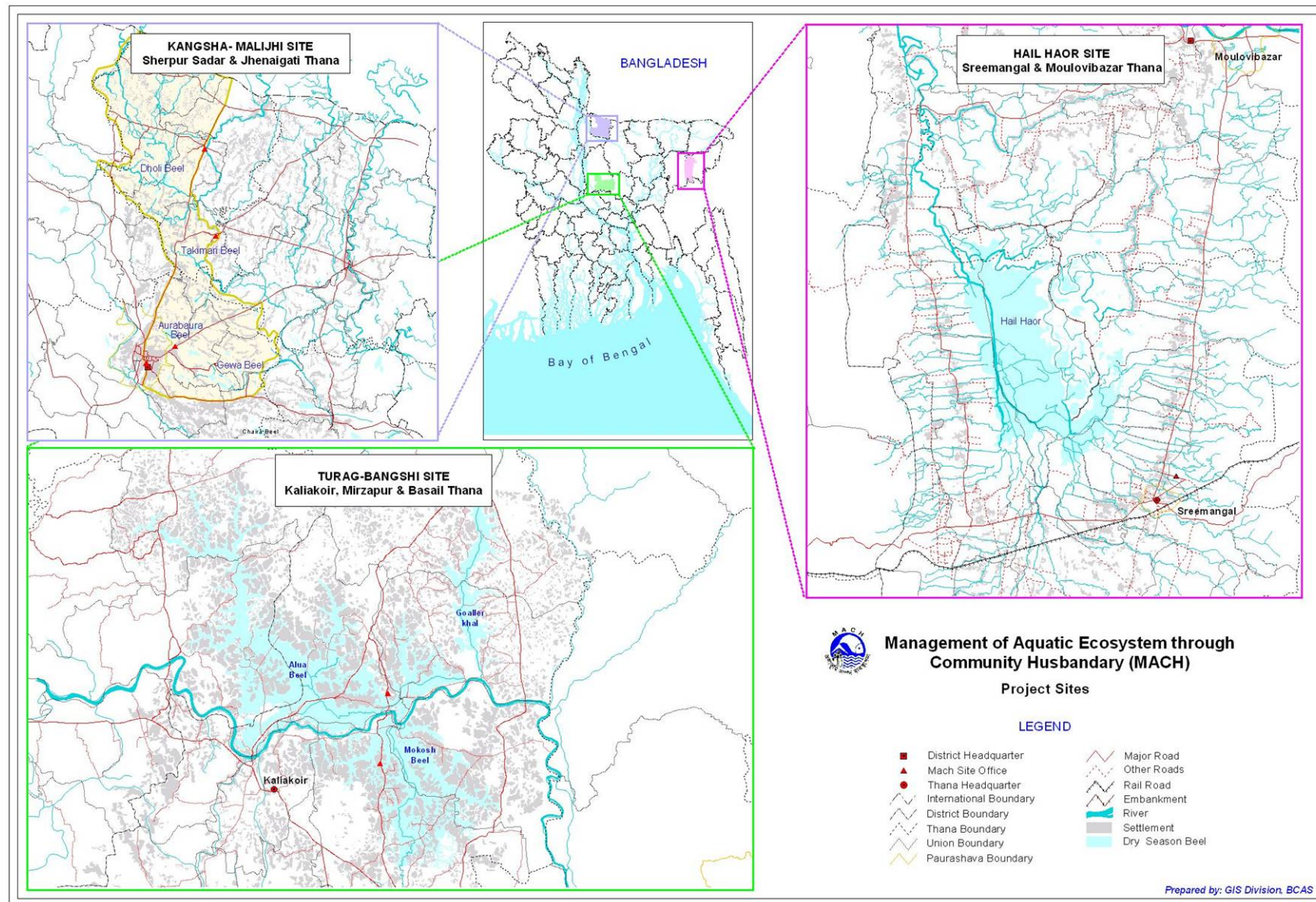
**Hail Haor** in north-east Bangladesh is typical of deeply flooded basins in that region known as *haors*. Water from the hills to the east and west flows through 59 streams into the haor. Flood control works downstream limit its connection with the main river system. The haor is located in five unions of Sreemongal Upazila and in two unions of Sadar Upazila of Moulvi Bazaar District. The watershed of Hail Haor covers about 600 km<sup>2</sup> (237 square miles) and 15% is in India. The average maximum wet season area of Hail Haor is about 13,000 ha, but the dry season area is typically just over 3,000 ha. Approximately 172,000 people live in 61 villages around the haor.

The **Turag-Bangshi** site is just north of Dhaka and is typical of low-lying floodplains in Bangladesh. It covers seven unions of Kaliakor Upazila in Gazipur District and one union of Mirzapur Upazila in Tangail District. The Turag-Bangshi River runs for approximately 30 km through the site with 26 beels (wetland depressions) and numerous canals on either side of the river. Water covers about 10,000 ha at full flood, but diminishes to less than 700 ha at the end of the dry season. Dry season water has been reduced for agriculture and irrigation. Approximately 225,000 people live in 226 villages that make use of the river and floodplains.

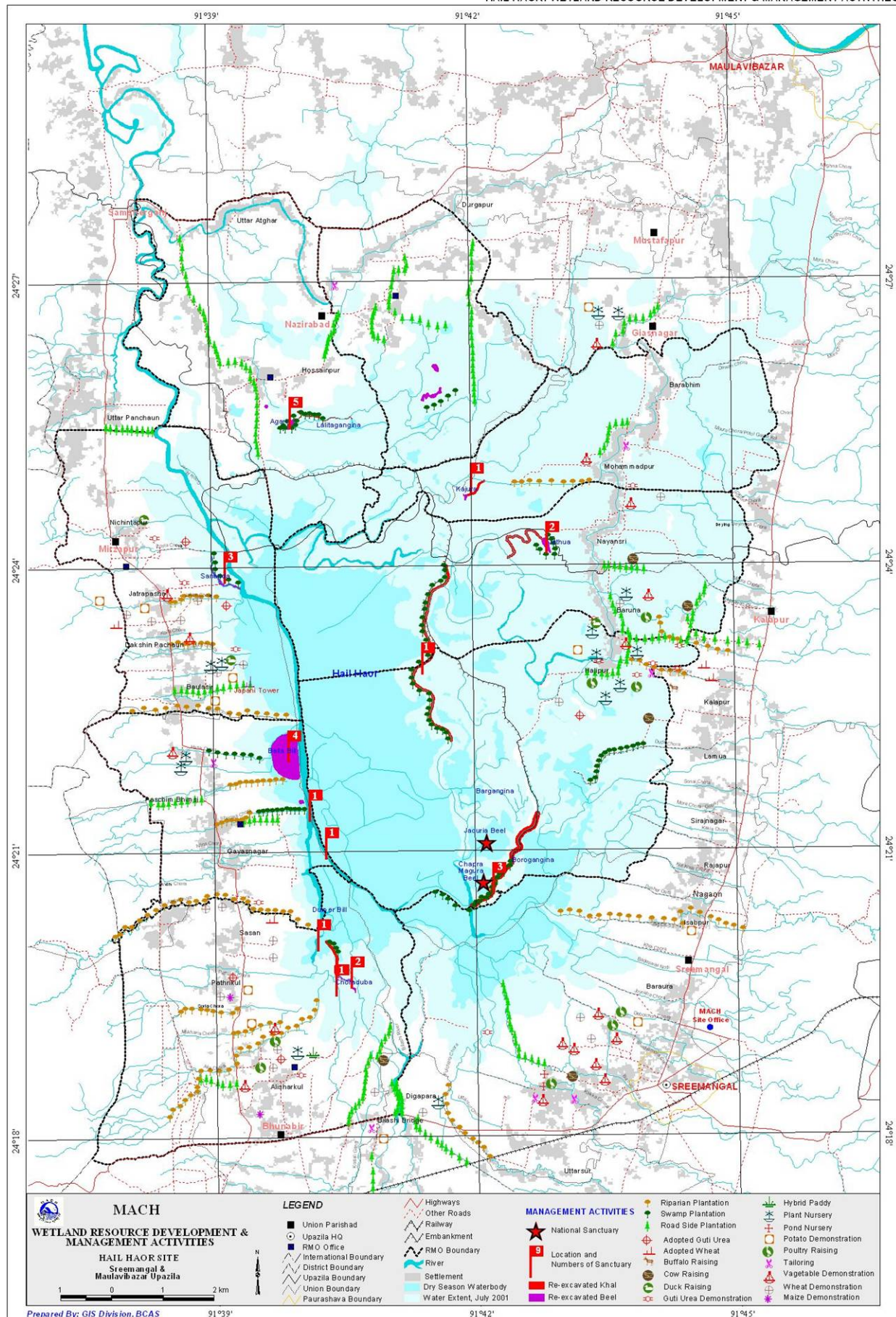
The **Kangsha-Malijhi** site is in north-central Bangladesh in Sherpur Sadar and Jhenaigathi Upazilas in Sherpur District. The area includes the catchments of the upper Kangsha and Malijhi river system. The hills here now have only remnants of natural forest. The area is prone to regular flash floods from these hills. The wetlands and floodplain have a water area of approximately 8,000 ha during the wet season, which falls to about 900 ha in the dry season. The floodplain area contains 47 beels, of which 18 are perennial. The population of the area is approximately 279,000 living in 163 villages.

Locations and key interventions are shown in the following four maps (a full set are in Annex 5).



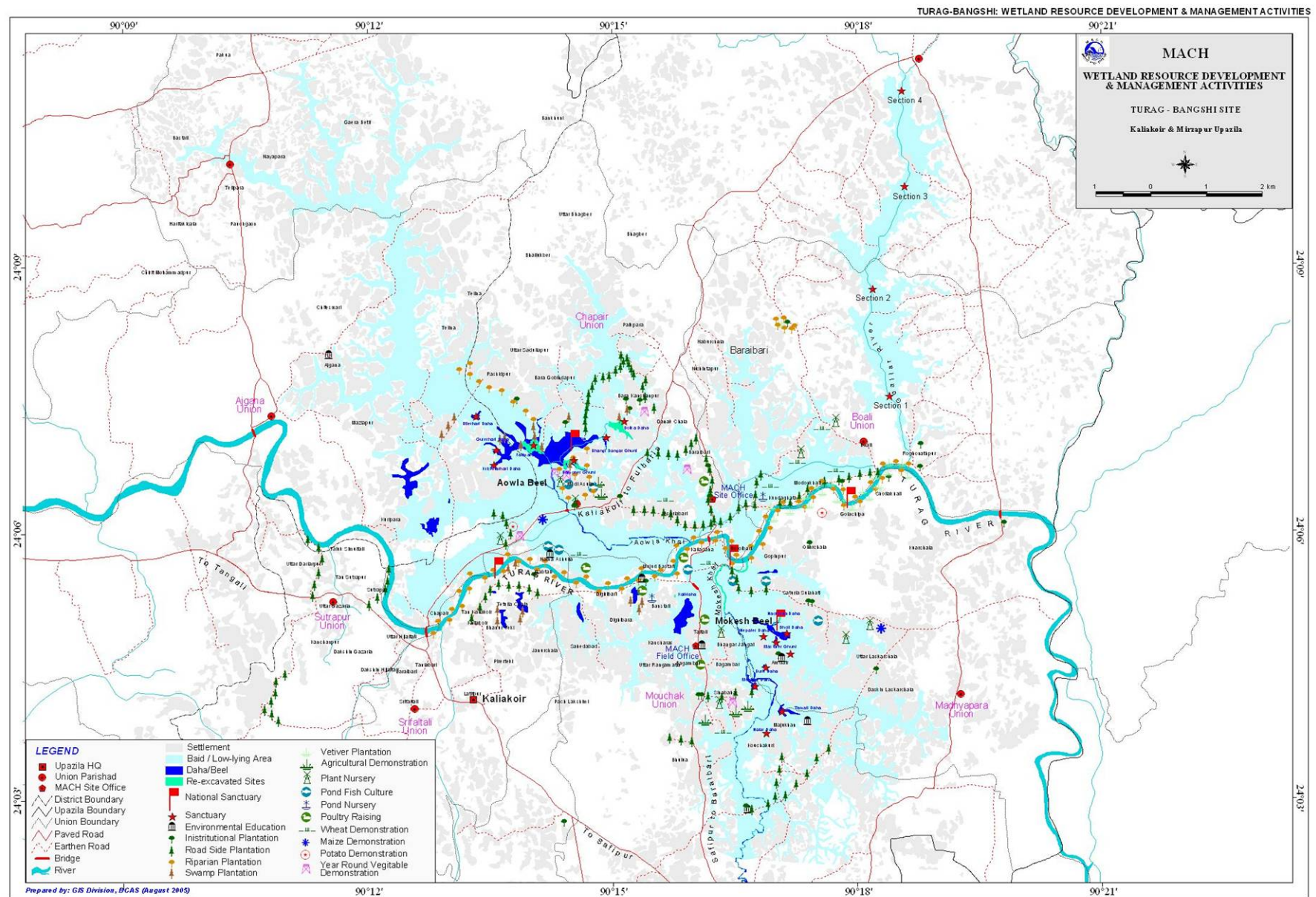




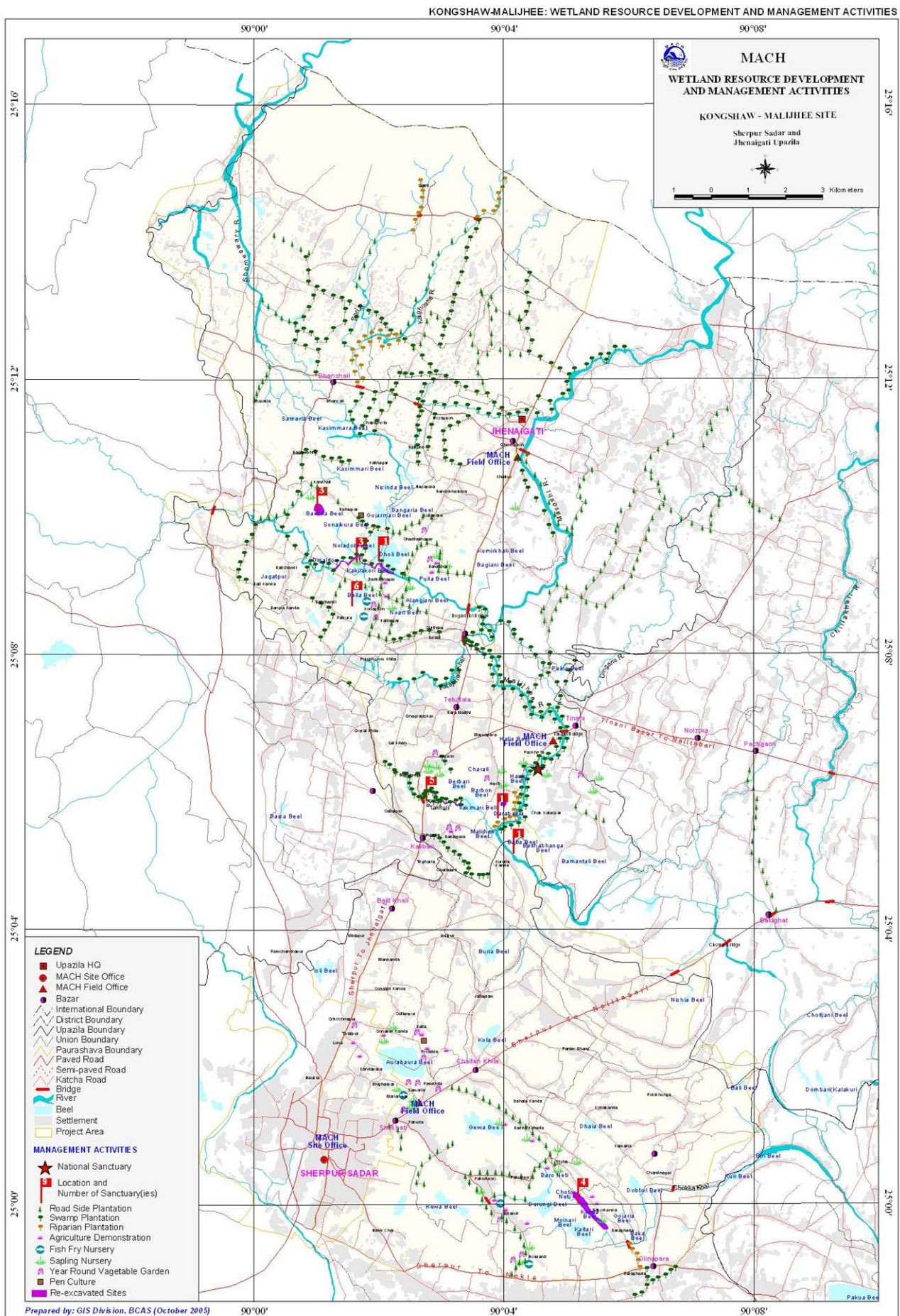




## MANAGEMENT OF AQUATIC ECOSYSTEM THROUGH COMMUNITY HUSBANDRY (MACH-II)







### 3. Summary of Achievements and Impacts

#### A. Resource management activities

The once extensive wetlands of Bangladesh have gradually diminished both in area and ecological quality, a fact recognized by both fisher communities and fisheries professionals. A combination of factors have been involved including drainage for agriculture, siltation from upper catchments, over-exploitation, and pollution. While this has a wide range of impacts the problem is most apparent in loss of dry season surface water affecting the most significant wetland product – fish catches. MACH, being a flexible and adaptive management project, has worked with the local communities to address all of these problems affecting their livelihoods in three large wetlands combining rivers, floodplains and perennial beels (floodplain depressions or lakes).

MACH organized local communities (fishers, farmers, women and other resource collectors) into 16 Resource Management Organizations (RMOs), each representing the whole user community of a management area. This addressed the lack of local institutions addressing environmental problems. Details of the institutional development of the RMOs are given later. Through project support, each RMO received use rights to one or more water bodies from the Ministry of Land on lease for a period of ten years (with renewal in five years). The RMOs made management plans (both longer 5-year plans, and then annual plans that are reviewed and revised each year) and set rules for use of these wetlands based on the local situation. The RMOs have adopted best practices in wetland management through their local plans based on their analysis of priority problems in their area and advice from the project on technical feasibility of interventions.

**Major problems** identified by the communities during their planning meetings included:

- Increased siltation and consequent degradation of habitats and dry season shortage of water,
- Excessive use of harmful gears (current jals, fine mesh seine nets),
- Destructive fishing methods such as dewatering and catching of fish fry (specially fry of snakeheads which move in shoals),
- Loss of indigenous fish species,
- Water pollution and fish kills, and
- Obstruction of fish migration between different habitats (river to floodplain beels).

**Major solutions** were identified by the communities which reached a consensus through participatory planning processes on solutions to address the problems in their respective RMO management areas. The solutions prioritized have been implemented in phases, most are common across RMOs and sites. The RMOs with MACH support have focused much of their effort on the 33 jalmohals (water bodies) over which the Ministry of Land has handed over responsibility and use rights to the RMOs via DoF, these cover just over 554 ha. However, an estimated 20,900 ha of land are covered by improved management in some form through the RMO's influence and related activities in tree planting for example. This covers the larger part of the three wetland systems and also some of the adjacent catchments for example along roads, streams, and some hill slopes.

**Wetland habitat rehabilitation:** RMOs identified locations within their respective wetland management areas that were so silted up that they dried out and could not support fish in the dry season. Excavation to restore and increase the habitat quality and quantity that is crucial for fish to survive the dry months and thus be able to breed in the coming season with the onset of monsoon rains has been planned and implemented with technical support from the project (see next section).

**Wetland sanctuaries:** The single most important resource management intervention has been establishing 63 wetland sanctuaries (Table 1). These are



*Gene George former USAID Bangladesh Director delivering his speech on opening of the Observation Tower of Baikka Beel National Sanctuary in Hail Haor Sreemongal*



areas from less than one hectare to over 100 ha that retain water throughout the year and where the community has banned all fishing so that fish can over-winter and then repopulate the wider floodplain during the monsoon. There is wide consensus on the need for refuges where fish would not be harvested or disturbed. The sanctuaries are established with the consensus of RMO members and local fishers in a small part (less than 10%) of the managed wetland, which is deep enough for fish to thrive in the dry months. In most cases, the sanctuaries include re-excavated areas. In addition six sanctuaries covering 18.6 ha have been established in Kaliakoir in areas adjacent to the Turag-Bangshi site. While the sanctuaries are primarily for protecting fish with the aim of restoring and enhancing yields from the rest of the wetland system outside the sanctuaries, they also benefit aquatic life in general, including waterbirds and plants. This is particularly the case in the large permanent sanctuary established in Hail Haor covering three adjacent beels (Chapra, Magura and Jaduria) which has been set aside permanently by the Ministry of Land by taking these water bodies out of the leasing system and within two years has attracted up to 7,000 wintering water birds.

**Table 1: Wetland sanctuaries existing in MACH sites in April 2007 by year of creation.**

Year and waterbody type	Hail Haor			Turag-Bangshi			Kangsha-Malijhee		
	No	Improved habitat* (acre)	No fishing area (acre)	No	Improved habitat* (acre)	No fishing area (acre)	No	Improved habitat* (acre)	No fishing area (acre)
Beel									
2001	6	9.49	11.44	9	5.24	26.20	12	5.92	11.63
2002	0	0	0	5	10.94	54.70	0	0.00	0.00
2003	1	21.88	21.88	0	0.00	0.00	0	0.00	0.00
2004	0**	100.50	211.72	6	5.00	25.00	1	1.50	4.30
2005	0	0.00	0.00	2	3.00	15.00	1	3.00	7.07
2006	1	4.88	4.88	-	--	-	-	-	-
2007	1	1.48	1.48						
River/khal									
2001	0	0.00	0.00	3	5.80	29.00	2	1.66	2.22
2002	1	1.19	10.32	0	0.00	0.00	3	2.20	2.88
2003	1	0.46	0.96	0	0.00	0.00	3	2.12	6.89
2004	0	0.00	0.00	0	0.00	0.00	1	0.50	0.78
2005	0	0.00	0.00	4	6.20	31.00			
<b>Total</b>	<b>11</b>	<b>139.88</b>	<b>262.68</b>	<b>29</b>	<b>36.18</b>	<b>180.90</b>	<b>23</b>	<b>16.90</b>	<b>35.77</b>

\* re-excavated area and/or area with fish protection devices such as hexapods within sanctuary (the area reported in MACH annual reports).

\*\* part of the same national sanctuary as the beel area reported in 2003 in this site, note that 111.22 acres is khas land which is part of the no-fishing zone but not formally declared as sanctuary by the government.

#### **Abandoned sanctuaries:**

Hail Haor - in several cases more than one spot with improved habitat is in a contiguous sanctuary (no fishing zone) so the number of sanctuaries reported here is reduced from previous reports. Four sanctuaries (total area 6.48 acres) were only observed for one year 2001-02. Another of 0.52 acres was planned and included in project reports for 2001 but was never actually established.

Turag-Bangshi - two of unknown characteristics, one replaced in 2001 the other in 2004.

Kangsha-Malijhee - one 0.21 acre fish protection device of 2001 was converted shortly after to a katha for fishing by the RMO with LGC approval.

**Closed season and fishing norms:** However, sanctuaries alone cannot restore wetland productivity. Developing local institutions – sets of rules and norms – which are widely accepted in the local communities and result in sustainable fish catches has been important. Based on their analysis of priority problems in their area, the RMOs took advice from the project on the technical feasibility of interventions. Each RMO along with the fishers has banned fishing for 2-3 months in the early monsoon when fish breed, this means that fish protected in the sanctuaries can safely repopulate the floodplain, otherwise brood fish might be caught just when they spawn. Fishing restrictions are the other key set of rules. The RMOs have banned complete dewatering of those water bodies under their direct management, this means that even outside the sanctuaries more fish can over winter, and they try to advocate this to leaseholders in other water bodies within the sites. They have banned using fixed gears, particularly barriers (*pati bundhs* - mat made up of split bamboo) that completely close off channels, so that fish can once again move between habitats at their needs. Similarly they have worked to stop use of other harmful fishing practices including use of fine mesh seine nets, fishing that targeted shoals of juvenile catfish, fishing festivals where many people from outside the area were attracted to fish out a wetland, and current jals (monofilament nylon gill nets). The RMOs are also trying to restrict abstraction of water for agriculture in the dry season to maintain sufficient water in the beels.

**Re-introduction of locally lost/threatened fish species:** Having restored wetland habitats and changed fishing effort so it is more sustainable, some fish species were able to recover, but others needed a helping hand. MACH has supported the RMOs in re-stocking nearly 1.2 million fish (mostly juveniles) of 15 native species. The fishers reported them as having been present in the sites but project monitoring showed they had declined to negligible catches and were threatened with local extinction. The objective was to restore self-sustaining populations of these fishes. Some beel resident species such as Ayre and Goinia in Hail Haor have been re-established, and others such as Meni, Deshi sharputi, Foli, Chital, Pabda, Shol, and Gojar have increased naturally or with help. However, fish such as Rui that depend on migration for their life-cycle have not been found to breed in the project sites. Beel resident species along with some riverine species may also be stocked where there is a connection between beels and rivers. Then riverine species stocked in the beel may migrate to the river to breed, which eventually enriches the beel's fish production. Kalibaush and Goinia are now found in Turag River due to reintroduction in the connected Mokosh and Aloa Beels. However, Deshi sharputi in Mokosh Beel did not sustain after re-stocking, this could be due to water pollution. No exotic or hybrid fish species were introduced.

**Demonstration activities:** The purpose of MACH demonstrations was to encourage aquaculture and agricultural practices that would be less damaging or not harmful for the wetland environment. A number of field demonstrations were supported. A significant effort on contour cultivation of pineapple is discussed later, but other demonstrations covered: pond nurseries; cage culture of fish; wheat, maize and vegetable cultivation to reduce irrigation water demand; and guti urea application to reduce fertilizer costs and washing out of nitrogen into water bodies.

The RMOs have also banned hunting of birds within their areas, and have worked to restore swamp forest (see later). All of these improved wetland management practices have benefited the fisheries in over 25,000 ha of wetlands.

## B. MACH Habitat Restoration

In recent decades physical changes notably siltation have drastically reduced the area and quality of wetlands, for example in Hail Haor MACH monitoring found that the wetland bed was rising by 5 cm per year. Along with other factors (flood embankments and water control structures and expansion of dry season irrigation) this has had two highly detrimental impacts on fisheries and wetland resources: it has blocked fish migration routes and has reduced the water available for aquatic life to survive in the six-month dry season. In response to this one of the main interventions identified through participatory planning has been re-excavation of beels and canals to restore greater areas of permanent water.

**Table 2: Status of re-excavation of beels and canals up to April of 2007**

Period/site	Beel re-excavation		Canal re-excavation	
	No. of schemes	Area excavated (ha)	No. of schemes	Length excavated (m)
MACH I*	27	24	14	9,991
MACH II	40	33	21	21,751
<b>Total</b>	<b>67**</b>	<b>57</b>	<b>35**</b>	<b>31,742</b>
<b>By sites (combining MACH I and II)</b>				
Sreemangal	35	25	12	11,369
Sherpur	14	11	17	10,873
Kaliakoir	18	22	6	9,500

\* About 90% of the work was completed through foreign currency fund

\*\* In some cases different parts of the same canals or beels were excavated in different or even the same years. The actual number of schemes may be higher than the sum of the annual number of canals excavated.

MACH initially undertook a limited program of excavation in response to local demands that was planned after careful review by fisheries specialists and engineers. However, project (foreign currency) funds were far less than the requirement for well-justified habitat restoration, so additional sources of funds were sought. In March 2003 agreement was completed for a complementary and interlinked project: "Investment Support to MACH" Project (ISM). ISM was funded with Government of Bangladesh local currency derived from previous USAID support (416b fund). All physical interventions undertaken during MACH-II have been implemented through ISM notably: excavation/re-excavation of degraded wetlands, and the construction of permanent fish shelters to enhance habitat and exclude fishers from fish sanctuaries (i.e. concrete hexapods and pipes). All interventions have been taken up following planning by and with the local Resource Management Organizations (RMOs) and local government, as with other MACH activities. Consequently MACH

has excavated about 32 km of link channels to improve fish and water movement and excavated over 57 ha of deeper pockets as dry season refuges for fish, within water bodies that have been made perennial. The water bodies made perennial cover 916 ha in total (Table 2). Almost all of this work has been done by manual labor generating about 2.03 million person days of work for local poor people.

Well ahead of each dry season the RMOs identified possible earthwork interventions, these were reviewed by the project team for their technical feasibility, biological impacts and social acceptance. Subsequently those selected schemes were endorsed by the RMOs, the Local Government Committee (LGC) and Project Management Unit/Results Package Team (PMU/RPT). Implementation has been through three systems:

- (i) Enlisted contractors were engaged where the volume of work was big and/or mechanical devices were required;
- (ii) ISM staff directly executed some of the small works with the support of the concerned RMO, which provided direct benefits to RUG group members by employing them; and
- (iii) Implementation directly by the RMO to maximize the community's direct involvement and to increase capacity of the RMOs. From 2005, based on assessments of the RMOs, those that were found more capable were given a chance to execute these schemes under MACH supervision. This was part of the exit strategy to pass on responsibilities to the RMOs and local government and to maximize local ownership.

The critical season when wetlands dry out completely threatening fish, and when manual excavation is possible, is short – often due to late or early rains lasting only for February-March. Consequently in most years only part of the planned excavation could be completed, and moreover some locations are never feasible for excavation by manual labor due to deep slushy soil. One such site is Dholi Beel in Kangsha-Malijhee site, considering the critical need to restore dry season habitat there, in 2004-05 the project engaged a contractor with a locally made dredger on a pilot basis. The scheme was implemented very successfully. After review it was decided to use this method for excavation in the Hail Haor permanent sanctuary where the shallower areas remained slushy during the short time between water recessions and early rains in March 2005, which prevented planned excavations from being completed. This was a learning process and fielding of small custom modified dredgers in 2005-06 was a slow process, as a result the planned schemes were again not all completed. Still the experience was sufficient to offer a solution to restoration of deeper pockets of permanent water as fish refuges in deeply flooded regions of the north-east of the country. In the dry season of financial year 2006-07 dredging was restarted in Baikka Beel, it was found to be more successful with the experience gained earlier, and two contractors completed substantial areas of dredging.

Traditionally branches of trees are used to create brush piles in rivers and beels as fish aggregating devices in Bangladesh – in effect mimicking the lost swamp forests, making it impossible to easily use a net, sheltering fish, and enhancing habitat by providing a surface for plants and animals that are eaten by fish. However, this is not environmentally sustainable given the very low tree cover in Bangladesh and high demand for wood. To attract and protect fish in permanent sanctuaries, MACH innovated permanent fish protection devices manufactured locally from reinforced concrete (namely tetrapods, hexapods and perforated pipes). Over

25,000 of these structures have been made and placed into designated sanctuary areas making it very difficult for anyone to fish there (Table 3). For MACH-II the earlier design of “tetrapods” (four points) was replaced by “hexapods” (six points) because the latter are easier to



*Left: Hexapod a fish aggregating device Right: Tetrapods being moved to fish sanctuary*

construct and each covers a larger area and provides more shelter. Considering the performance of these devices, the demand for permanent fish protection devices increased in the project communities, and the technique has also been extended through outreach activities to other areas.

**Table 3: Number of fish protection devices installed up to April 2007**

	MACH I	MACH II	Total
Tetrapod	9,569	-	9,569
Hexapod	245	7,214	7,459
Pipe	3,979	4,035	8,014
<b>Total</b>	<b>13,793</b>	<b>11,249</b>	<b>25,042</b>

Physical interventions also involved a range of works to support the local organizations and wetland conservation measures (Table 4).

**Table 4: Summary of other structural works up to April 2007**

Structure	MACH I	MACH II	Total
1. Demarcation pillar (RCC)	317	416	<b>733</b>
2. Signboard (RCC)	47	76	<b>123</b>
3. Photo pillar	36	-	<b>36</b>
4. Signboard with stone plate depiction	-	10	<b>10</b>
5. RCC angle frame box	4	-	<b>4</b>
6. Bird stand*	-	6	<b>6</b>
7. RMO Office building	-	13	<b>13</b>
8. FRUG Office building	-	8	<b>8</b>
9. Box culvert	-	3	<b>3</b>
9. Pipe culvert	-	17	<b>17</b>
10. Observation tower	-	1	<b>1</b>
<b>Total</b>	<b>404</b>	<b>550</b>	<b>954</b>

RCC – reinforced concrete

\* intended to serve as nesting platforms for birds of prey

There are 16 RMOs and 13 FRUGs and office buildings have been planned and constructed for all of them so that they have a permanent base for their organizations for meetings and for handling cash in the case of FRUGs, and as a center for other community functions. All of the FRUGs and 13 RMOs have functioning office buildings, two more RMO buildings will have been completed by the end of June 2007, leaving one to complete in 2007-08. This has helped strengthen and motivate RMOs where they have been completed, but the RMOs and FRUGs were required to arrange title to the land itself and this proved a lengthy process. An observation tower has been constructed in the central sanctuary of Baikka Beel in Sreemangal in order to provide facilities for visitors to watch wintering waterbirds and to enjoy the beautiful panoramic view over the wetland. Information and awareness are vital if fishing rules and sanctuaries are to be observed, so a large number of signboards and demarcation pillars of different types have been constructed and placed in strategic locations. Some small box culverts and pipes have also been constructed to improve local road communication as well as fish migration through the dikes.

### C. Wetland and Riparian Tree Planting

Tree planting for habitat restoration and improvement has been one of the MACH project's key interventions since its inception in 1999. The habitat restoration program envisaged amelioration of the environment and micro-climate to benefit people and wildlife, and for soil and water conservation in the watersheds of the project wetlands. It also aimed to increase the national tree cover and generate financial returns for the country in general and for poor people (Resource User Groups) in particular. Trees have been planted along the banks of streams and canals (riparian plantations) that drain into the project wetlands for bank stabilization and as corridors for movement of wildlife; on marginal lands along rural roads and embankment slopes; on deforested public lands in the wetlands (swamp forest) and watershed hills; on river alluviums; in homesteads



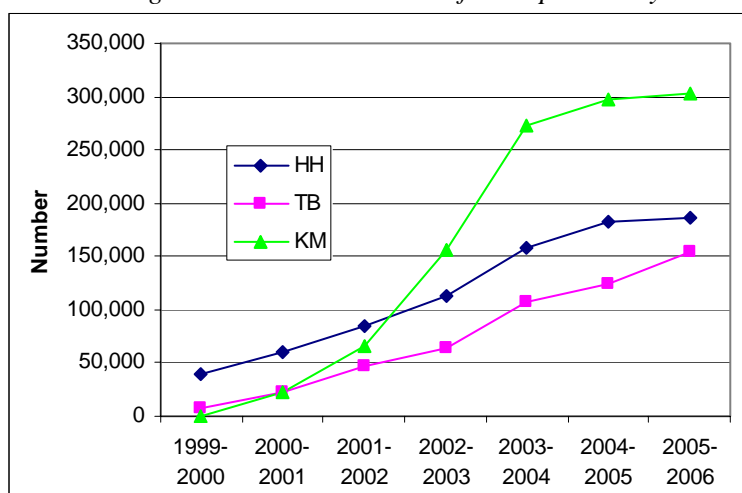
*Maintenance and caretaking of tree planting*

of RUG members; and in the grounds of public buildings (schools, religious institutions, hospitals, offices, graveyards, etc.). A wide variety of native trees suited to site specific conditions were planted including ones valued for quality wood, fruit, appearance, sources of nectar, and ones suited to wetland & riparian conditions. Lastly improved cultivation methods were introduced for hillslopes, namely contour cultivation of pineapple.

Tree planting has been organized as a benefit sharing activity implemented with direct participation of local community based organizations - Resource Management Organization (RMOs) and Plantation Management Committees as the main focal points, and local land owners, the land owning agencies and local government (Union Parishad) as the other beneficiaries. Each stakeholder will receive a fixed share of anticipated benefits from tree felling under a benefit sharing agreement, based on those already used in social forestry programs. The division of shares depends on the ownership of the land, for example in the case of private land more goes to the landowner, but in all cases a share goes to the local people organized into a committee to manage the plantation, and in many cases a share will go to the concerned RMO and UP. To instill a greater sense of community ownership, local boys' and girls' clubs have voluntarily participated in the program, this encourages greater participation and better care of the plantations.

Figure 1: Cumulative total of trees planted by MACH

A total of 644,081 saplings of 56 species (48 native and 8 domesticated exotic) had been planted under the program by the end of 2006 (Table 5, Fig 1), 21% to restore swamp forest. Of these just under 237,000 were surviving when a census was conducted in late 2006 (Table 6). The survival rate was about 45% for riparian planting, but was lowest for swamp plantations where in the early stages of the project small saplings were used which were found to have low survival. By 2021 the standing value



of these trees should be about US\$ 4.0 million at current prices. Swamp forest will be preserved as a long-term investment in ecological restoration and is not scheduled to be felled. However, once the trees are sufficiently grown, branches may be lopped to provide an income to the RMOs provided this is approved by the UFC and is in keeping with the management plans. The other trees are expected to be felled after 15 years of growth, and replanted. Assuming that the existing trees survive to harvesting (most losses are in the initial years after planting), the return from the first felling cycle of the other trees should be about Tk 226 million or US\$ 3.3 million by 2021 (net of replanting costs).

Table 5: Numbers of trees planted by habitat type and area

Year	Riparian	Swamp	Roadside	Public building	Total no. of plants	Total extent (km/ha)
1999-2000	13,722	18,882	10,220	3,966	46,790	39.46 km + 3.08 ha
2000-2001	15,080	11,625	16,845	14,628	58,178	37.45 km + 8.41 ha
2001-2002	44,764	5,524	14,547	26,213	91,048	48.20 km + 9.11 ha
2002-2003	94,888	4,778	3,475	33,880	137,021	89.95 km + 20.08 ha
2003-2004	32,934	72,956	84,121	14,865	204,876	117.24 km + 34.16 ha
2004-2005	31,900	11,200	13,970	10,382	67,452	15.45 km + 21.63 ha
2005-2006	6,860	28,996	0	2,860	38,716	23 km + 0.42 ha
<b>Total number</b>	<b>240,148</b>	<b>153,961</b>	<b>143,178</b>	<b>106,794</b>	<b>644,081</b>	
<b>Total extent (km/ha)</b>	<b>160.15 km + 29.78 ha</b>	<b>56.65 km + 26.76 ha</b>	<b>153.95 km</b>	<b>41.47 ha</b>		<b>370.75 km + 98.01 ha</b>

Improved watershed management has included introducing contour planting of pineapple in the hills surrounding Hail Haor where siltation was raising the wetland bed by 5 cm per year. This has reduced runoff and erosion rates and at the same time permitted denser planting, resulting in increased fruit size, improving soil retention and fertility, which increased farmer incomes- doubling the net return after costs for the demonstration plots. By the end of 2005, a total of 32 farmers had adopted the contour planting method on 72 plots covering 92 acres (37 ha). In addition to watershed environment



improvement, the farmers themselves benefit. Detailed information on two demonstrations indicates that over a 3-year period of planting and repeated harvests the contour plots give a financial return net of costs of Tk 128,600 per acre, which is Tk 74,990 per acre or Tk 185,000 per hectare more than the traditional cultivation system. This is a significant breakthrough in changing the pineapple farmers' attitude towards adoption of better cultivation methods and techniques.

**Table 6: Number of trees surviving in October 2006**

Site	Riparian	Swamp	Roadside	Public building	Total
HH	11,183	15,724	7,551	13,653	48,111
TB	21,977	19,541	15,785	15,911	73,214
KM	74,747	5,819	33,758	1,298	115,622
<b>Total</b>	<b>107,907</b>	<b>41,084</b>	<b>57,094</b>	<b>30,862</b>	<b>236,947</b>
<b>% surviving</b>	<b>44.9</b>	<b>26.7</b>	<b>39.9</b>	<b>28.9</b>	<b>36.8</b>

#### D. Industrial pollution mitigation

Bangladesh has maintained an impressive rate of economic growth in recent years, averaging 5% per annum growth in GDP over the last five years, with growth in the ready made garment (RMG) manufacture being particularly good. Much of this growth has been generated by small and medium-scale enterprises (SMEs) and it is likely that the future development path of Bangladesh will remain closely linked to the performance of these industries. Most of them are found near the banks of natural streams or rivers in an industrial belt around the rapidly growing urban centers. However, this economic growth has brought with it a range of problems, particularly extensive water and air pollution. The principal polluting industries are textile (dyeing and printing), tanneries and paper and pulp, the former two being principally export orientated industries. The pollution can be broadly categorized into biodegradable organic compounds, non-biodegradable or persistent organic compounds, inorganic compounds and heavy metals. All of these effluents need treatment before disposal, although the vast proportion of waste is discharged without treatment.



*Industrial pollution*

One of the biggest industrial clusters in Bangladesh is located in Kaliakoir Upazila north of Dhaka, where there are many textile and dyeing factories. During participatory planning the communities which MACH has been working with in the Turag River floodplains reported that these industries use the surrounding wetlands, particularly Mokesh Beel and Ratanpur Khal, which flows through the beel, as a disposal ground for untreated waste, which they reported resulted in poor catches of bad smelling fish. Effluent from industries downstream in the Turag catchment also appears to be entering the river and is carried upstream during low river flows by tidal effect. As a result, water quality has deteriorated to a level which is unsuitable for certain types of aquatic life.

Since 1999 MACH Project has addressed industrial pollution issues of Kaliakoir, where more than 274 industries are located. Most of these industries are socially compliant but not environmentally compliant. It is estimated that these industries are discharging 30 billion litres of waste water in surrounding water bodies, particularly Mokesh Beel and Ratanpur Khal. In addition, effluent from industries downstream in the Turag catchment also appears to be entering the river and is carried upstream by late season tides. Large areas of surface water have a dark black appearance and foul smell due to high sulfide levels and low or no oxygen in dry season. There are also reports of poor catches and large fish kills in the area during dry season.

Regular monitoring results indicated that water in the beel and khal has biological and chemical oxygen demands respectively more than double and more than four times higher than the national acceptable standard, high chemical oxygen demand, seasonally high pH levels of between 9 and 11, and sulfide concentrations that averaged 50% above the national acceptable standard but peaked at five times that level (Tables 7 and 8; Fig. 2). High concentrations of heavy metals such as chromium were also found in surface water close to the industries, although aquatic plants were found to absorb some of this pollution such that sediments were within European permissible levels, the possible effects of animal and human consumption of these plants is not known. The problems were traced to local textile related industries which were found to be inefficient – producing more waste water with higher biological oxygen demand than both Bangladesh and World Bank standards. Focus group discussion and in-depth interviews with community members and health practitioners revealed that

the perception of the community is that health problems are increasing as a result of industrial pollution of the wetlands that they traditionally use as a source of water to irrigate crops, for bathing and for fishing.

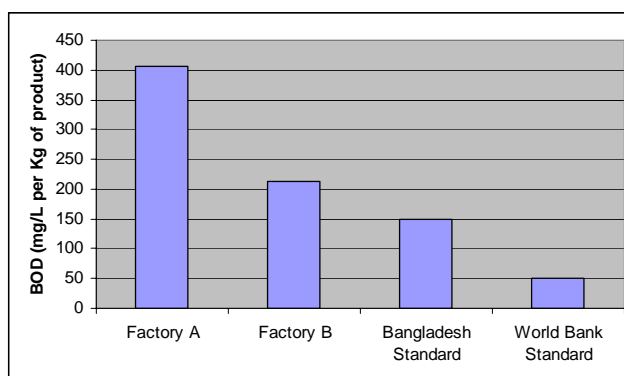


Figure 2: BOD levels of factory effluent in Kaliakoir.

Table 7: Median values of different parameters in water in seven locations of Mokesh Beel ecosystem in 2001.

Parameter	Bangladesh Standard (mg/l)	Median value (mg/l)	Range (mg/l)
BOD	150	407	380-500
COD	200.0	960	350 – 1600
DO	4.5 - 8.0	1	0.6 - 1.2
TSS	100.0	195	115 – 427
Sulfide	2.0	3.1	1.6 - 10.2
Oil and grease	10.0	27	17 - 45

Table 8: Results of 24-hour composite effluent samples from five textile factories

Identification number	pH	COD (mg/l)	BOD5 (mg/l)	Sulfate (mg/l)	TDS (mg/l)	TSS (mg/l)
Factory A	9.7	161	41	85	1354	108
Factory B	8.9	748	210	215	1284	33
Factory C	11.2	522	144	90	1280	171
Factory D	9.4	174	87	520	1266	43
Factory E	9.4	654	198	20	2998	27
Maximum permissible in textile effluent	9.0	200*	150	-	2100	100

\* Refers to surface water limit as no limit is given for textile effluent

To support the RMOs so that they would be able to show evidence of water quality trends in the area, and considering reports that in the dry season poor water quality in the Turag River was affecting the overall fishery, MACH trained and equipped local volunteer college students to become monitors for regular DO sampling in the beel and river. This program will continue long term through the UFC providing funds for the costs of monitoring from its endowment income. This monitoring has revealed that along most of the Turag River within the area managed by RMOs and downstream, there is little or no detectable DO in the dry season (Fig. 3).

Research in the industries themselves identified potential alternative production options which can increase dye fixation by up to 70% and consequently save an average factory about US\$ 67,000 a year and significantly reduce repeat dyeing and effluent discharge. Some of the industries are now showing an interest in adopting these technologies. The studies also highlighted the need for more effluent treatment facilities and better management of those that already exist. Effluent Treatment Plants are a legal requirement for factories approved after 1995, but in 2000 only two factories in the area had such plants and they were functioning below optimum. The project has worked with industries to advise on setting up treatment plants and one new one has been established and four more are under construction. However, the number of textile related factories in the area increased from 20 to 80 in late 2005, so the pollution problem overall is worsening. This means that there is an immediate need to increase the rate of implementation of proposed pollution mitigation options if there is to be any reduction in pollution. Without this the efforts of the communities and MACH that have seen fish yields in the greater Turag-Bangshi area restored from about 60 kg/ha to about 300 kg/ha by 2004 are likely to be irreplaceably lost.

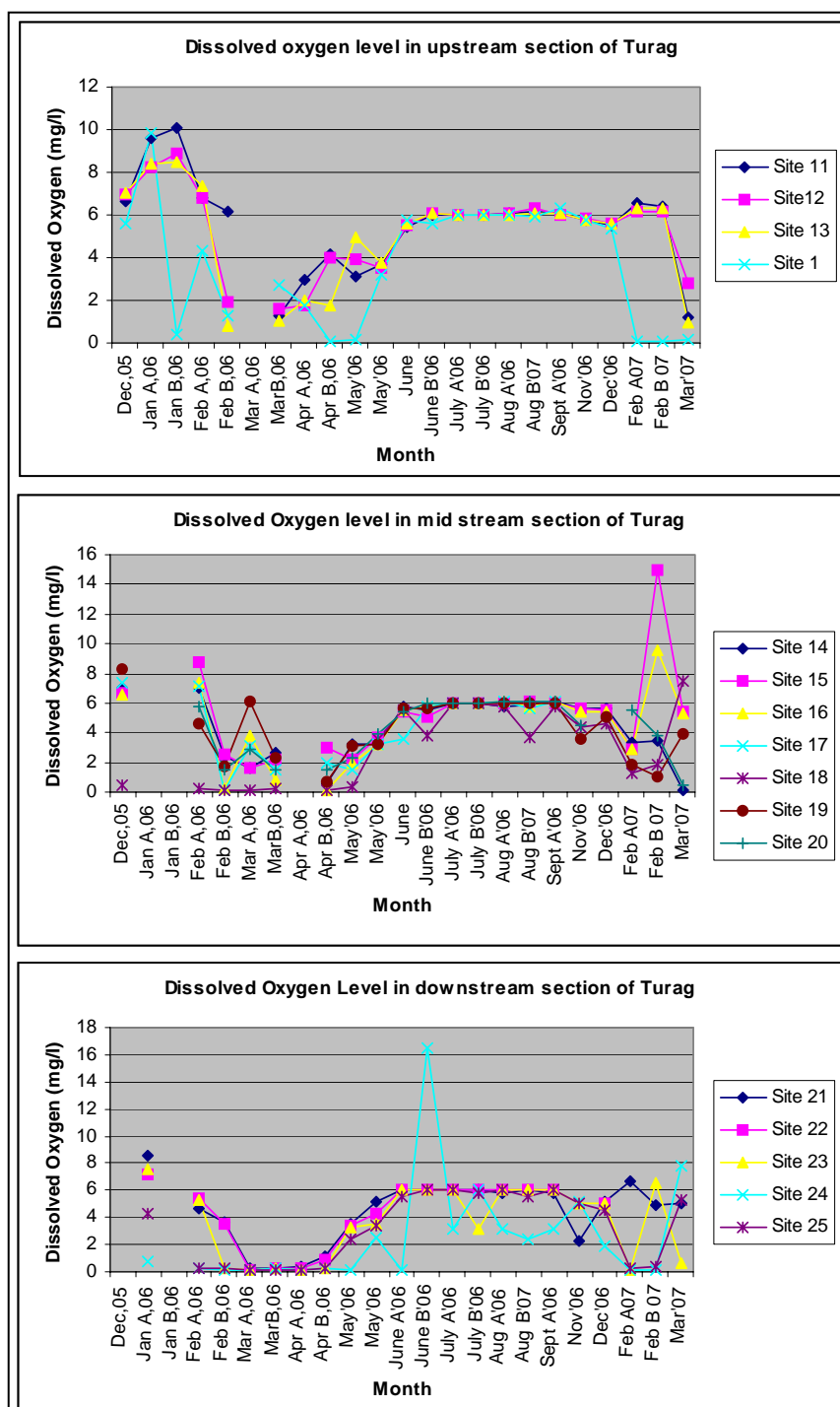


Figure 3: Trends in dissolved oxygen levels in three sections of Turag River December 05-March 07

To support the industries to clean up, web-based networks for dye managers and ETP managers (<http://www.sei.se/asia/dyework/>, <http://www.sei.se/asia/etp/>) have been established; six booklets and four briefing notes have been published and distributed to BGMEA members, BTMA members, factories in the Kaliakoir area and international buyers, and workshops have been held with the major buyers and through them with their suppliers. However, while most industries within the project area seem to be convinced of the need for cleaner production and to comply with laws regarding effluent, few are meeting their legal requirements regarding Effluent Treatment Plants, and the process of adoption by the industries has been very slow. This has frustrated the RMOs which have lobbied locally through their own production of posters and holding meetings and rallies.

Consequently MACH shifted emphasis in 2006 to supporting the Kaliakoir UFC and to influencing the Department of Environment (DoE) against industrial pollution. A documentary film on the pollution problem and meetings between the UFC (Upazila officials, UP chairmen and RMO leaders) and senior staff of the DoE (including its DG) have been used to raise the issue. This has been

followed by developing a Memorandum of Understanding between the UFC and DoE with the aim of improving enforcement in the area. In addition a meeting between the RMOs and the concerned Advisor of the caretaker government helped result in the government setting nationally an urgent timetable for industries to comply with existing legislation and set up ETPs in 2007. Another result has been a meeting locally between the GoB and industries agree to the time frame and to ensure compliance.

### E. Resource Management Organizations

The key building block to the MACH approach for sustainable wetland management has been establishing 16 Resource Management Organizations (RMOs), each representing the whole user community of its management area. This approach evolved during the project. Initially participatory planning sessions were held in different villages and areas of the three sites (11 in Hail Haor, eight in Turag-Bangshi, and five in Kangsha-Malihee). These initiated the process of planning for resource management, and the development of community organizations. Initially small groups of representatives were nominated from each village to then come together to form committees, but this was then remodeled to fit with the local environment and needs. In the Turag-Bangshi site local committees were formed to protect particular deeper spots within the wetlands, and these were later joined together to form RMOs. In Sherpur the RMOs were intended from the outset to represent several villages and manage a complete wetland. Hail Haor is a vast wetland complex so the RMOs focused on leasing particular waterbodies for improved management, they do not attempt to manage the whole system, but do demonstrate best practices and influence and benefit the wider area.



*Dumuria RMO meeting in the newly built office*

**Table 9: Trainings conducted for RMO members (number of participants covered)**

Type of training	Hail Haor		Turag-Bangshi		Kangsha-Malihee	
	MACH-I	MACH-II	MACH-I	MACH-II	MACH-I	MACH-II
Natural resource planning and management	109		66		156	
Plantations	73	38	48	-	56	80
Financial management	25	27	19	92	16	32
Review of RMO	249		313	-	303	-
Organizational management	131	36	73	-	74	20
Participatory M&E	26	-	30	-	21	-
Cross visit	-	-	-	51	-	-
Leadership development		40		19		20
Accounts keeping	-	32	-	52	-	32
Role of women	-	36	-	16	-	-
Good governance	-	299	-	104	-	100
Inter RMO networking	-	24	-	12	-	16
UFC and endowment fund	-	85	-	344	-	-
Fish culture	-	47	-	-	-	-
<b>Total</b>	<b>613</b>	<b>664</b>	<b>549</b>	<b>690</b>	<b>626</b>	<b>483</b>

Developing the capacity of the RMOs and their members has been an ongoing process but with an emphasis in 2002-03 on resource and planning issues, and in 2004-06 on organizational development and finances. From October 2005 to April 2007 extensive training was given to improve the managerial skill of the RMOs covering: good governance, networking, women's role in decision making, orientation on the Upazila Fisheries Committee (UFC) and Endowment Fund (EF) operation (Table 9). A service provider's workshop was conducted in each Upazila where all the Upazila level government officers attended and explained their arrangements for providing different types of services. Previously the voice of the RMOs in UFC meetings was not strong, but now after a long process of facilitation, training and confidence raising, they can raise their problems and issues without any hesitation. In some cases they can influence the decision making process. They have demanded support from government officials as and when necessary. Several RMOs have already



received a number of types of help from Upazila level service providers. A clear understanding has been established among the RMOs, based on experience in the last two years of trial operation, that if they perform well and make reasonable proposals, then they will qualify to receive grants from the endowment fund for an indefinite period for the improvement of their waterbodies.

All but one of the RMOs have been registered with the Social Welfare Department as independent organizations, mostly since 2001-02 (Table 10). Out of 1,411 members, 53% come from RUGs, 23% are women, and 44% are fishers. Members had initial misconceptions that RMOs were membership organizations where they would get individual benefits, also there were no specific criteria for representation from different stakeholder categories. During MACH II, RMOs revised their constitutions to make it clear to everyone that this is a representative type of voluntary organization and members are nominated by their peer groups in the local community (non-RUG members) or directly representing their RUG. Provision was made in the constitutions for representation of key poorer stakeholder groups with targets set for: 60% from RUGs, 25% women (mostly from RUGs) and 30% poor fishers, and during 2005-2007 the RMOs gradually revised and expanded their membership to replace any members who had not been active and to enhance representation of these stakeholders.

#### Member pressure on exploitative leaders

The Chairman of Jethua RMO is an ex-Union Parishad chairman and is locally very influential. He kept Tk. 30,000 which had been collected on behalf of the RMO from a fishing contractor authorized by the RMO. The general members in the General Body meeting created pressure to collect money from him but couldn't succeed. Then they jointly informed the Senior Upazila Fisheries Officer (SUFO) who is the Member Secretary of the UFC asking that he help to resolve the matter. The SUFO then raised the issue at the UFC meeting where the chairman promised that he would repay the money within one month. However, he has failed to do this and the general body is deciding what further steps to take

**Table 10: RMO organizational changes**

Name of RMO	Site	Date of formation	Date of registration	Total members			Female members			Fisher members		
				Start	Oct '05	April '07	Start	Oct '05	Apr '07	Start	Oct '05	Apr '07
Agari	HH	24/03/2001	04/09/2001	45	58	58	5	14	15	-	-	0
Balla	HH	10/12/2000	15/05/2001	40	54	57	-	13	16	15	30	31
Barangangina	HH	24/01/2002	09/09/2002	25	48	50	2	9	12	8	32	30
Dumuria	HH	12/12/2000	24/03/2002	45	52	59	2	13	19	18	32	31
Jethua	HH	16/11/2000	01/01/2001	42	62	62	-	6	06	7	29	29
Kazura	HH	22/02/2001	06/09/2001	29	40	40	4	11	12	2	15	15
Ramedia	HH	19/10/2003	01/04/2004	52	56	56	10	14	14	11	11	13
Sananda	HH	20/11/2000	19/12/2000	40	80	80	2	11	14	8	16	16
Aloa Beel	TB	25/04/2001	06/04/2002	85	182	173	2	34	44	16	55	77
Goalia River	TB	14/09/2003	Submitted	68	68	92	6	6	15	33	33	44
Mokash	TB	02/07/2000	03/05/2002	73	133	154	-	36	36	15	38	37
Turag River	TB	14/04/2001	06/04/2002	57	134	105	3	23	27	6	53	53
Bailsha	KM	20/04/2001	20/03/2002	49	105	116	8	30	31	12	69	73
Dhali Bailla	KM	19/04/2001	20/03/2002	49	114	114	4	24	25	30	61	61
Kewta	KM	10/02/2001	08/12/2001	37	88	73	3	16	14	6	51	47
Takimary	KM	16/05/2001	11/03/2002	48	122	122	4	31	31	29	63	63
<b>Total</b>				<b>784</b>	<b>1396</b>	<b>1411</b>	<b>55</b>	<b>291</b>	<b>331</b>	<b>216</b>	<b>588</b>	<b>620</b>

There has been a continual process of change: increasing members, RMOs dropping inactive members in accordance with their constitutional process, RMOs asking RUGs and the community to select new representatives, and increasing women's representation. By April 2007 nine RMOs had general bodies with 25% or more women members, and 13 included over 30% poor fishers as members. Out of 272 Executive Committee members, 60 are women and 21 of them hold office bearer posts.

Initially the role of local elite members was greater than that of the poor, but gradually attitudes have changed and a balance has been achieved with all general body members active in decision making. One of the main reasons is constitutional changes that introduced secret ballots. Previously office bearers were chosen by a show of hands among the general members, but elite members influenced the general members support. In their last choice of office bearers nine out of 16 RMOs conducted elections through secret ballot for at least one office bearer position. Where this has occurred the general members were happy that this was a fair process and it created a momentum among the whole

community. As a consequence of greater RMO responsiveness, in Hail Haor the RMOs have ensured that local poor fishers got access to jalmohal fishing contracts which was very difficult earlier.

Resource management planning has been an ongoing process, but from 2005 all RMOs reviewed their plans and performance and made revised resource management plans and maps through a participatory process involving the wider community that has been repeated and is set to become annual in line with the Bangla year (and leasing year). The resulting management maps and rules are displayed in the RMO buildings. They have also prepared calendars of key events identifying assistance required from relevant government officers. Accordingly the officials are attending RMO events such as observing international days, annual rally, audit, elections, Annual General Meetings, and release of reintroduced fish.

The key components of the management plans have become local norms. So far 63 effective fish sanctuaries have been established (containing some 74 spots where habitat has been improved) - every RMO has at least one sanctuary - and by now poaching events in the sanctuaries are rare. Dewatering within the RMO management areas has now totally stopped. Closed seasons of 2-3 months to allow fish to breed are well observed in two sites, and in parts of Hail Haor (which is much larger). All the RMOs have been promoting an end to use of destructive gears like current jal and brushpiles, nowhere have these totally stopped but a substantial reduction in their use has been reported. Bird hunting has been banned by the RMOs, and if anybody tries to hunt within the RMO influence areas the community stops them. The RMOs have conducted rallies, meeting, and miking to inform the wider community of these rules.

To improve transparency and broaden participation in the RMOs, different sub-committees have been formed in most RMOs, including: audit, sanctuary management, and plantation sub-committees. Each has a written terms of reference and five members, is chaired by a member of the executive committee, and reports back to the General Body of the RMO. The audit sub-committee members have been trained in conducting internal audits. In addition the RMO leadership hold regular meetings with the wider community in villages (Sherpur) and for sub-areas (Kaliakoir). Stakeholder based meetings are also held with fishers to finalize the resource management plan and yearly budget, and to fix gear fees and fishing contracts; meetings are also held with women, farmers, and pump operators for establishing management rules. Resolution books are fully maintained by the RMO members themselves.

A participatory self monitoring system is being introduced with the RMOs so that the general members can regularly assess the performance of their organizations. Pictorial report card tools for self monitoring have been developed through consultations with the RMOs which are being oriented on how to use these. Participatory monitoring, using tools designed for each purpose, will cover the functioning of the RMOs, trends in fish catches, and the functioning of the UFCs.

As of 30 April 2007, the 16 RMOs had bank deposits of Tk 671,735 giving an average including small amounts of cash in hand of over Tk 42,000 per RMO accumulated for use in maintaining sanctuaries, meetings, etc from collection of subscriptions, fees from gear users, and net income from awarding fishing contracts. Thirteen RMOs have office and community centers built by the project and three others have been under construction in 2007 and are due for completion in June of 2007. Having their own buildings has improved the self confidence, self image and management ownership of RMO members.

However, it became apparent that site based inter RMO networks were needed to address bigger issues such as prevention of mass fishing festivals ("gini fishing"), reducing lease costs, and campaigning against pollution. In Kaliakoir this developed spontaneously in response to the continuing severe industrial pollution problem, and site based meetings between the RMOs are held once in a month. In Kangsha-Malijee and Hail Haor sites these network meetings are held once every three months. These networks have already shown their worth, for example by other RMOs coming forward to help if an RMO falls under financial difficulties. For example, Kazura RMO in Hail Haor was unable to purchase land for construction of its office building due to financial limitation. It raised the issue at the network meeting of the RMOs and six out of seven RMOs donated a total of Tk. 14,000 to help with the land purchase. Besides this Kazura RMO also collected a donation of Tk 3,000 for purchasing land from the local UP Chairman. RMO representatives regularly attend Union Parishad meetings to explain their activities and to seek necessary assistance from local elected government.

The RMOs also are members of the Upazila Fisheries Committee (UFC) which is the main co-management body established by MACH, where they report on progress. Since late 2005 they have been able to submit their project proposals to get financial support from the endowment fund/trial funds, and two rounds of small schemes and projects proposed and implemented by RMOs have been completed. All the RMO members have received orientation training on UFC and endowment fund operational processes and they are now well aware about the role and functions of the UFC. RMOs are now capable of preparing their wetland development schemes through a participatory process, and can present these in the UFC for receiving financial support from the endowment fund. They are also taking technical advice if and when necessary from the respective government officials during the implementation of their schemes. In each Upazila a three member monitoring team has been formed by the UFC to monitor the progress of the projects/schemes of the RMOs.

To give direction to the RMOs and the facilitating project staff of CNRS for strengthening the capacity of the RMOs, a system of assessing their progress was introduced in 2004, this originally used over 100 items of information clustered in six indicator themes and derived from discussions with the RMO executive, general members, non member fishers, landless and women, and project staff plus review of the RMO records. This has helped focus capacity building and creates peer pressure. The system has been updated and simplified, while retaining the same themes and maintaining comparability, so that it can be continued by the UFCs after MACH ends. In the most recent assessments the Upazila Fisheries Officers have conducted the assessments with MACH staff. Table 11 shows the categories of indicator and most recent summary assessment compared with previous assessments.

**Table 11: Summary of RMO assessments recorded as % of achievement of ideal for each indicator theme.**

Scores (%)	Turag-Bangshi					Hail Haor									Kangsha-Malijhee				
Indicator	Aloa	Goalia	Turag	Mokash	Ave- rage	Agari	Ramedia	Kazura	Dumuria	Bara- gangina	Jethua	Balla	Sananda	Ave- rage	Taki- mary	Kewta	Dhali- Baila	Bailsha	Ave- rage
Jan '07																			
Resource management	68	55	45	77	61	45	59	55	85	55	45	45	45	54	75	65	55	85	70
Pro-poor	73	65	73	68	70	71	36	64	91	95	77	77	68	73	95	77	86	100	90
Women's role	83	42	75	67	67	58	58	67	100	67	8	75	58	61	75	25	58	75	58
Organization	68	68	86	86	77	68	73	45	100	75	65	95	86	76	82	65	68	73	72
Governance	68	41	59	64	58	50	50	36	73	73	41	73	50	56	77	64	55	73	67
Financial	69	42	69	75	64	63	75	50	94	94	38	88	69	71	94	75	69	75	78
Networking	88	64	100	75	82	50	69	31	69	56	44	63	44	53	44	50	31	44	42
Overall score	74	54	72	73	68	58	60	50	87	73	45	74	60	63	77	60	60	75	68
Changes in category																			
January 2007	A2	B1	A2	A2		B1	A3	B1	A1	A2	B2	A2	A3		A2	A3	A3	A2	
July 2006	A2	A3	A2	A2		A3	A3	B1	A1	A3	B2	A3	B1		A2	B1	A3	A2	
January 2006	A2	B1	A3	A2		B1	B1	B1	A3	B1	B2	A3	B1		A2	B1	A3	A2	
July 2005	B1	B2	B1	A3		B2	B1	B2	A3	B2	B2	B1	B2		A3	B2	A3	A3	
December 2004	C	C	C	C		D	B2	C	B2	D	D	C	D		B1	C	B1	B1	
Change in % score (Jul 2006 – Jan 2007) (+ unless otherwise stated)																			
Resource management	0.0	-9.1	-9.5	9.1	-2.4	-9.5	0.0	4.5	16.8	13.6	-4.5	-4.5	0.0	2.0	15.9	10.5	4.5	12.3	10.8
Pro-poor	11.6	-3.8	-5.1	-9.6	-1.7	0.0	-8.1	-19.7	-3.5	-4.5	10.6	-6.1	-4.0	-4.4	-4.5	21.7	-2.5	0.0	3.7
Women's role	0.0	0.0	0.0	-8.3	-2.1	0.0	0.0	0.0	16.7	0.0	0.0	8.3	25.0	6.3	8.3	0.0	0.0	0.0	2.1
Organization	1.5	3.2	14.1	11.4	7.6	8.2	12.7	0.0	10.0	15.0	15.0	10.5	26.4	12.2	-8.2	15.0	-1.8	12.7	4.4
Governance	-13.1	-21.6	-9.7	-11.4	-13.9	-18.8	0.0	-13.6	-2.3	-2.3	-15.3	-2.3	6.3	-6.0	8.5	-5.1	-8.0	-13.0	-4.4
Financial	11.6	-27.1	11.6	17.9	3.5	0.0	10.7	7.1	8.0	15.2	1.8	18.8	11.6	9.2	29.5	10.7	11.6	17.9	17.4
Networking	12.5	-5.7	8.3	-16.7	-0.4	-8.3	-9.8	-35.4	-6.3	-10.4	-20.5	-4.2	-16.3	-13.9	-14.6	-25.0	-43.8	-22.9	-26.6
Overall score	3.5	-9.1	1.4	-1.1	-1.3	-4.1	0.8	-8.2	5.6	3.8	-1.9	2.9	7.0	0.8	5.0	4.0	-5.7	1.0	1.1

Note: categories are: ≥80%- A1, 70-79%- A2, 60-69%- A3, 50-59%- B1, 40-49%- B2, 30-39%- C, <30%- D

Shaded cells indicate a drop in performance / status.



## F. Public Awareness Program

MACH has raised understanding of the causes of wetland degradation and loss and the benefits of improved management systems adopted by the communities with the support of the project. This has been done by targeting the participants of community organizations (RMOs and RUGs) to motivate and inform them, particularly poorer resource users but also local opinion leaders, to take these initiatives; the wider local community including local government to endorse and comply with the wetland management initiatives (interventions and rules) established; and more senior practitioners and policy makers to support and promote these approaches. The latter is discussed more fully in section L, this section focuses mainly on the site based awareness program.

As of April 2007 a total of 6,033 awareness events had been held, attended by more than 562,000 people. Of them 2,232 events covering more than 306,000 people were held during MACH-I and the remainder were held during MACH-II. The nature of each type of activity is elaborated in Table 12.

**Table 12: MACH awareness raising events and attendance up to April 2007**

Type of event	Coverage	Hail Haor		Turag-Bangshi		Kangsha-Malijhee		Total	% RMO related (CNRS)	% RUG related (Caritas)
		MACH-I	MACH-II	MACH-I	MACH-II	MACH-I	MACH-II			
Uthan/Para boithak (Courtyard Meeting)	Events	288	397	267	426	409	637	2,424	53	47
	Persons covered	10,860	7,880	7,670	7,380	8,560	6,770	49,120	44	56
Village meeting (general)	Events	141	316	104	128	200	567	1,456	83	17
	Persons covered	5,280	7,690	8,520	3,640	12,730	12,640	50,500	79	21
Union Parishad/ Upazila/ District level meeting	Events	23	0	15	66	17	29	150	75	25
	Persons covered	2,410	0	1,190	680	5,010	260	9,550	24	76
School and University program	Events	5	65	227	51	60	116	524	100	0
	Persons covered	1,730	690	1,130	1,010	360	970	5,890	100	0
Observance of international and national days (art and quiz competition/ fish fortnight/field day)	Events	31	14	17	23	19	5	109	71	29
	Persons covered	17,920	4,050	9,630	14,030	13,420	2,380	61,430	72	28
Baul song, video show, and community meeting	Events	122	0	80	0	78	1	281	61	39
	Persons covered	46,900	0	39,410	0	75,850	40	162,200	41	59
Drama show	Events	0	35	0	39	0	66	140	100	0
	Persons covered	0	25,480	0	5,490	0	30,290	61,260	100	0
Knowledge sharing workshop to discuss formation of FRUG	Events	18	231	25	264	2	214	754	7	93
	Persons covered	70	4,390	1,590	4,490	470	4,290	15,300	19	81
Village level meeting (watershed management)	Events	77	1	0	3	0	11	92	100	0
	Persons covered	720	20	0	1,700	0	1,140	3,580	100	0
Exhibition and fair	Events	3	14	2	25	2	57	103	65	35
	Persons covered	14,450	20,140	5,740	29,100	14,890	59,350	143,670	73	27
<b>Total</b>	<b>Events</b>	<b>708</b>	<b>1,073</b>	<b>737</b>	<b>1,025</b>	<b>787</b>	<b>1,703</b>	<b>6,033</b>		
	<b>Persons covered</b>	<b>100,340</b>	<b>70,340</b>	<b>74,880</b>	<b>67,520</b>	<b>131,290</b>	<b>118,130</b>	<b>562,500</b>		

*Note: persons covered is the sum of reported attendance in each event rounded to the nearest 10, one person may have attended several events over the seven years.*

1. **Project introductory meetings** were held at para (neighborhood), village, upazila and district levels to orient stakeholders about the aims and objectives of the project and the value and function of wetlands. These were normally day-long events attended by 30 to 200 people. Since inception 2,424 Uthan Boithak (courtyard meetings) were held at the para level; 1,456 village meetings reached a similar number of participants, and 9,550 local leaders attended 150 Union Parishad/Upazila and District level meetings. In these meetings the participants discussed their problems relating to natural resources and tried to find solutions. Uthan Boithak has been found to

be more effective for interactive communication, usually 10 to 30 people participate in this type of meeting to discuss their problems and livelihood issues, and to recommend sustainable resource management solutions.

2. **School and University Program:** Students are considered one of the most powerful change agents at community level. Therefore, MACH has initiated programs mainly with selected schools in the project areas to help educate students on environmental issues (which are not well covered in existing curricula). More than 5,880 students attended these classroom sessions. In addition, students participated in rallies in observance of special events and university teachers and students have started to show interest in making field visits as part of their courses or as part of their wider learning. Several student groups have made visits to Baikka Beel sanctuary in Hail Haor. In addition as part of a USAID program, a group of 20 students from universities in Dhaka visited RMOs, RUGs and the permanent sanctuary in Hail Haor to gain knowledge about community development and local resource management efforts.



*Courtyard meeting on wetland management*



*Spreading the word about protecting nature among the future generation*

3. **International and National Day Observance:** Special events have been taken up at both the national and field level in observance of environment related days, including the government's annual fish week/fortnight. Rallies, discussion meetings, drawings and quiz competitions for students, and cultural events were held to mark these days. Information relating to natural resource management was disseminated through these events. More than 61,400 people are estimated to have participated in 109 special events since the projects inception. Significantly, MACH facilitated the Department of Fisheries taking up national press conferences, newspaper supplements and a seminar for the World Wetland Day 2007 under the theme "fish for tomorrow".



*A rally brought out on Environment Day 2006 by a Local Government Committee*

4. **Folk Songs and Video Shows:** Traditional folk media such as folk song (baul song) can be very effective for disseminating development messages. Besides, video shows highlighting local issues have also played a significant role. During MACH-I the project sponsored production of a video documentary which was shown widely, and for local singers to compose songs on wetland issues and the process of local resource management and its importance. Under the MACH initiatives a total of 281 events of folk song/video shows were held attended by over 162,200 people, mostly during MACH-I. In MACH II several video documentaries were produced but dissemination has targeted national policy makers and mass media through TV screening, although some local shows were also arranged it was not possible to give data on the numbers of people reached.
5. **Live Drama** has been adopted in MACH-II as a more effective and attractive media for locally conveying complex messages about wetland management. Scripts of the dramas were composed highlighting key messages on wetland issues. A positive direction for further development of local resources was reported to have been given during the performances. A total of 140 live drama events were organized and more than 61,200 people were educated through these programs.

6. **Knowledge Sharing Workshops** have been held to maximize participation of local leaders and share achievements and issues with them. Some 15,300 local community leaders, representatives of relevant government offices and NGOs participated in 754 of these workshops.
7. **Village Level Meeting (watershed management):** Siltation and loss of perennial water bodies is a major threat for the sustainability of wetland resources. To tackle this problem special village level meetings of Watershed Management Committees were held. In these meetings prospective and actual participants discussed the means and ways to protect the upper watersheds of the project water bodies. More than 1,200 villagers participated in 81 meetings which formed the basis for the community organizations working on issues outside the RMO wetland areas on for example tree planting along streams and in degraded hill areas.
8. **Exhibitions and Fairs** were organized at district and upazila levels to demonstrate project outcomes on special days and events. At national level, exhibitions were also held in observance of relevant days. In addition the project has targeted urban communities and leaders in the rest of Bangladesh through participating in several “America Week” fairs through stalls, lectures and drama shows. A total of 103 local exhibitions and fairs were organized, in addition to participation in fairs organized by USAID and the DOF.
9. **Awareness Raising at Policy Level:** Government officials, development partners and a cross section of professionals and practitioners (NGOs, academics, etc.) have been oriented on MACH activities and achievements through meetings, workshops, seminars and field visits, of which field visits have been the most effective method. These initiatives have helped make significant policy changes particularly in the Ministry of Land and have also influenced DOF thinking on wetlands. This is further discussed in section L.

## G. Co-Management and Governance

Community based management is explicit in the name of the MACH project, but for this to be sustainable in the socio-economic context of the country, well functioning institutional linkages between the community organizations and the local administration are essential. Co-management involves sharing responsibilities between stakeholders - resource users and government, and commonly involves devolving a greater share of management responsibilities from government to empower local communities. Fig 4 outlines the links between the community based organizations (RMOs and FRUGs) established by MACH and local government.

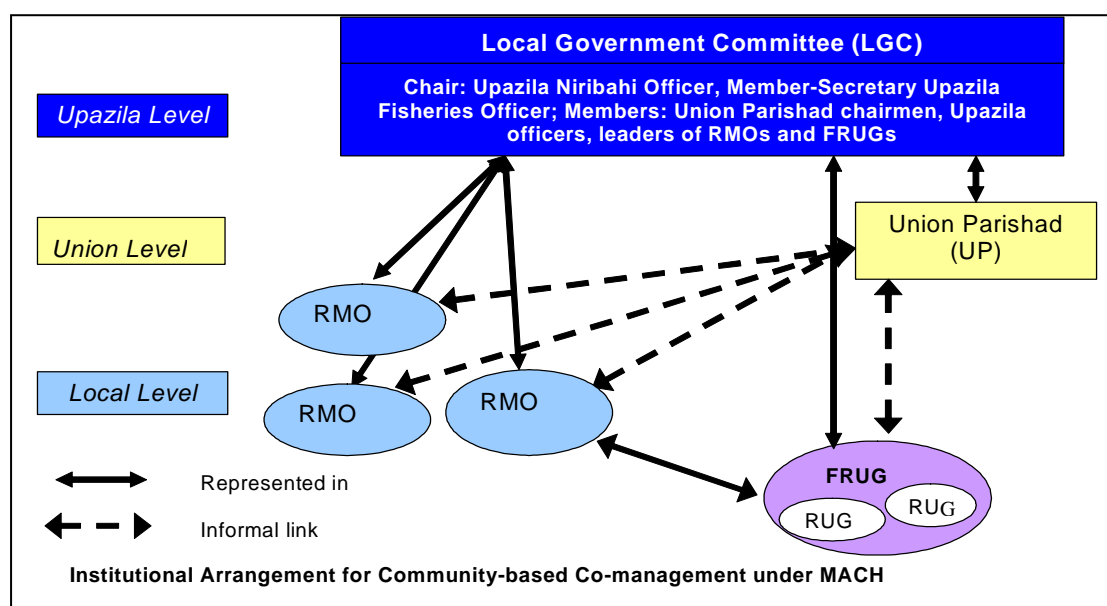


Figure 4: Co-management arrangements and links between organizations established through MACH Community organizations and Union Parishads

Section H below notes that primary poor resource users (mainly fishers) have been organized into small groups to develop alternative livelihoods. The project strategy was for wetland resource development and sustainable management to be undertaken by separate community organizations

known as Resource Management Organizations (RMOs). A high percentage of these resource users (60%) are represented in the RMOs along with other stakeholders, as discussed in section E. The capacity and skills of the community representatives have been developed for resource management and operating their organizations and in taking decisions and linking with local government agencies to access support.

All of the RMOs are recognized by government in multiple ways: the RMOs are registered with the Social Welfare Department, their access to jalmohals is through agreement of Ministry of Land to reserve those water bodies for their management, their management plans are endorsed by both local government and officials of the Department of Fisheries, and they have been accepted as local institutions that are invited by the relevant Union Parishad to discuss wetland resource management issues, observe and report in its meetings (the UP Chairman also acts as adviser to the RMO). The links with Union Parishad's are vital since this is the lowest level local government body and is an elected body. Factions that arise related to development works frequently are based on UP members. In the MACH sites all the concerned UPs were involved in the planning process. However, in addition the UP chairmen sit in specific Upazila level co-management bodies for each site. UP endorsement has been very effective for the RMOs when interventions were implemented such as earth works, plantations, awareness programs, sanctuaries, and establishment of fishing norms. They participate in and monitor the implementation of activities, and have a key role in conflict resolution.

#### ***Local Government Committee (LGC) (re-named as Upazila Fisheries Committee- UFC)***

The original design of MACH provided for establishing a committee in each of the four Upazilas covered by the project for coordination. Accordingly Local Government Committees (LGCs) were formed. They were chaired by the Upazila Nirbahi Officer, the Upazila Fisheries Officer was Member-Secretary, and representatives of other relevant government departments at Upazila level, concerned UP Chairmen, the RMO representatives, and partner NGOs were members. These committees coordinated, supervised and took appropriate steps for successful implementation of the project activities. Over time they played an increasingly important role and were identified as having great potential for ensuring sustainability outside and after the project. The success of the LGCs during MACH encouraged the DoF to propose adoption of this approach more widely in all upazilas where it has community managed fisheries, and MACH proposed that they continue after the project.

As a part of the mainstreaming of this approach, all four old LGCs under the MACH Project have been replaced by Upazila Fisheries Committees (UFCs) in line with the Inland Capture Fisheries Strategy of the Government, this has involved the inclusion of a few new members and additions to the terms of reference. The LGCs were replaced by UFCs through a government order issued in February 2007 by the Ministry of Fisheries and Livestock. In addition one new UFC has been formed in Moulvibazar Sadar Upazila to fill a gap in the coverage of areas where MACH has worked (this part of Hail Haor had been covered by the Sreemangal LGC but in the long term that is inappropriate for handling funds that are used in a different upazila). Representatives from the FRUGs have also joined the UFCs, and two women representatives from the CBOs (RMOs and FRUGs) have also been added to the UFC, with their selection based on decisions of a meeting among women office bearers from the CBOs within the upazila.

The UFCs also provide a pathway, where necessary, for issues to be placed through the UNO before the Upazila Development Coordination Committee, and where necessary to the District level. During the project the LGCs were to a considerable extent dependent on logistic and other support through the project, but steps have been taken to make the UFCs viable without project support through an endowment.

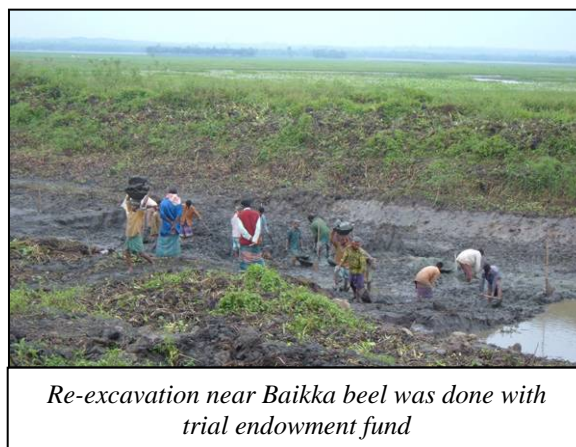
#### ***Endowing co-management***

Generally, at the end of a development project when the fund flow stops, the activities and institutions gradually weaken or disappear and the benefits can dwindle. As part of its effort to establish sustainable management systems after it ends, MACH decided that an endowment fund should be left with each of the UFCs where the principal could never be touched but the accrued interest could be used to carry on their functions including meetings, awareness, and supporting the RMOs for restoring wetland habitats. After consultations with all levels from local to national, endowment funds



were included in the design of the Investment Support to MACH (ISM) project approval by the Government of Bangladesh.

To develop capacity among the LGCs/UFCs and RMOs for processing and managing small schemes, and bearing in mind that the endowments will only yield operational funds 12 months after they are opened, equivalent funds were placed with the LGCs/UFCs on trial basis during both 2005-06 and 2006-07 financial years. After approval of the revised Project Proforma in May 2005, MACH drafted a management guideline circular in consultation with legal experts, based on the experience of the RMOs and LGCs, and considering issues raised in trial operation of equivalent funds provided as grants to the LGCs/UFCs. After review and comments from MoFL and Senior/ Upazila Fishery Officers (S/UFOs), modifications were made and the final circular covering a total endowment of Tk 36 million was approved by MOFL in January 2006 through the DoF. The allocation of endowment funds is shown in Table 13.



*Re-excavation near Baikka beel was done with trial endowment fund*

**Table 13: Breakdown of endowment funds by UFC**

	Sreemangal	Kaliakoir	Jhinaighati	Sherpur	Moulvibazar	Total
Endowment (Tk. in lakh)	124.00	91.00	68.00	25.00	52.00	360.00
Likely annual fund (Tk. in lakh)	7.78	5.71	4.27	1.57	3.27	22.60
UFC Support Fund (%)	10	15	17	25	18	17
RMO Activities Fund (%)	90	85	83	75	82	83

Note: differences in % reflect the number of RMOs in an upazila – the fewer the higher the % of expenses for committee operation and supervision.

Salient features of the approved endowment fund system are:

- The principal is placed in a fixed deposit in a nationalized scheduled bank in each Upazila, this cannot be withdrawn except in the case of an MoFL decision at the Secretary level.
- The interest accruing every year will be automatically deposited in two accounts – the UFC support fund can be spent for administration, logistic support, training and awareness raising; the RMO activities fund is for wetland protection and development schemes undertaken by the RMOs. For this purpose, the RMOs submit schemes every year for approval of the UFC.
- Decisions on the use of these two accounts each year are taken by the UFC in which the UNO, concerned Upazila officers, Union Parishad chairmen and leaders of the RMOs are all voting members. Operation of the two operating accounts is by the chair and secretary of the UFC and is subject to normal government audit and scrutiny by DoF – the DFO - and DC.
- Execution of schemes is monitored and supervised by a team from the UFC and there is also monitoring internally by a team formed by each RMO itself.
- If the funds are misused and the objective of sustaining and further restoring wetland productivity and biodiversity is not attained, then the endowment funds can be dissolved by the MoFL, and the principal money plus any amount left in the two operating accounts will be withdrawn and deposited in the Government Treasury.

Endowment Funds have been placed under the concerned UFCs on different dates subject to availability of fund under the ADP starting from June 2006 to June 2007.

#### ***Trial Endowment Fund operation***

It took some time to develop a guideline of operation for the Endowment Funds (EF) and for the guideline to be issued as a government circular by the MoFL. Moreover, funds had to be available from the ISMP and after placement of the EF in bank accounts at the Upazila level the interest on the capital amount is only available after one year. So, to develop the capacity of the RMOs and UFCs in operating the EF, trial funds equivalent to the probable amount of interest to be earned were placed in favor of each UFC in 2005 and again in 2006. The funds are placed in two STD accounts of each UFC held at a schedule bank at Upazila level. The amount placed in account 1 is used to cover the expenses of meetings, logistic support to government officials for supervising and monitoring the RMO

activities funded from the EF/trial fund; and for organizing some awareness raising programs on wetland management. The amount in account 2 is used to make grants to the RMOs for schemes to improve the status of wetland resources. Both accounts are operated under joint signature of UNO and S/UFO.

RMOs have prepared proposals for schemes in consultation with the local resource users and those were presented in the UFC meeting for scrutiny and approval. After approval of the most suitable schemes within the available fund, the schemes are executed by the RMOs. Usually RMOs undertake schemes on habitat restoration (excavation), sanctuary maintenance including guarding, stocking of threatened fish species, awareness building, creating swamp forest, enforcing rules against harmful fishing, and in Turag-Bangshi site monitoring dissolved oxygen in the polluted water bodies. During the year 2005-06 (1<sup>st</sup> year of trial EF operation) the overall performance of execution of schemes and activities was affected by late release of funds and the lack of first hand experience of the RMOs. But in 2006-07 their performance improved. A summary of the activities undertaken by the RMOs through the trial funds and the amount approved is given in Tables 14 and 15; as can be seen from the comments while capacity has developed this is a slow process and the UFCs still need careful checking to ensure that the officials make visits and expenses that support the schemes the UFCs approve.

**Table 14: Summary of schemes and grants made to RMOs to trial endowment fund operation**

Site	Name of RMO	2005-2006			2006-2007	
		No. of schemes	Amount approved (Tk)	% of funds spent	No. of schemes	Amount approved
Kaliakoir	Mokosh	4	57,826	97%	7	74,371
	Turag	7	72,710		7	77,352
	Alua	7	50,825		5	35,608
	Goaliar	4	44,500		4	40,410
Sreemangal	Sananda	4	73,771	58%	2	44,250
	Balla	3	72,180		2	69,460
	Dumuria	3	98,610		2	129,260
	Jethua	3	94,100		2	60,600
	Baragangina	3	69,250		7	78,105
	(including Baikka beel sanctuary)	5	115,225			75,802
	Kajura	3	76,390		2	87,400
	Ramedia	2	73,593		3	66,090
	Agari	2	76,444		3	93,555
Sherpur sadar	Kewta	3	105,000	0% (scheme not possible due to dispute)	4	104,990
Jhenaigathi	Takimari- Dharabasia	8	135,920	44% (late release of funds by UFO)	5	71,540
	Dholi-Baila	4	141,200		5	124,695
	Bailsha	5	133,900		3	82,770
<b>Total</b>		<b>70</b>	<b>1,491,444</b>		<b>63</b>	<b>1,316,258</b>

**Table 15: Summary of funds used for UFC costs under trial endowment fund operation**

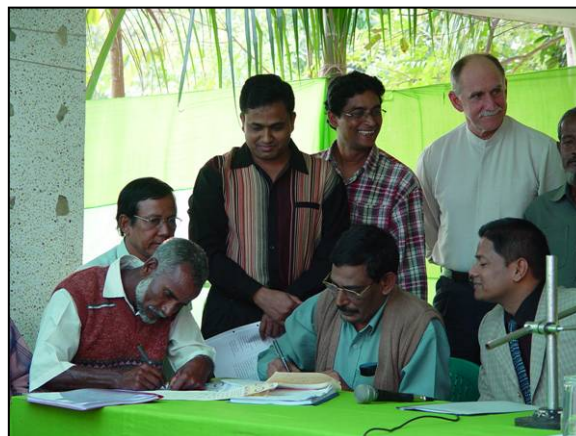
UFC	2005-06			2006-07
	Amount in Tk approved (released)	% of released fund spent	Performance/ comments	Amount in Tk approved (released)
Kaliakoir	63,750 (24,150)	98%	Need further orientation to make use consistent with supervision of schemes implemented by RMOs.	63,750 (33,990)
Sreemangal	139,680 (55,690)	80%		82,970 (55,000)
Moulvibazar sadar	--	--	Not formed then	UFC formed in 2007 so fund could not be placed
Sherpur	35,100 (28,555)	96%	Overall performance better, but not consistent with the execution of STD-2 fund.	35100 (18,150)
Jhenaigathi	72,900 (42,725)	100%	Needs further orientation for holistic use of SDT-1 fund.	72,900 (30,000)

## Networking

Looking beyond the MACH sites, various fisheries and wetland related projects of DoF and other agencies have established community based organizations for better wetland management. There was a need for the community managers of these wetlands- beels, baors, haors and rivers- to communicate with one another and with the government. Informal or formal networking among these community based organizations had been proposed as part of the exit strategies of different projects, as a way of strengthening their future sustainability by improving learning between wetland communities and managers, and by sharing issues and where necessary lobbying for access rights and other support. MACH collaborated with Fourth Fisheries Project in 2006 to provide opportunities (meetings, workshops and exchange visits) for sharing and learning between the community based organizations established by both projects to manage various fisheries.

## H. Federations of Resource User Groups (FRUGs)

Initially MACH through the MACH Caritas component of the project introduced savings, micro-credit and skill development training for poor fishers and other wetland resource users through the typical small group approach (Resource User Groups – RUGs) that has been successful in Bangladesh. The aims were to increase incomes of the poor, diversify income sources and reduce fishing pressure, as discussed in the next section. This program quickly built up from 1999 to 2002. Thereafter groups and membership increased modestly to fill in gaps in coverage, with the emphasis moving to capacity building to ensure the sustainability of the group system all the while managing the resource using best management practices. By the end of April 2007 there were 5,202 RUG members (Table 16).



*Handover of revolving fund to Kalapur Federation of Resource User groups in Hail Haor*

**Table 16: Development of RUG/FRUG micro-credit program**

Period(Nov-Oct)	RUG members	No. of borrowers	Loans disbursed(Tk mill)
1999	959	0	0.00
2000	2,019	511	2.33
2001	3,549	2,027	8.27
2002	4,580	3,728	14.45
2003	4,598	3,305	10.96
2004	4,689	3,551	18.52
2005	5,104	3,607	22.44
2006	5,203	3,686	26.22
2007	5,202	1,211	13.10

*From Nov of previous year. 2007 data is up to 30 April*

The long term sustainability of revolving funds that now total about US\$ 0.42 million was an issue along with whether the participants should remain dependent on the NGO indefinitely. The strategy adopted to address this has been to establish Federations of RUGs (FRUGs) as legal entities which are registered membership-based social welfare organizations, and to phase out NGO support.

Thirteen such FRUGs have been formed roughly coinciding with Union Parishad (local council) boundaries. Each FRUG comprises the members of the constituent RUGs (average of 19 RUGs and 390 members) and has its own executive committee representing all of the RUGs, and its own constitution (Table 17). All of the FRUGs have been registered with the Social Welfare Department, although due to issues related to government policies and procedures the three in Kaliakoir only received registration in 2007.

The revolving loan funds (RLFs) have been handed over to the FRUGs for their independence in a phased process. As of April 2007 nine FRUGs had taken possession of their RLFs and were managing their own revolving funds (about Tk. 20 million each). Hand over of RLFs to the other four FRUGs is due to be completed within June 2007 (three were delayed due to the registration process and one FRUG is relatively small and had previously a poorer record in loan repayment which has been

gradually improving). All of the FRUGs are due to take possession of the accumulated savings of their RUG members by June 2007. The savings will be held in common bank accounts, with individual savings records continuing to be maintained by passbooks as they have when MACH Caritas managed the system.

**Table 17: Status of FRUGs**

Particulars	Up to April 2007
No. of FRUGs	13
No. registered	13
No. with handed over revolving fund	9
No. of RUGs	250
No. of male RUGs	167
No. of female RUGs	83
Total individual members	5,202
% men	64
% women	36
% fishers	59
% men in executive committees	65
% women in executive committees	35
% fishers in executive committees	56
Total savings (Tk in million)	8.69 mill
Total active loans (Tk in million)	22.03 mill
Revolving fund principal grant (Tk in million)	20 mill

The General Body of each FRUG has been formed from three representatives chosen by each RUG and holds an annual general meeting. The Executive Committee (EC) comprises of one representative from each RUG, each of whom has a two year term in office, and meets once a month to take decisions regarding all activities approved in the general body. Through this mechanism the RUGs present monthly progress reports on meetings, savings, credit, training, and social action; decisions on follow up actions to ensure collection of overdue loans are made, income and expenditure statements are presented; credit disbursement is reported on; and loan applications for the next month are reviewed and approved.

Already the handed over FRUGs have developed a sense of ownership of their revolving funds and are playing a pivotal role in ensuring collection of overdue loans, and not a single loan is made to RUG members without the approval of the EC. This process of empowerment increased their self confidence. To strengthen weaker RUGs the EC members jointly visit those groups to motivate them. The FRUGs maintain their own resolution books and are gradually developing their capacity through learning by doing. The FRUGs have their own credit operational manuals developed with the help of project staff, and all the EC members of each of the FRUG have undertaken credit management and cost benefit analysis training.

At the beginning of the year each RUG and FRUG prepares its yearly activity plan by itself, with RUG plans being forwarded to the FRUG they belong to. They also are expected to review performance in regular meetings, and through an audit sub-committee. In addition the FRUGs are obliged to have an external audit by the social welfare department after each financial year of operation. An additional review process is the participation of the presidents of each FRUG in the respective Local Government Committee where they present their progress on credit and can seek assistance from local government officers and Union Parishads when needed.

During MACH-II a system of regular assessments was developed, every six months all 13 FRUGs were assessed against a set of over 100 indicators clustered into seven themes that relate to the functioning and objectives of the FRUGs, their membership and governance. The results of the most recent assessment from October 2006 are compared with the first in August 2005 (Table 18). The results were summarized into a set of grades, in general this indicates that all the FRUGs have improved their management and governance although there are some questions over the likely sustainability of some – those not yet in the “A” category. A simplified version of this assessment system has been developed and the assessments were done by a combination of project team and the Upazila Social Welfare and Fisheries Officers. After MACH ends it is expected that the Upazila officers will continue to make assessments on behalf of the UFCs and report these back to the FRUGs and UFCs as part of monitoring for a learning and improvement.



**Table 18: Results of FRUG assessments in August 2005 and October 2006 showing achievement against seven categories of indicator (as a percentage out of the possible maximum score for each category of indicator).**

FRUG	Credit/ IGA mgt		Pro- poor		Women's role		Organiz- ation		Govern- ance		Finan- cial		Network- ing		Overall %		Grade	
	'05	'06	'05	'06	'05	'06	'05	'06	'05	'06	'05	'06	'05	'06	'05	'06	'05	'06
<b>Hail Haor</b>																		
Kalapur Union	54	60	71	67	56	67	46	61	67	75	38	63	27	50	51	63	<b>B1</b>	<b>A3</b>
Sreemongal Union	46	45	67	67	56	67	46	44	64	75	17	44	32	50	47	56	<b>B2</b>	<b>B1</b>
Giasnagar-Nazirabad Union	46	50	50	50	44	67	50	56	56	67	17	38	29	42	42	53	<b>B2</b>	<b>B1</b>
Mirzapur Vhunobir Union	41	61	71	58	44	50	39	61	50	67	17	56	27	50	41	58	<b>B2</b>	<b>B1</b>
Ashidron-Vhunobir Union	41	50	71	58	39	100	46	61	62	83	17	63	29	67	44	69	<b>B2</b>	<b>A3</b>
<b>Kangsha-Malijee</b>																		
Aura Baura Beel	48	45	88	67	56	67	53	78	50	75	29	69	32	88	51	70	<b>B1</b>	<b>A2</b>
Pakuria Dhala Bhatshala Union	61	65	93	67	72	83	67	67	75	83	58	63	39	75	66	72	<b>A3</b>	<b>A2</b>
Jhenaigathi Union	41	30	89	58	6	17	32	64	47	58	8	17	31	58	36	43	<b>C</b>	<b>B2</b>
Malijikanda Union	44	45	86	67	50	67	43	75	50	75	25	63	31	75	47	67	<b>B2</b>	<b>A3</b>
Dhan Shail Union	39	15	86	67	22	50	21	43	50	58	8	17	25	58	36	44	<b>C</b>	<b>B2</b>
<b>Turag Bangshi</b>																		
Chapair Madhapara Boali (Chambo)	44	56	82	58	39	67	32	57	44	67	12	13	19	58	39	54	<b>C</b>	<b>B1</b>
Sutrapur Chapair Union (Suchana)	59	61	96	58	72	100	61	79	69	92	19	13	19	75	57	68	<b>B1</b>	<b>A3</b>
Mowchak Madhapara Union	41	55	79	50	56	83	39	71	47	83	8	13	15	67	41	60	<b>B2</b>	<b>A3</b>

The FRUGs are now functioning with a sense of ownership and self-identity, linking with their RUGs, and holding effective meetings. All the FRUGs except one have their own office building. Existence of their own office building increased self confidence among them and most have effective credit programs where women are playing an active role. The nine FRUGs that so far have taken ownership of their RLFs were found to be progressing well and taking seriously their review of loan applications. Weaknesses that were identified and that are being addressed included: linkage with service providers, improving capacity to analyze financial operations and monitoring their staff. MACH is also working to strengthen links between RMOs and FRUGs so that they would work consistently for better management of wetlands.

The nine FRUGs that are operating their own RLFs have each recruited one of the experienced previous project field staff of Caritas. They are now working as the staff of the concerned FRUGs and are paid salaries derived from part of the interest payments the FRUGs receive. The FRUG staff are managing the day-to-day work of savings and loan repayment collection, and also administer loan dispersal. Service rules for the FRUG staff have been developed, under which the staff are responsible to their employers and the office bearers of the FRUGs are supervising and monitoring their staff. To support this the FRUGs were given training in how to monitor and supervise staff.

During the phase out period of the MACH project, which extends to June 2008, the emphasis has been on strengthening FRUG financial and general management skills and their recognition and capacity to work with other local organizations including the UFCs. Five workshops between FRUGs and RMOs and local service providers (government agencies and NGOs) have been held, one in each Upazila, to improve the access that poor people can get to training and other support services available in their areas through a link between FRUGs and other organizations. In each site quarterly inter-FRUG coordination meetings are proposed to maintain some uniformity among them and to help them address bigger issues through a united platform.

## I. Livelihoods

From the outset MACH recognized that restoring and sustaining fisheries would require the communities to limit fishing, and this could have adverse impacts on poorer fishing dependent households. To maintain and enhance the livelihoods of poorer households a major project component has been the Resource User Groups, as of April 2007 5,202 households have members belonging to

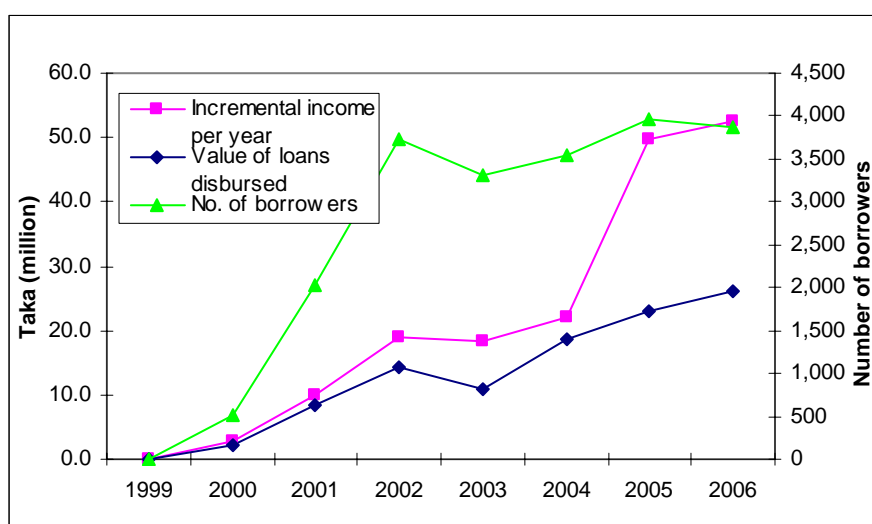
these savings and credit groups. A major part of this program has been to develop the capacity of resource-poor people particularly for professional/income generating skills, but also for awareness of wetland resource issues and in how to manage their groups (Table 19).

**Table 19: Training provided by MACH-Caritas up to April 2007.**

Training Head	2000	2001	2002	2003	2004	2005	2006	2007	Total	Batches
Group development	1,574	2,304	2,286	487	544	711	2,016	-	9,922	506
FRUG development	-	-	-	-	218	527	1,848	347	2,940	140
Resource awareness	-	1,268	2,166	536	315	318	1,090	-	5,693	305
Skill development	351	655	963	519	508	544	946	154	4,640	295
Health care and nutrition	357	537	641	-	-	-	-	-	1,535	71
Development allies*	53	50	58	-	-	-	-	-	161	8
<b>Total</b>	<b>2,335</b>	<b>4,814</b>	<b>6,114</b>	<b>1,542</b>	<b>1,585</b>	<b>2,100</b>	<b>5,900</b>	<b>501</b>	<b>24,891</b>	<b>1,325</b>

\* this covers local leaders and elected representatives, not RUG members

Up to late 2006 a total of 14,829 loans had been disbursed to RUG members for use in 35 different types of income generating activities or trades that were alternatives to fishing (Fig 5). These have helped fishers or the family members of fishers take up new occupations altogether, or at least earn an income from other non-wetland sources that helps to compensate for refraining from fishing in protected areas and during closed seasons. Popular enterprises include poultry and livestock, but occupational skills have also been developed for example as mechanics and electricians. Borrowers have on average reduced their fishing effort by 20-30%. By the end of 2006 almost 4,000 families reported increased annual income of 70% over their previous incomes.



**Figure 5: Micro-credit support through MACH**

**Table 20: Changes in income for AIGA credit recipients by year of first loan in MACH-I**

1 <sup>st</sup> Year	1999	2000	2001	2002	2003	Overall
Tk/day						
2000	58	70			86	
2001		54	77		88	
2002			50	83	73	
change %						
2000		21			24	50
2001			43		15	64
2002				66	-12	46

Base year is the year before the first loan. The same households were surveyed as second time in August 2003.

Sample: 2000 = 35; 2001 = 25; 2002 = 35; only Hail Haor and Turag Bangshi considered, KM site only has 2002-2003 data.

By 2006, those participating in training and credit activities earned an extra US\$ 0.77 million, mainly from new enterprises supported by the project, as compared with their pre-participation incomes (daily incomes rose from about US\$1 per day in 1999 to US\$1.31 per day in 2006). This primarily impacted the poor who are most dependent on aquatic resources. Over 85% of households in the project areas are involved in fishing, and all of those supported with training and credit were low

income households owning less than 0.2 ha of land, and therefore the poor have benefited the most from the project impacts.

**Table 21: Estimated increases in income of RUG members after receiving support for new income sources (training and credit) in MACH-II.**

Item	2004	2005	2006
Sample	891		
Base income (Tk./day)	60**		
Increased income in Tk./day	69	87	89
Increase in % on base	16	45	50

*\*\* reported for preceding year in November 2003*

Income changes were estimated based on a survey of a sample of RUG borrowers. Year wise projections of income of the surveyed members are shown in Tables 4.19 and 4.20. During MACH-I successive years' batches of first time borrowers reported being poorer and achieving greater gains in income in their first year. The average percentage gain in income was 43%. Thereafter the income gain per year for this repeat sample of RUG members was only about 3% a year (because the Hail Haor participants experienced a fall in income between 2002 and 2003). During MACH-II there was little income gain in 2004 (probably due to floods), but the RUG members caught up with a 45% income gain by 2005. Although the gain in 2006 rose modestly, this was to a total of 50% over the baseline, this represents the gain over three years for a larger sample of new participants.

In addition, fishers in the MACH project sites gained on average about US\$ 4.33 million per year in 2004-5 from higher catches associated with resource management improvements, as compared with baseline data from 1999. Although this is shared among the owners of fishing gears and leaseholders in jalmohals not managed by the RMOs, the majority of this benefit was expected to go to those people catching fish either as cash income or as increased fish consumption.

As shown in Fig. 6, overall fish consumption has been significantly higher in all sites in the last four years compared with the baseline year. Major findings indicate that small beel and wetland resident fish and prawns constitute the main fish consumed for all households and particularly for poorer households. The vast majority (55-75%) of fish consumed in these sites and throughout the country is purchased in local markets. This is consistent with studies by Helen Keller International which indicate that over 50% of all fish consumed in rural Bangladesh are purchased.

**Hail Haor:** Per capita fish consumption for all social classes increased significantly from 48 g/day in the baseline period to 57 g/day in impact year-6, however from impact year 3-6 consumption has remained at a relatively high level fluctuating about an average of 60 g/day. Comparing the average of the last four years (impact years 3 to 6) with the baseline, the highest increase, 36%, in fish consumption occurred among marginal farmers followed by 25% and 22% for medium farmers and landless respectively. Per capita fish consumption of large farmers fell slightly averaging just over 51 g/day. It is notable that where once large farmers had the highest per capita fish consumption, but by the later years of MACH monitoring all of the poorer categories of household had higher fish consumption than large farmers. Increasing production in the haor and involvement of the poor fishers and others in AIG activities to help raise family income is expected to sustain these levels at a minimum.

**Turag Bangshi:** In Turag-Bangshi area all landholding categories had similar low levels of fish consumption before the project and all have gained significantly. Averaged by household, per capita fish consumption for all social classes significantly increased from 29 g/day at baseline to 40 g/day in impact year-6 (when consumption levels were lower than in the previous two years), the average of the last four years (i.e. impact years 3-6) was 43 g/day. Here all landholding classes have gained but larger farmers have the highest fish consumption levels and have gained the most (with consumption in the last four years averaging 65% higher than baseline for large farmers and 75% higher than baseline for medium farmers). The increases in fish consumption in impact years 3-6 compared with the baseline for landless, marginal and small farmers were in the 41-44% range. At the end of 6th impact year per capita fish consumption had increased overall by about 49%.

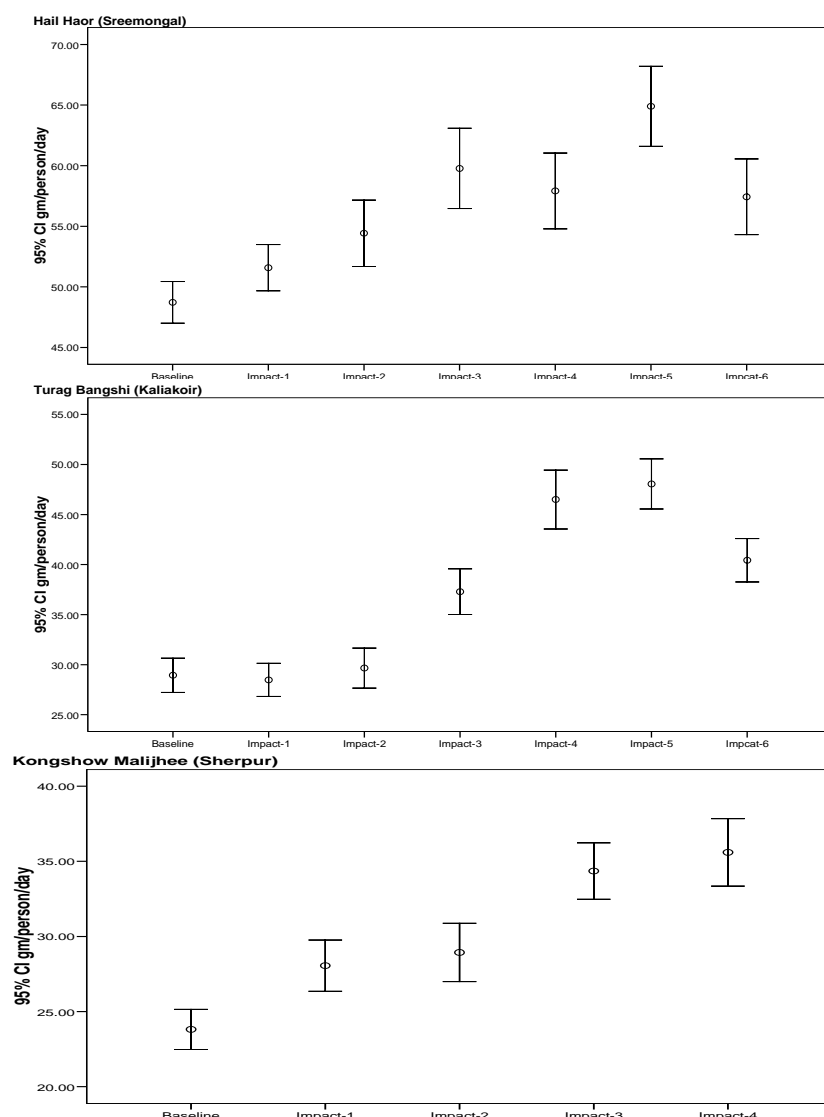


Figure 6: Fish consumption- mean with 95% confidence interval (g/person/day) from monitoring

**Kongshaw-Malijhee:** Households in Kangsha-Malijhee had the lowest fish consumption levels of the three sites initially and this remains the case, but all landholding categories have made similar gains, and even after one year of project activities consumption increased significantly compared with 2-3 years in the other sites. Moreover, unlike the other sites in the relatively dry year of 2005 fish consumption did not fall compared with 2004. Per capita fish consumption averaged 36 g/day in impact year-4, up from 24 g/day during the baseline period. Per capita fish consumption of landless households increased by 44% and for large farm households by 59%. Similar gains of 36-73% were found for the other landholding classes.

In all three sites the highest quantity of fish was consumed in the post monsoon months (October to December), that is the period when fish catch and availability are at their highest. The lowest per capita consumption was in April, the driest month of the year. The monthly variation of fish consumption largely depends on the availability of fish and the purchasing capacity of the people.

## J. Wetland impacts

From the outset of the project (the baseline pre-intervention year of 1999) a rigorous monitoring program was set up to quantify impacts on the fisheries. Fishing catch and effort were recorded at 10-day intervals in 23 fixed monitoring locations covering 1,825 ha and representing the range of wetland habitats present in all three sites. The two main indicators considered were Catch Per Unit Area (CPUA) and species diversity, and for each site a 12 month reporting or analysis year was defined where the first comprises a baseline before any interventions (such as sanctuaries or excavation or fishing norms) could have any effect. The periods that comprise a monitoring year differ between sites, reflecting when the project started activities in each (Table 22).

**Table 22: Definitions of reporting years**

Year	Hail Haor		Turag Bangshi		Kangsha-Malijhee	
Baseline	Apr 99 -	Mar-00	May 99 -	Apr-00	Aug 00 -	Jul-01
Impact-1	Apr 00 -	Mar-01	May 00 -	Apr-01	Aug 01 -	Jul-02
Impact-2	Apr 01 -	Mar-02	May 01 -	Apr-02	Aug 02 -	Jul-03
Impact-3	Apr 02 -	Mar-03	May 02 -	Apr-03	Aug 03 -	Jul-04
Impact-4	Apr 03 -	Mar-04	May 03 -	Apr-04	Aug 04 -	Jul-05
Impact-5	Apr 04 -	Mar-05	May 04 -	Apr-05	Aug 05 -	Jul-06
Impact-6	Apr 05 -	Mar-06	May 05 -	Apr-06		

Although catch per unit area has fluctuated, it has been consistently higher in all three sites since MACH started and on average has shown a rising trend, almost doubling in Hail Haor, more than doubling in Kangsha-Malijhee and increasing by over four times in the Turag system (Table 23).

**Table 23: Catch Per Unit Area (kg/ha) by year in three sites.**

Year	Hail Haor (Sreemongal)	Turag Bangshi (Kaliakoir)	Kongshow Malijhee (Sherpur)
Baseline	171.1	57.8	150.2
Impact-1	205.0	124.7	149.2
Impact-2	190.8	104.8	273.4
Impact-3	287.3	140.1	315.6
Impact-4	161.8	315.2	416.1
Impact-5	388.6	320.7	307.1
Impact-6	256.0	234.7	
Average of Impact 1 & 2	197.9	114.8	211.3
Average of Impact 3 & 4	224.6	227.6	365.9
Average of Impact 5 & 6	322.3	277.7	307.1
Last year as % of baseline	149.6	406.0	204.5
Last 2 years as % of baseline	188.4	480.4	240.8

*Note: No data for Impact-6 in Kongshow-Malijhee so only one year in average of 5 and 6.*

MACH from its inception has been concerned over the interpretation of this data as catch is also dependent on the area of water coverage and timing of the annual monsoon floods. Analysis has taken into account the relationships between hydrological events and fish production. Field data and subsequent analysis has shown a very high correlation between the timing and the extent of flooding on fish production: the earlier the inundation and the larger the flood the greater the overall fish production (for example 2004 was a high flood year, partly explaining the apparent positive impacts of improved management whereas 2005 was a low flood year).

In Hail Haor the low CPUA in 2003 monsoon may have been because there was less fishing due to less water and weeds. This mainly occurred in the two biggest monitoring sites. In the Turag-Bangshi site CPUA increased significantly during the intervention years, increasing dramatically by the first impact year. This was a highly degraded beel area and the project is fairly confident that these increases are a direct result of program interventions such as sanctuaries, excavation and closed seasons during the fish breeding period. Project activities started later in the Kangsha-Malijhee site, but we believe that the jump in CPUA in impact years 2 and 3 is a result of sanctuaries and habitat restoration in this area. In 2004 water levels were relatively high, compared with a drier year in 2005, which is one factor behind the fall in CPUA in 2005. In addition in Turag-Bangshi site in 2005 the effects of pollution from the expanding number of textile dyeing factories in the area probably started to have an effect.

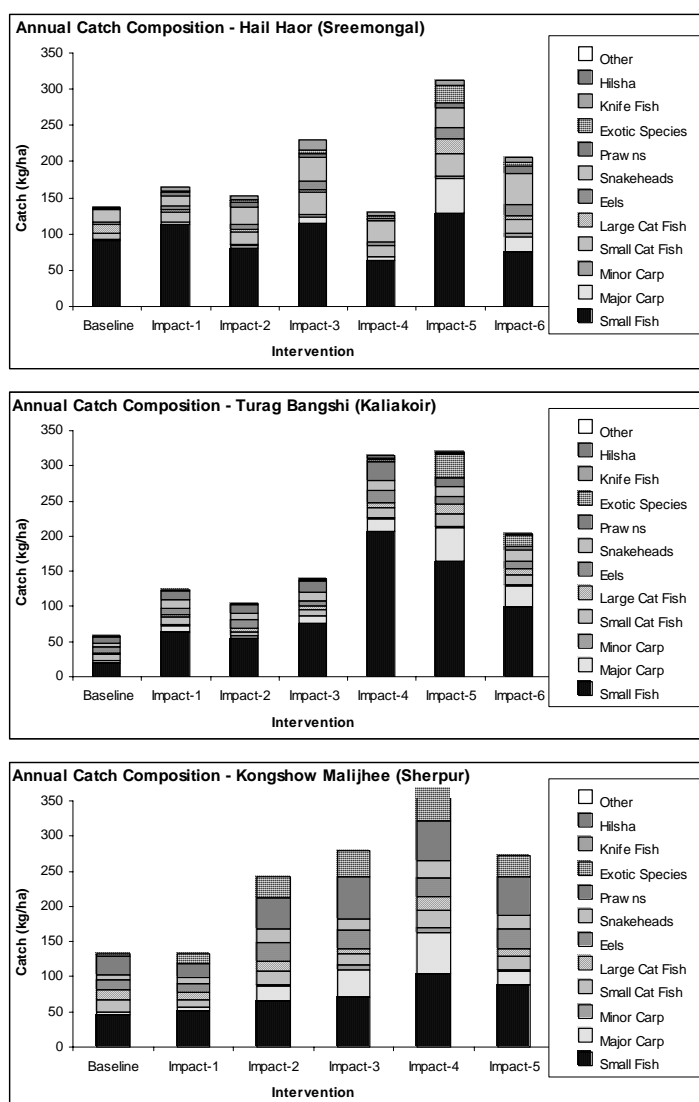
At the species level variation in number of species recorded in the surveys reflects observation of some species in one year, but not the other year. However, combining all impact years, in Hail Haor a total of 96 species has been recorded and species diversity has been maintained or increased during the project period (Table 24). The pattern is similar in Turag-Bangshi site where combining all impact years a total of 97 species were observed. In Kangsha-Malijhee a total of 88 fish species was recorded in the impact years, a relatively greater gain in species diversity which may reflect initiatives there by RMOs to reintroduce locally rare or lost species as well as conservation measures.



**Table 24: Number of fish species recorded in sample catches in monitoring areas**

Year	Hail Haor	Turag Bangshi	Kangsha Malijhee
Baseline	71	82	64
Impact-1	71	81	67
Impact-2	69	86	71
Impact-3	76	91	73
Impact-4	67	85	84
Impact-5	81	85	68
Impact-6	75	83	

As can be seen from Fig.7, in all three sites in the baseline year miscellaneous small fish of a number of species comprised a high proportion of the catch. In the less degraded fisheries (Hail Haor and Kangsha-Malijhee) the recovery has mainly been of other fish such as snakeheads and small catfish able to over winter in the sanctuaries. In Turag-Bangshi while those species groups have recovered, small fishes have also increased substantially in catches.

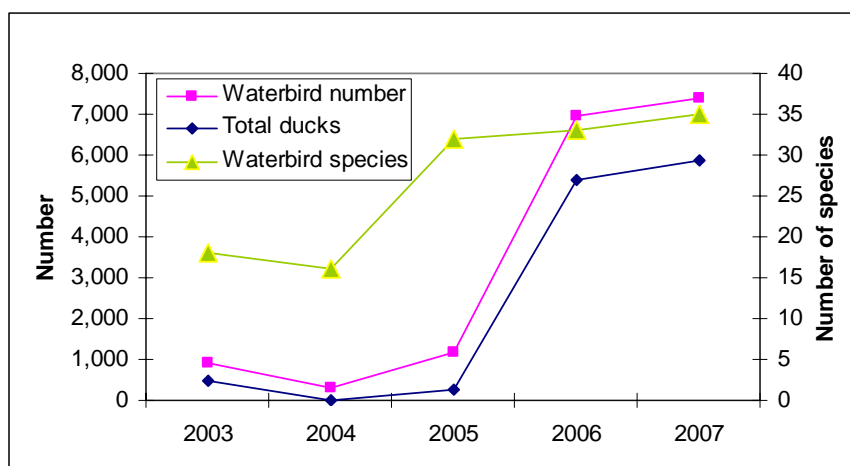
**Figure 7: Composition of fish catch per hectare**

Considering the quantities of fish caught by species, the diversity of native fish species caught has increased from the baseline. The indices calculated and reported in Table 25 are based on the weight of fish reported for each species in the catch from monitoring areas in each year and are a measure of the diversity – the higher the number of species and the more even the amount of fish spread across species, the higher the index. It appears that overall diversity of fish in Hail Haor has increased since MACH started, but despite the greatest gains in productivity being in Turag-Bangshi site there has been no change in the diversity of catch there, while increases in diversity of catch in Kansha-Malijee site have been very small.

**Table 25: Biodiversity indices for fish catch (Shannon indices)**

Year	Hail Haor		Turag-Bangshi		Kangsha-Malijee	
	native fin fish	all fish	native fin fish	all fish	native fin fish	all fish
Baseline	2.759	2.801	3.221	3.242	2.643	2.696
Impact 1	2.884	2.969	3.279	3.350	2.786	2.967
Impact 2	3.303	3.419	3.275	3.310	2.826	2.919
Impact 3	3.290	3.405	3.346	3.427	2.953	2.965
Impact 4	3.242	3.357	3.097	3.184	2.968	3.082
Impact 5	3.430	3.599	3.146	3.351	2.974	2.987
Impact 6	3.294	3.428	3.239	3.415	-	-

Although surveys of plants, birds and other wildlife were conducted at the start of MACH in Hail Haor and Turag-Bangshi sites, few changes in plant diversity were expected as a result of MACH interventions, apart from tree planting which for example has seen the restoration of patches of swamp forest in the sites. Of the sites, Hail Haor has historically been regarded as an important site for wetland biodiversity in Bangladesh, with relatively more information available on, for example, birds recorded there. However, wintering waterfowl numbers had disappeared from tens of thousands reported in the late 1960s to a handful at the start of MACH. With the creation of a permanent wetland sanctuary covering about 100 ha in Baikka Beel in late 2003, the RMO has banned fishing, hunting, and collection of aquatic plants, except for limited grazing in part of the area. Between 2004 and April 2007, 113 species of birds were recorded within the 100 ha sanctuary. Both numbers and diversity have increased, reaching 7,200 birds of 35 water bird species in January 2007 (Fig. 8).

**Figure 8: Baikka Beel mid-winter waterbird census**

These include large flocks of Fulvous and Lesser Whistling-duck; Northern Pintail, Common Teal, Garganey and Purple Swamphen. Rare globally threatened species have also returned to the area: several Pallas's Fish Eagle and Greater Spotted Eagle (both vulnerable) now spend the winter here, as do the near-threatened Black-headed Ibis and Ferruginous Pochard. Overall 147 species of bird had been recorded in Hail Haor up to February 2000, but by April 2007 an additional 22 species had been added, the total includes five threatened and seven near-threatened species.

### K. Outreach Program

The aim of the outreach program has been to replicate through extension and demonstration some of the MACH project's best practices of physical interventions for wetland habitat restoration and improved management techniques developed in the past years for MACH sites. Through the outreach endeavor, it is expected that in addition to benefiting the fisheries and user communities of these locations, the target national organizations, projects and donors will be sensitized to the potential for this type of intervention and will seek to mainstream this in future through their own programs. Available interventions through this program included: re-excavation of link canals and dry season fish refuges, placement of permanent and temporary fish shelters in sanctuaries, provision of community centers, and restoring/planting swamp forest. To have the desired impact, this program needed to be linked with existing initiatives from government or NGOs that have already established

community organizations for resource management but currently lack the financial resources to make significant improvements in habitat.

Existing DoF projects were circulated for proposed sites where habitat restoration and MACH best practices might be adopted and which lacked resources to do this themselves. Many of these potential sites lacked local institutional arrangements to support implementation or had other project support. A number of sites were proposed from the DoF's Fourth Fisheries Project (FFP), these were initially screened based on that project's assessments of the sustainability and capability of the CBOs, and in terms of accessibility for MACH support. In 2005 a review team was formed by MACH to visit candidate sites and identify feasible habitat restoration activities, and in 2006 given the knowledge already gained, the concerned Upazila Fisheries Officers were asked to send details of possible schemes. Then a team combining an engineer, a biologist and a community specialist along with the concerned DoF officers made thorough feasibility visits in three batches. Initially it was agreed with FFP to provide support for nine sites, in the second year of support postponed works were completed in four of these sites, and one other site was added. This choice of project and sites was because FFP is a mainstream DOF project (which ended in mid 2006), rather than being NGO led, which gives a greater chance for mainstreaming best practices, for example in habitat restoration, in the Department. It was also easier to link up with one project rather than several; but it has only been possible to support some of the many sites and communities that requested assistance. For convenience those sites and communities that demonstrated a need and that were in Dhaka or Rajshahi divisions were selected.

Memoranda of Understanding were signed between the Department of Fisheries, the concerned Fisheries Management Committee (registered community organization formed by FFP and equivalent to an RMO), and MACH covering the works that were agreed upon through the planning process. In total 34 schemes of work were implemented in the 10 sites, with the last of the 2006-7 schemes completed in early June 2007 (Table 26).

**Table 26: Summary of outreach schemes**

Activity	FY 2005-06		FY 2006-07		Total	
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
a) Sanctuary establishment by brushwood/ bamboo piling, and/or demarcation with signboard and pillar	13	9.28	9	6.17	22	15.45
b) Sanctuary establishment by permanent structures (1,450 hexapod and 330 pipes)	2	2.45	-	-	2	2.45
c) Sanctuary establishment by excavation	1	2.02	1	0.21	2	2.23
d) Plantation - samplings planted	-	-	31,000	42 km	31,000	42 km
e) Community buildings construction	5	-	2	-	7	-
<b>Total schemes</b>	<b>21</b>	<b>13.75</b>	<b>13</b>	<b>6.38 ha + 42 km</b>	<b>34</b>	<b>20.13 ha + 42 km</b>

Note: more than one scheme was undertaken for the same sanctuary in some sites (for example earthwork or brushpiling in one year and sign boards in the other year)

Overall MACH worked in 20 fish sanctuaries under its outreach program. It supported the successful establishment of nine new sanctuaries in these 10 waterbodies, and also improved the depth, protection, and/or delineation of 11 old sanctuaries. The total cost of the works was about Tk 16 million. As part of the package MACH has provided engineering, fisheries and community organization/social advice for all these sites through a small team which has made periodic visits to advise the FMCs and which aimed at strengthening local capacities. Details of the sites and the activities undertaken in each are given in Table 27.

**Table 27: Outreach support provided by MACH (all sites were formerly under Fourth Fisheries Project)**

Site	Upazila and District	Achievements
Tangaon River FMC	Pirgonj, Thakurgaon	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Excavation of part of the existing main fish sanctuary (0.21 ha), excavation up to the design depth not possible due to seepage</li> <li>3. Installed 525 hexapods and 105 pipes as fish protection devices in the main existing sanctuary</li> <li>4. Brushwood piling in two new sanctuaries (0.8 ha)</li> <li>5. Demarcation of the main existing sanctuary and two new sanctuaries with 12 RCC pillars and 6 signboards</li> </ol>
Jamuneswari River FMC	Badarganj, Rangpur	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Demarcation of two existing sanctuaries with 8 RCC pillars and 4 signboards</li> <li>3. Brushwood piling in one of the existing sanctuaries (0.9 ha)</li> </ol>
Masankura FMC	Pirgacha, Rangpur	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Demarcation of the existing sanctuary with 8 RCC pillars and 4 signboards</li> <li>3. Brushwood piling in the existing sanctuary (0.45 ha)</li> <li>4. Attempts to create a new sanctuary through excavation were unsuccessful</li> </ol>
Ichhamoti River FMC	Sathia, Pabna	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Established 3 old and 1 new sanctuaries through brushwood piling (3.5 ha) and demarcation with 8 RCC pillars and 4 signboards</li> <li>3. Tree plantation in Ichhamoti River embankment (42 km) – 31,000 samplings planted</li> </ol>
Silonda FMC	Sathia, Pabna	<ol style="list-style-type: none"> <li>1. Established 2 new sanctuaries through brushwood piling (1.2 ha) and demarcation with 8 RCC pillars and 2 signboards</li> </ol>
Balajan river FMC	Mithamoin, Kishoregonj	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Excavation of Furunga Beel to create a new sanctuary (2.02 ha), although not to intended depth due to seepage</li> <li>3. Improvement of Furunga Beel and one other new sanctuary through brushwood piling (3.58 ha) and demarcation with 4 RCC pillars and 2 signboards</li> </ol>
Jalghagutia Beel FMC	Netrakona Sadar, Netrakona	<ol style="list-style-type: none"> <li>1. Constructed Office Cum Community Center</li> <li>2. Installed 925 hexapods and 225 pipes as fish protection devices in the existing sanctuary</li> </ol>
Old Brahmaputra Nod FMC	Trishal, Mymensingh	<ol style="list-style-type: none"> <li>1. Brushwood piling in two existing and one new sanctuaries (1.8 ha) and demarcation with 12 RCC pillars and 6 signboards</li> </ol>
Gur Nodi FMC	Singra, Natore	<ol style="list-style-type: none"> <li>1. Brushwood piling in one new sanctuary (0.45 ha) and demarcation with 4 RCC pillars and 2 signboards of the new sanctuary and one old sanctuary</li> </ol>
Konai Brahmaputra Kole	Fulchari, Gaibandha	<ol style="list-style-type: none"> <li>1. Construction of Office Cum Community Center (1 #)</li> </ol>

At all of the above sites, staff from MACH worked with the community organizations and local government and imparted MACH best practices and supported transparent processes between groups and the government counterparts. The mode of operation of the work was chalked out in the MoUs signed with MACH. In each case a project implementation committee (PIC) was authorized to monitor the activities comprising Senior Upazila Fisheries Officer (Convener), MACH project Engineer (Member Secretary), Upazila Engineer, two members from the concerned community and where present the team leader of the local FFP partner NGO. The PICs had overview of all activities, and were monitored by DoF and MACH. Implementation progress was good, except where affected by the weather. The objectives of creating understanding and enthusiasm among local government DOF officials, and the communities, and of strengthening the resource base and capacity of these CBOs have been achieved.

In addition the DOF has requested MACH to provide livelihood support to professional fishers adversely affected by the national closed season on hilsha fishing designed to protect jatka (juvenile hilsha) for the early months of each year. A program is in preparation for livelihood support modeled on the Caritas component of MACH and targeted at the poor workers on jatka fishing boats from Chandpur District. However, this raises a number of challenges. For example, how a program started through a project can continue for long enough so that its clients/members can achieve sustainable alternative livelihoods. Also what the ultimate status of micro-credit would be under this program, could independent credit and savings organizations, such as the FRUGs established in MACH sites, be established by local NGOs under DoF supervision. The funds have been reserved for this purpose, and a final decision and request from the Ministry of Fisheries and Livestock (which may request that this be managed through Palli Karmo Shahayak Foundation (PKSF)) has been pending for some time.

## **L. Influence and uptake**

Although MACH had been working since 1998 towards the sustainable management of three large wetlands through community participation, it is essentially a pilot project to develop and demonstrate suitable approaches. By the latter stages of the project period several components of the approaches had been developed and found to be effective. The issue was how to extend best practices from some 31,000 ha of seasonal and permanent wetlands supported by the project to more of the 4 million ha of perennial and seasonal floodplains and 12,000 or so state property water bodies (jalmohals), given that these wetland resources, and particularly fish catches, are declining.

Several government agencies have responsibilities and impacts in these wetlands, but as the major economic return from them is fish, one of the primary targets for potential uptake has been the Department of Fisheries (DoF) even though it has limited responsibilities for much of these wetland systems. The other main target has been the government and administration as a whole by showing that local government can be effective in a limited co-manager role working with community organizations.

Some of the key best practices applicable for sustainable wetland management identified for uptake through MACH are:

1. Local co-management of natural resources based on devolving responsibilities to community based organizations linked with local government.
2. Networks of community managed and government endorsed wetland sanctuaries.
3. Habitat restoration through excavation of silted up wetlands and planting of flood tolerant native trees.
4. The effectiveness of training and credit support for the poor to develop alternate incomes that are linked with reducing resource exploitation (fishing effort) through changing or diversifying occupations and observing resource use rules.

MACH cannot guarantee that these approaches and practices will be taken up by others, but has generated awareness of issues and the merits of best practices in different forums. Most effectively MACH has taken government officials, particularly from DoF, Ministry of Fisheries and Livestock (MoFL), and Ministry of Land (MoL), and personnel from projects and NGOs working in similar programs to its field sites to see the successful approaches, which has been effective in changing attitudes. There has also been a cumulative effect, MACH does not work in isolation, other projects in the fisheries and environment sectors have been testing similar approaches, so through NGO partners working in several projects and officials experiencing similar approaches the messages have been reinforced. This has successfully influenced higher authorities and policy makers to replicate the approaches.

1. Most wetland/fish sanctuaries are small and established in a part of a jalmohal by the community or agency holding fishing rights there. But, after showing the result of smaller sanctuaries established in MACH areas, MACH was able to convince the MoL to set aside in key areas some complete waterbodies (jalmohals) as sanctuaries waiving its normal revenue. For example, MoL has declared a large area (two jalmohals) covering 122 acres in Hail Haor as a permanent sanctuary for time to come foregoing its large amount of annual revenue from those waterbodies. With this precedent, the government (DoF) is now promoting a plan to establish one sizable sanctuary in part of a jalmohal in each district.
2. A co-management approach between community based organizations (CBOs) with devolved responsibilities for waterbodies and local government at Upazila level was not in practice in other similar projects where CBOs had links with the DoF but no formal link with local government. But observing the advantages and effectiveness of the Local Government Committees formed by MACH for scaling up of improved management, DoF has been encouraged to propose that this continue for the long term and to adopt this approach, renamed as Upazila Fisheries Committees, in its new "Inland Capture Fishery Strategy", see below.



3. Lessons of best practices such as sanctuaries and habitat restoration have been adopted within DoF, and through MACH's outreach program (above) they have been implemented jointly with DoF in nine sites supported by DoF's Fourth Fisheries Project. They have also been adopted by other government agencies, for example Local Government Engineering Department in its Sunamganj Community Based Resource Management Project in the north-east. For protection and congregation of fish and other aquatic fauna in the sanctuaries of non-flowing wetlands MACH developed some permanent structures (concrete hexapods and pipes) which were found suitable and cost effective since they are long lasting. Most of the recent wetland management projects under DoF have adopted these structures with some modification for their sanctuaries. In the past there were swamp trees in the wetlands which provided shelter and food substratum for many aquatic animals including fish. But in course of time these swamp forests have been felled. MACH has worked to re-establish those lost swamp trees in the MACH sites. Many of the projects under DoF and other agencies (for example SEMP) have adopted the idea of re-establishing lost swamp trees in the haor areas.
4. Many fisheries and wetland management projects have included a livelihoods or alternative income generating activity component (Community Based Fisheries Management projects, Sustainable Environmental Management Programme haor and floodplain component, etc.). Most of these have not yet been influenced by the MACH approach, since NGO-run micro-credit is well established in Bangladesh and the FRUGs were only handed over revolving funds in the latter stages of MACH. However, the effective linkage of AIGAs with effort reduction in MACH has influenced DoF and government. The government had already banned catching of juvenile hilsha ("jatka") in an attempt to reverse the collapse of Bangladesh's most important single-species fishery, but this has created severe seasonal hardship for specialist fishers. The government is now seeking ways to extend AIGAs to these fishers, and has included support through MACH's outreach program to pilot this in Chandpur area.

The greatest influence and scope for uptake is expected to be through the adoption of DoF's "Inland Capture Fisheries Strategy" which has embedded within it as central components all four of these areas of influence and best practice. The strategy was approved by Ministry of Fisheries and Livestock in early 2006, and a program to implement it is being developed by DoF and MOFL. This impact and scope has also been recognized in the Poverty Reduction Strategy Paper which for inland capture fisheries seeks to promote the MACH approach in the next few years.

### **M. Communication initiatives for influence and uptake**

To further these efforts, in February 2006 MACH developed a Communications Strategy to more systematically share lessons learnt and examples of best practices on improved wetland resource management with national level policy stakeholders and donors. Under the strategy MACH has produced: a series of policy briefs on nine themes, six case studies or success stories to substantiate the findings, and a set of policy reflections of MACH stakeholder representatives from all three sites (see Volume 4). These documents aim to inform future planning, practice and decisions. Keeping in mind the wider policy audience both at national and local levels, the documents are in both Bangla and English. The types of product developed were based on the findings of a communications needs assessment conducted among policy stakeholders by the Rural Livelihoods Evaluations Partnership (RLEP) which was an initiative of the UK DFID.

A stakeholder analysis during planning for communication products identified that the more influential policy stakeholders include not only government officials who have direct influence on policy but also the donors and national NGOs that form the wider network within which policy influence takes place. Based on the stakeholder analysis, the policy briefs and other documents are being distributed as far as possible by hand through various meetings within government and organized by the project and by USAID.

To maintain access to information and lessons generated by MACH after the project ends, the MACH website [www.machban.org](http://www.machban.org) has been restructured and will continue beyond the project. In addition, DoF will incorporate MACH documents in their website [www.fisheries.gov.org](http://www.fisheries.gov.org) and documents are being uploaded to the parent website of Winrock International [www.winrock.org](http://www.winrock.org) and the widely used website of the Bangladesh Local Consultative Group [www.lcgbangladesh.org](http://www.lcgbangladesh.org) with links also provided

from the USAID website. A CD containing all the important publications and documents produced under the project is under production for distribution to key stakeholders, libraries and information centers.

Concurrently, under the strategy MACH also produced four thematic documentaries: “Baikka Beel-er Katha”, “Environmental Pollution caused by Discharge of Industrial waste Water”, and “Co-management – the MACH approach”, and a summary video on MACH approaches and achievements. All four videos have been televised, and have been used in workshops and other events, including a Co-management Week where senior representatives of development partners and civil society organizations attended, and events during World Wetland Day. The video on pollution has been an important advocacy tool in raising awareness among the Department of Environment (DoE) and Ministry of Environment and Forests about the extent of pollution caused by industrial effluent in the Turag River and Mokesh Beel in Kaliakoir upazila. After showing it to senior officials of the DoE, other government agencies, Bangladesh Textile Manufacturers Association (BTMEA) officials and media representatives, two TV channels (ATN Bangla and Baishakhi) ran news stories on the problem on their main news. Finally the video was shown to Dr C. S Karim, Advisor to the Ministries of Environment and Forest, Agriculture, and Fisheries and Livestock at his office. Consequently, a decision came out from the Advisor’s office according to which all industries have to submit plans on establishing Effluent Treatment Plants (ETPs) and open a Letter of Credit for purchasing such equipment by 21 April 2007 and finally set up ETPs by October 2007.

### *Examples of events*

**World Wetland Day 2007:** MACH was instrumental in influencing the DoF to take up a series of activities nationally in observance of the World Wetland Day on February 2, 2007. This was the first time the World Wetland Day was observed nationally in Bangladesh. The focus was to raise awareness among policy makers and a wider audience about two issues: the factors that threaten tomorrow’s fish catches and that could eventually deprive the next generation from enjoying a diet of fish, and the success and potential of community based co-management approaches such as MACH to reverse this trend. A press conference chaired by Dr. C.S. Karim, the Advisor to the Ministries of Agriculture, Fisheries and Livestock and Environment and Forest was held, and a short documentary film prepared by MACH was shown there and on Bangladesh Television on *Fish for Tomorrow* drawing attention to the degradation of wetlands. This was complemented by newspaper supplements in three national dailies (Daily Star, Daily Ittefaq, Prothom Alo) sponsored by and containing features on DoF, MACH and WorldFish Centre - CBFM-2.

**Co-management Week** On May 28-31, 2006, MACH and the Nishorgo Support Project, with the Government of Bangladesh, (GoB) jointly organized a “Co-Management Week” in Sreemangal. The event brought together key donors and representatives of civil society for a round table discussion and visits, and grassroots stakeholders from all the sites of both projects for a series of workshop sessions. Lessons learned and progress of joint GoB-USAID initiatives for co-management of wetlands and forests in Bangladesh were shared among donors and policy makers, and the efforts and commitment of the local co-management stakeholders of the two projects received public recognition and their findings and conclusions have been disseminated.



*Open discussion in Sreemangal Co-management week on 28<sup>th</sup> May 2006*

**Inland Capture Fisheries workshop:** On August 21, 2006 the Department of Fisheries with support from MACH and Community Based Fisheries Management project phase 2 (CBFM-2) organized a round table discussion between senior representatives of different government agencies, development partners, NGOs and projects, including the then minister and secretary of the Ministry of Fisheries and Livestock. At the event the key components of the Department’s Inland Capture Fisheries Strategy, which has been developed based on lessons from recent projects including MACH, were presented to a wider audience and agreement was reached on the need to take up actions and a larger

coordinated approach to implementation of the strategy. Subsequently through its outreach support, MACH has worked with the Inland Capture Fisheries team that DOF created as a result of this workshop, to develop a program proposal on inland capture fisheries development.

#### 4. Sustainability, policy impact and uptake

The long term sustainability of approaches to wetland management developed by MACH and of the wetlands and livelihoods of people dependent on them in Bangladesh depend on three areas:

1. The long term success of organizations, institutions and resources at the local level in the wetlands where MACH has worked;
2. Changes in the policy arena – in policies and in attitudes among stakeholders influencing policy, which can support or reinforce local arrangements and enable their uptake; and
3. Uptake of successful components of MACH experience for expansion of similar community based co-management to other wetlands.

Fig 9 illustrates major elements of the MACH approach to sustaining its impact particularly in the first two areas. All three are discussed below.

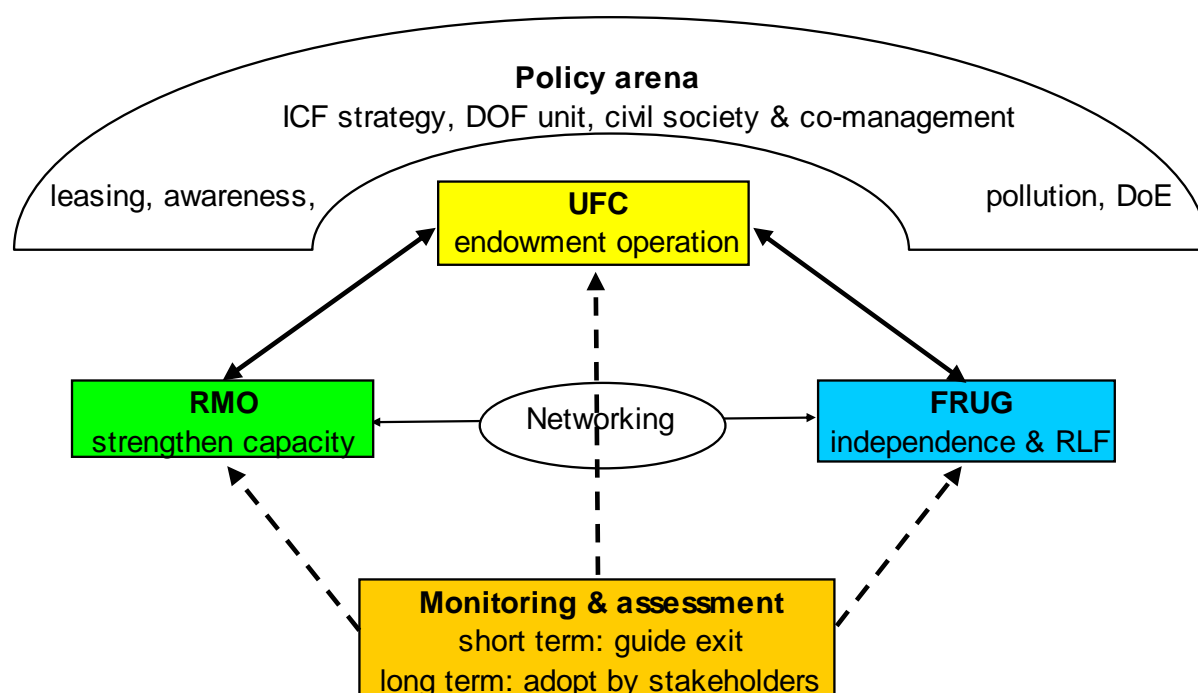


Figure 9: Components of the MACH exit strategy

##### A. Sustainability through local institutions

In the three MACH working areas, many of the elements of the project exit strategy towards long term sustainability have been summarized in the previous sections. Here we give an overview of how they fit together.

##### *FRUGs and revolving funds*

The FRUGs are by now formally independent entities with their own legal status through registration, their own revolving funds, constitutions, and staff. The transition to continuing their operations but through a worker paid by the RUG members out of the interest they pay on their loans has already been completed in most of the FRUGs. The revolving funds (comprising initial contributions from the project and accumulated “interest” payments made by the RUG members) are sufficient to support the investment needs of existing RUG members, and it is expected that they will gradually add some new members from among local poor resource users, for example on recommendation of the RMOs, as some RUG members lift themselves out of poverty and become ineligible or no longer need to receive loans from the FRUG. In addition efforts have been made to develop the managerial capacity of the FRUG executive committees, and to develop links between the FRUGs and local agencies and organizations that could provide training and expert advice when needed.

*RMO strengthening and resource access*

Similarly the RMOs are separate entities registered with the Social Welfare department and by now well recognized locally and in the Upazila Fisheries Committees. A lengthy process of capacity building has been completed, and the RMOs have demonstrated capacity to raise funds themselves (to cover leases and some costs of management activities), to prepare and update management plans, to prepare and manage implementation of small works to restore habitat, to protect sanctuaries, and to lobby for support from others when there are threats to the wetlands and fisheries they manage. Ultimately the demonstrated economic benefits in terms of fish yields that have been restored from a degraded level are a strong incentive for the RMOs to sustain their practices and procedures. Coordination among the RMOs in each site through their own meetings and through the UFC linkages with government (all of which has been facilitated by MACH) are also believed by the RMOs to be important to their sustainability.

*Co-management linkages and endowment fund*

The key element in the sustainability plan of MACH within its wetlands is the Upazila Fisheries Committee (UFC). This is a co-management body bringing together Upazila officials, Union Parishad chairmen and leaders of the RMOs and FRUGs (see sections 4.x and 6 for details). These have already been functioning (called LGCs) for most of the life of MACH project. In addition to functioning to coordinate management and resolve problems, the endowments that have been placed for them will generate enough funds from their interest each year to cover the costs of the UFCs meetings, regular visits by officials to the RMOs and FRUGs to advise and check on their progress, awareness raising activities, and most importantly grants for habitat restoration and management by the RMOs. This has already been trialed successfully for the last two years of MACH project, giving all parties experience in managing funds. Lastly links between RMOs and Union Parishads are by now well established, and at the local level this is vital to legitimizing the continued operation of rules and norms to sustain fishery resources.

*Monitoring and information*

While project funded monitoring systems designed to quantify impacts cannot continue after the project. MACH has worked in two areas to help the stakeholders have information systems that will help them to take informed decisions. From the top down, simplified assessment methods have been developed for reviewing the capacity and performance of the RMOs and FRUGs, the officials in the UFC (mainly UFO and social welfare officer) have already conducted such assessments with MACH staff, and are expected to continue this as part of their monitoring for the UFC. From the bottom up, a system of report cards, checklists and tables has been developed that the RMOs and FRUGs can use for their members to review the progress of the organization and give feedback to the leaders, and for the CBOs to use in assessing how the UFCs function. This is expected to keep a pressure on those leading the different elements of co-management to follow and improve on the good practices that have been in place during the project period. In addition the RMOs have started some monitoring of their own through group work and local volunteers that they can use to generate evidence of changes in their areas – to show trends in fish catches and in Kaliakoir to show trends in water quality.

**B. Sustainability through external influences and policy change**

Site level issues that are taken up at a national level give an external pressure and incentive to sustain present arrangements and ensure the health of these wetlands. This is in process in two sites. Considering the achievements in restoring wetland biodiversity in Hail Haor and its international significance it has been identified as meeting the criteria for designation under the Ramsar convention as a wetland of international importance. The DoF has proposed this to the MOFL which is supportive of this and plans to propose its designation in the relevant national committee. This would firstly give a boost of national and international recognition for the achievements of the CBOs and UFCs, and secondly would set a precedent for the DoF's interests extending from a narrower view of fisheries to conserving and maintaining wetland habitats and ecosystems and the adoption of its co-management approach elsewhere. In Turag-Bangshi site a Memorandum of Understanding is at the final stages of approval for signing between the Kaliakoir UFC and the Department of Environment to address problems of industrial pollution affecting wetlands in this area. This is the outcome of a dialogue between the stakeholders in the UFC (RMOs, UP chairmen and Upazila officials) and the DoE over



the most critical issue for wetlands in Kaliakoir – the rapid expansion of textile dying factories discharging untreated effluent into the river and wetlands. It is expected that this agreement will result in DoE helping to enforce existing rules and laws with the aim of industries discharging water that meets Bangladesh legal standards and thereby restoring an acceptable water quality year round for aquatic life and local people.

MACH has set precedents for some changes that can become wider policy level changes. The most notable of these is the Ministry of Land agreeing to give up leasing as a source of revenue and instead to accept a nominal payment for permanent sanctuaries - a few key jalmohals have been taken out of leasing on an indefinite basis for protection by the communities in their entirety as sanctuaries. The most notable of these is the jalmohals that form Baikka Beel sanctuary in Hail Haor. The other key precedents are by the Ministry of Fisheries and Livestock in establishing five Upazila Fisheries Committees that will operate after MACH, and setting up endowment funds for each of these.

At a higher level of national policy, “Unlocking the Potential – a National Strategy for Accelerated Poverty Reduction” was finalized and issued by the General Economics Division, Planning Commission, Government of People’s Republic of Bangladesh on 30 October 2005. This forms the national Poverty Reduction Strategy Paper (PRSP) a key policy document for the government emphasizing poverty reduction as its main policy objective. Although the document gives only a brief treatment of fisheries and makes scattered references to wetlands, it is notable that it endorses the further adoption of MACH approaches as its policy agenda for inland capture fisheries over the next two years (see Annex 2) as a way of ensuring long term use rights and appropriate plans to restore capture fisheries. It also stressed community participation in biodiversity management particularly for fisheries.

Most significantly, MACH has also been able to influence the content of DoF’s Inland Capture Fisheries Strategy which is a national level strategy and includes a number of key elements of the MACH approach that are vital to sustainability including UFCs, sanctuaries, watershed and water quality issues, and leasing policies. A National Fisheries Policy was earlier finalized and approved by the Government of Bangladesh in 1998, but no plan or strategy on how to achieve its objectives was developed. A donor review of the sector was conducted in the early 2000s (Fisheries Futures Review) but was not endorsed by the government. To operationalize and update the policy, during 2002-6 the Department of Fisheries (DOF) worked, with support from its Fourth Fisheries Project, to develop a series of sub-sectoral strategies and from these an overall fisheries sector strategy.

During this time MACH worked to influence the Inland Capture Fisheries Strategy. DOF formed a working group for this involving various stakeholders including MACH project and its partners. Through field visits to MACH sites and a series of workshops and working sub-groups, MACH successfully advocated the incorporation of key MACH approaches for replication and wider uptake through the strategy. Key steps in the process were the iterative and participatory drafting of the strategy and action plan for inland capture fisheries which were approved by the Ministry of Fisheries and Livestock in early 2006, and the development of a program concept paper for inland capture fisheries development based on this strategy which was prepared and has been presented to potential donors by the government in early 2007 (for this MACH provided consultant and staff time).

One of the key elements of the strategy and the plans for its implementation is a proposed switch from leasing as a source of revenue generation to use of leases at nominal rates for limiting access and ensuring use rights as an incentive for communities to adopt sustainable fishing levels and practices. This is something that MACH has advocated for some time. Several of the key elements are based on lessons and policy messages generated by MACH, including the widespread promotion of fish sanctuaries and habitat restoration, concerns to address pollution problems, and the adoption of co-management of fisheries along with devolution of greater responsibilities to community organizations. This has culminated in the adoption of the Local Government Committee concept from MACH, now named as Upazila Fisheries Committees (UFC), as a central part of the strategy.

Two key events in this process were led by MACH. Firstly, a one day workshop arranged by MACH in Dhaka in February 2005 chaired by the Director General DOF, where agreement was reached on the UFC structure and terms of reference, an additional detailed ToR for SUFO/UFOs was agreed, and the endowment fund concept accepted in principle (details of government orders establishing UFCs and endowment funds are given in Volume 3). Secondly, a half day round table meeting/

workshop was held in August 2006, chaired by the then Minister for Fisheries and Livestock, and jointly organized with CBFM-2 project, where DOF presented its strategy and the key issues requiring action. Based on the discussion among policy makers from the concerned government agencies, donor representatives, and others a proceedings that set out priority areas for a programmatic approach was prepared and distributed, and DOF established an inland capture fisheries team. MACH has been represented in the working group supporting this team, and as part of its outreach support provided consultant and other support to DOF to develop its program concept document for implementing its strategy ready for submission to potential funding agencies.

### **C. Sustainability through expansion building on MACH**

Ultimately the impact of MACH will be sustained when the key lessons and best practices are scaled up. Although within the project period this has been done to a limited extent through influence on other projects, ultimately it depends on mainstreaming wetland conservation and restoration into widespread practice as part of the sustainable or wise use of wetlands. This is what is provided for in the program proposals developed by DOF under its new strategy, but which will require substantial funding.

The 12,000 or so jalmohals in Bangladesh are a key part of wetland systems as they generally hold dry season water, but they are only part of the systems, also floodplains are critical. Within this there is a need to change policy on access rights and leasing from only supporting community management and longer term use rights through development projects to a program approach that expands switching to long term user rights for low lease payments. A national approach across all Upazilas will disperse the effort but help to improve management in a wide range of inland wetlands, it will be fundamentally different from the concentrated intensive approach of MACH. However, that more intensive approach deserves replication for other major wetlands.

The Inland Capture Fisheries Strategy is based on community management secured by long term leases used to define access and not as a source of revenue, and promoting protection and restoration of habitat for fish. A program approach for improved governance of wetlands will involve:

- administrative changes,
- modifying existing organizations,
- capacity building, and
- building new local institutions.

To enable this, the Ministry of Land and local administrations need to be convinced. MoL would need to be brought into decision making on land uses and wetlands and change its orientation. Already jalmohals now contribute an insignificant percentage of the total government budget, but the land administration would need reorientation towards ecological sustainability and benefiting poor people, and to itself providing a planning support role. There would also need to be greater coordination among relevant sectors: fisheries, environment, agriculture and water resources. While local administrations may be unwilling to confront damaging practices when locally or nationally powerful interests are involved.

Some of the challenges for scaling up are:

- how to facilitate the process,
- how to ensure quality,
- how to ensure sustainability,
- how to compensate fishers for access limits, and
- how to manage funds.

Some of the issues in meeting these challenges include:

- Government agencies alone will face difficulty to facilitate developing effective CBOs.
- Local government involvement is essential.
- Establishing more Upazila Fisheries Committees, as MACH has done, will be vital.
- CBOs need support to develop before they can sit on such committees or take on resource management responsibilities.

- NGOs have a key role in facilitation, but vary in capacity and commitment to establishing independent CBOs so care is needed in partnering and efforts are needed to develop the capacity of all involved in facilitating the process.
- Funds and staff are limited and cannot be spread everywhere so time-bound funding is needed for establishing community based management in priority locations.
- A challenge fund could make grants for establishing effective CBOs for fishery management and for wetland/fishery restoration after reviewing local proposals.
- Work with existing NGOs to provide training and credit for new occupations for fisher households

MACH already assisted DOF in preparing a program approach concept paper based on the ICF strategy which addresses these issues.

## 5. Economic value of wetlands and estimated value of MACH impacts

### A. Introduction

Putting an economic value on something as abstract as the ecological services of a wetland is a difficult idea for most people. While we are familiar with paying for the rice and fish that are grown and caught in wetlands, there is no direct market for services such as clean water, biodiversity, and flood control. There is, however, a growing recognition that such natural benefits do have real economic value and that these values need to be included in decision-making processes. If this is not done then public decisions on uses and changes in use of wetlands will be ill-informed and may not be economically efficient since the costs of changing or losing wetlands will not have been counted (irrespective of any non-economic reasons for maintaining and protecting wetlands). The total value of wetlands can be considered to comprise not only direct human uses (marketed or otherwise), but also indirect benefits to human activities and livelihoods and the potential future benefits of this type which may not be realized at present, and lastly non-use benefits – the values that people place on wetlands as habitats, reservoirs of diverse wildlife and as part of our heritage and culture (Table 28).

**Table 28: Examples of economic wetland benefits.**

Use Benefits			Non-Use Benefits
Direct Use Benefits	Indirect Use Benefits	Option Benefits	Existence Benefits
<ul style="list-style-type: none"> <li>Commercial and subsistence harvest:               <ul style="list-style-type: none"> <li>fish</li> <li>trees</li> <li>wild food plants</li> <li>crops</li> <li>fuel</li> <li>fodder</li> </ul> </li> <li>Recreation:               <ul style="list-style-type: none"> <li>boating</li> <li>birding and wildlife viewing</li> <li>walking</li> <li>fishing</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>nutrient retention</li> <li>water filtration</li> <li>flood control</li> <li>shoreline protection</li> <li>groundwater recharge</li> <li>external ecosystem support</li> <li>micro-climate stabilization</li> <li>erosion control</li> <li>associated expenditures, e.g., travel, guides, gear, etc.</li> </ul>	<ul style="list-style-type: none"> <li>potential future uses (as per direct and indirect uses)</li> <li>future value of information, e.g., pharmaceuticals, education</li> </ul>	<ul style="list-style-type: none"> <li>biodiversity</li> <li>culture</li> <li>heritage</li> <li>bequest value</li> </ul>

*Modified from Barbier et al. (1997)*

### B. Economic value of Hail Haor wetland

Total economic value is now well established as a framework for defining ecosystem, including wetland, economic benefits (Barbier et al. 1997). This approach was adopted by MACH to value Hail Haor wetland. This site was chosen as the largest wetland where MACH was working, but the assessment focused mostly on direct values. Many of even these more readily quantified benefits have tended to be ignored and under appreciated in Bangladesh. Although a researcher independently from MACH undertook a valuation study later in Kangshaw-Malijhee site with cooperation from the project, this is not strictly comparable to the Hail Haor valuation and so has not been reported here.

The approach taken was to estimate the annual value of various economic outputs from the land covered by the wet season water area. The economic output valued was the gross revenue generated by primary activities associated with the wetland resources. Estimation of value added by activity and alternative activities was not attempted. However, since these wetland outputs are either resource extraction or public values the share of value addition will in fact exceed alternative agricultural production activities. This implies that the estimation of relative wetland value is conservative.

With the exception of the value of wetland land use for agriculture, all of the benefits valued are derived from the use of common pool resources (mainly fisheries) and public goods such as flood mitigation. The assessment was made in 2000 at the early stage of introducing improved community based management practices, and reflected conditions when the common pool resources were in a degraded condition due to externalities, open access and inappropriate property right regimes; for example extraction of maximum short term fish catches encouraged by the leasing system, over fishing where there was open access, and siltation of wetlands due to poor soil management practices in nearby hills. Table 29 outlines the methods adopted.

**Table 29: Summary of potential benefits of wetlands and the valuation estimation approaches used in Hail Haor**

Type of benefit	Method/comments
<b>Direct values</b>	
Fisheries	The data collected by the on-going sample monitoring system was utilized. MACH on a monthly basis estimates fish yield for four water classifications. Per ha data was then scaled up utilizing GIS estimates of water area.
Non fish products	A stratified sample household survey was conducted in villages surrounding Hail Haor. Results were scaled up based on total population of the surrounding villages.
Tea estate vegetation use	Tea estates use water hyacinth as mulch. An RRA of selected estates was conducted to estimate per ha consumption. Estimates of total tea estate area were used to scale up the results.
Pasture	The area of pastureland was estimated by deducting from the non-inundated area in each month the area of boro rice and utilizing the GIS database to determine pasture area. An extremely low value of returns per ha pastureland was then used to scale up.
Boro rice (dry season)	Similar to pasture, area was estimated and a standard value of boro rice production was used.
Aus-Aman rice (monsoon season)	Not grown in floodplain/wetland as defined here
Transportation	An RRA survey was conducted at key boat launching sites.
Recreation	The value of tourism to the region was partially attributed to the Haor. Data on tourist expenditure patterns was collected through surveys of Hotels and tourists
<b>Indirect values</b>	
Flood control	A cost avoidance approach was used. The cost avoided was given by a proposed BWDB flood control scheme proposed for the Haor.
Water quality	Not estimated but will be a significant value as the Haor acts to purify water through natural processes.
Aquifer charge	Not estimated but will be a very significant value as the Haor acts to maintain the charge of local aquifers that provide critical drinking and agricultural water
<b>Option values</b>	
Value of maintaining ecosystem and its components for potential future uses	Not estimated, other than through biodiversity value (see below)
<b>Existence values</b>	
Existence values	The intrinsic value of the Haor nationally and internationally was not valued, however unlike many smaller wetlands in Bangladesh it is likely to be significant as the Haor is internationally important for its biodiversity – listed in Asian wetlands directory (Scott 1989). Since the valuation it has been listed as one of only 19 Important Bird areas in Bangladesh (Birdlife International 2004), and has been proposed as a Ramsar site.
Biodiversity	Key informants provided information on the value of MACH and other potential projects to be partially targeted because of experience in Hail Haor. The annual cost of these investments was then used as a surrogate measure.

The ecosystem approach of MACH and detailed monitoring program gave an opportunity to make a detailed assessment of the economic value of Hail Haor by developing a simple bio-economic model using data from 1999-2000. For this calculation the 1999 maximum haor extent was used (12,300 ha). The annual economic output value estimated for Hail Haor in this study is Tk 454 million (USD 7.98 million). The net present value (NPV) of this benefit stream over 15 years is Tk 4.6 billion (USD 79.7 million).<sup>2</sup> The NPV of one hectare of this wetland is Tk 373,000 (USD 6,568). Value is presented in both absolute terms and per hectare of the haor. Table 30 indicates that the annual value of non-fish aquatic products including aquatic grasses, plants for human consumption, snails, mussels and other products is as high as that of fish. The value of dry season pastureland in the haor is also very significant at Tk 40 million (9% of haor value). The biodiversity value (Tk 43 million) represented the value of MACH project and likely foreign development assistance to be provided to Bangladesh due experience in protecting the haor. The estimates are conservative since a number of important benefits and uses from the haor that are difficult to value were not included. Although boro rice is grown in a significant part of the wetland, it is clear that if the rest of the haor to be converted to rice production there would be an economic loss to the nation as well as to the local community, since at that time the net return from Boro rice was only Tk 18,254 per ha (BBS 1999) where as that of the wetland was

<sup>2</sup> NPV was calculated for the 15-year period based on a real inflation-adjusted opportunity cost of capital of 6%.  
MACH-II Completion Report Volume-I June 2007



worth at least 37,000 Tk per ha. This strongly shows that maintaining and improving management of wetland resources offers higher economic benefits than conversion of wetlands to Boro rice production.

**Table 30: Estimated value of Hail Haor economic outputs in 1999-2000.**

Type of good or service	Total returns (Tk)	Value per area (Tk /ha)*	Percent
Commercial fisheries	56,272,200	4,580	12
Subsistence fisheries	83,651,100	6,800	18
Non fish aquatic products**	127,973,300	10,410	28
Boro rice value	63,857,500	5,190	14
Project / biodiversity funds	43,650,600	3,550	10
Pasture value	40,292,800	3,280	9
Flood control	23,443,200	1,910	5
Recreation	7,025,600	570	2
Transportation	8,758,300	710	2
<b>Total (Tk)</b>	<b>454,924,600</b>	<b>37,000</b>	<b>100.0</b>
<b>Total (US\$)</b>	<b>\$7,981,100</b>	<b>\$650</b>	

Water quality, aquifer recharge benefits and existence value were not valued.

\* Total output value divided by maximum water area (12,300 ha in 1999).

\*\* Includes aquatic plants used by local residents and by tea estates.

Exchange rate at that time US\$ 1 =Tk 56.9

### C. Value of benefits derived from MACH

With the management improvements put in place through MACH and the co-management systems it has established, significant increases in the value of the wetlands in all three sites could be expected, compared with the value at the start of the project as shown above. The interventions adopted through MACH are not expected to affect all of the components of total wetland value, and equally data is only available on some indicators, which by design are linked with the main expected impacts. As the same bioeconomic model is not available for the other two MACH sites, and since only some components of wetland value are believed to have changed due to the MACH intervention, values are only estimated for these changes to assess the economic benefits from MACH. Moreover, other changes, in land uses for example, cannot be directly attributed to MACH.

The main impacts expected from MACH are in terms of changed fish catches. Use of non-fish aquatic resources was also monitored for a sample of households in all three sites but no clear trend emerged, and the RMOs did not set any rules on collection of plants for example. The RMOs did ban hunting of birds in the sites, but this in any case had an insignificant economic value at the start of the project, while benefits from protection are already counted in the biodiversity fund surrogate measure above. Most of the other impacts are generated directly from activities undertaken by local people as a result of support through MACH. For example, the returns from trees planted, from income generating activities supported, and from contour cultivation of pineapple to the farmers. In addition to these activities with marketed outputs there were expected to be benefits from reduced soil erosion and siltation, from eco-tourism, and possibly from improved flows of water and water retention for irrigation. These last impacts could not be assessed as there is no data on any change in sedimentation rates, eco-tourism in any significant numbers only started at Baikka Beel in 2007 and there is limited data, and there is insufficient information on impacts of water flow changes on irrigation to estimate any reduced cost of irrigation. There were in addition various demonstrations of improved agricultural practices, but there is no data to indicate what uptake and net benefits there was from these other than through the returns to FRUG borrowers who were involved.

Therefore only the following impacts that are directly attributable as impacts of MACH have been valued, calculations are shown in Table 31:

1. Changes in annual fish catches (gross value of catch per ha, costs of catching are presumed to have stayed constant)
2. Present value of expected returns from felling trees
3. Increase in household income from activities supported by FRUG loans after allowing for costs and loan repayment
4. Net incremental returns from contour pineapple farmers.

**Table 31: Valuation of impacts of MACH project, actual benefits to 2006 and projection for 15 years. Valuation at 2006 prices.**

Year starting	Fish yield (kg/ha)				Fish price (Tk/kg)	Fish production (t)		Additional value of fish (Tk million) fixed 2006 price (Tk 64.88)	Trees (not swamp) Harvest 15 years after planting, less replanting costs (Tk million)	Pineapple		IGAs						Total benefits (Tk million) at 2006 constant prices
	Turag Bangshi (4,374 ha)	Hail Haor (12,490 ha)	Kang-shaw-Malijhee (8,210 ha)	Overall fish yield (kg/ha) 25,074 ha		Fish production (t)	Incremental production (t)			Cumulated area planted (acre)	Incremental (net) gain	Income Tk/day after loan repayments	Income Tk/day constant 2006 prices	Participant income in yr (Tk)	No. of borrowers	Value of loans disbursed (Tk million)	Incremental income per year constant 2006 prices (Tk million)	
1999	57.8	171.1	150.2	144.5	38.81	3,622	0	0	0	0	0	52.4	78.9	19,141	0	0	0	0
2000	124.8	205.1	150.2	173.1	42.32	4,340	717	46.53	0	1.2	0	68.1	96.5	24,838	511	2.33	3.30	49.82
2001	104.8	190.8	150.2	162.5	45.83	4,074	451	29.27	0	5.94	0	66.1	88.4	24,119	2,027	8.27	7.09	36.36
2002	140.1	287.3	149.2	216.4	49.64	5,425	1,803	116.98	0	30.62	0.09	66.4	83.9	24,243	3,728	14.45	6.80	123.88
2003	315.2	161.8	273.4	225.1	53.76	5,644	2,022	131.17	0	71.79	0.39	67.7	80.6	24,692	3,305	10.96	2.08	133.63
2004	320.7	388.6	315.6	352.9	58.22	8,848	5,225	339.03	0	77.44	2.00	69.5	78.1	25,364	3,551	18.52	-1.00	340.03
2005	234.7	256.0	416.1	304.7	63.05	7,640	4,018	260.67	0	92.67	3.85	86.7	91.9	31,642	3,975	22.89	18.92	283.44
2006	277.7	322.3	307.1	309.5	64.88	7,762	4,139	268.55	0	92.67	2.22	89.0	89.0	32,485	3,877	26.21	14.36	285.13
2007	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	3.08	88	90	32,063	3,926	24.55	16.61	317.27
2008	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,001	25.02	16.93	316.83
2009	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,078	25.50	17.26	317.16
2010	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,156	25.99	17.59	317.49
2011	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,236	26.49	17.93	317.82
2012	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,317	27.00	18.27	318.17
2013	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,400	27.52	18.62	318.52
2014	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	4,485	28.05	18.98	318.88
2015	277.7	322.3	361.6	327.4		8,209	4,587	297.58	13.28	92.67	2.32	88	90	32,063	4,571	28.59	19.35	332.52
2016	277.7	322.3	361.6	327.4		8,209	4,587	297.58	20.75	92.67	2.32	88	90	32,063	4,659	29.13	19.72	340.36
2017	277.7	322.3	361.6	327.4		8,209	4,587	297.58	38.23	92.67	2.32	88	90	32,063	4,748	29.69	20.10	358.22
2018	277.7	322.3	361.6	327.4		8,209	4,587	297.58	60.28	92.67	2.32	88	90	32,063	4,839	30.26	20.48	380.66
2019	277.7	322.3	361.6	327.4		8,209	4,587	297.58	63.43	92.67	2.32	88	90	32,063	4,932	30.85	20.87	384.21
2020	277.7	322.3	361.6	327.4		8,209	4,587	297.58	26.34	92.67	2.32	88	90	32,063	5,027	31.44	21.28	347.52
2021	277.7	322.3	361.6	327.4		8,209	4,587	297.58	4.37	92.67	2.32	88	90	32,063	5,123	32.04	21.68	325.95
2022	277.7	322.3	361.6	327.4		8,209	4,587	297.58	0	92.67	2.32	88	90	32,063	5,222	32.66	22.10	322.00
NPV (6%)								2,724.35	70.74		20.86						155.87	2,971.83
NPV US\$ mill (approx, using only 2006 exchange rate)								40.06	1.04		0.31						2.29	43.70

The benefits from MACH are estimated for a period up to 2022, allowing a projection of 15 years from the present. The valuation is made in constant 2006 prices. Since virtually all of the benefits considered here accrue for items that are consumed domestically and which have a high local demand relative to supply or desirable levels of national production, and the benefits mostly go to poorer people, values are based on local market prices. For estimating a present value of benefits a real rate of return (or discount rate) of 6% has been assumed.

In estimating the value of increases in fish catches, the results of monitoring during MACH have been used. This shows the increase in catch per hectare in each site, based on representative areas of the range of wetland habitats found there. Grossing up by the total monsoon water area gives an estimate of total production. To allow for annual fluctuations the average yield of the last two years with survey data has been used to project. This gives a long term average fish yield of 327 kg/ha after MACH compared with 144 kg/ha in the baseline year combining the three wetlands, resulting in an incremental fish production estimated at 4,587 t/year, valued in 2006 prices at Tk 297 million per year. This benefit accrues to those catching fish including leaseholders of parts of Hail Haor that are not under RMOs, the additional benefits to local fish traders and other links in the marketing chain are not considered here. The benefits estimated are conservative because an average fish price based on that faced by local people in the sites is used, but relatively more of the gain in production has come from recovery of higher value species which local people sell rather than consume themselves.

MACH has supported local communities, groups and institutions to plant 644,081 trees of which 236,947 were surviving in late 2006, of these just over 41,000 are to restore swamp forest and will not be felled (although they may be lopped for branches once they are more mature). For the remainder the potential benefits from felling after 15 years have been estimated. It was estimated that each non swamp tree would by then generate 6 cubic feet (cft) of timber and 1.2 cft of fuelwood, the former valued at Tk 200 per cft and the latter at Tk 20 per cft. After deducting a cost of replanting of Tk 60 per tree, this would give a net return to the shareholders in the trees of Tk 1,164 per tree. The total present value of felling the trees in this way would be just over Tk 70 million or US\$ 1 million. Under the benefit sharing agreements that cover the different plantations, local poorer people (through committees and RMOs) will receive on average just under a third of the net income, with the rest going mainly to the involved landowners, except that 12.5% of the income from trees on public lands going to the Union Parishads for their development works.

Estimates of increased income from IGA loans up to 2006 are based on actual data from project monitoring: the amounts borrowed, numbers of borrowers, and the increment in household daily income reported by a sample of participants. Estimates after 2006 assume that the average participant income of 2005 and 2006 will continue (at constant 2006 prices). The amount of loans (number of borrowers and amount) are expected to grow gradually – the revolving loan funds are expected to grow with the addition of 16% of the interest earned each year. Interest is at 12%, it is assumed based on experience so far that about 80% of the interest is needed to cover FRUG operating costs, and the FRUG constitutions provide for 80% of the net income after those costs to be added to the revolving funds (the remainder goes into an emergency reserve fund). Although the impacts during the project period appear impressive, after inflating previous year's incomes to 2006 prices, the average gain in income per participant household over a year after the project is estimated to be about Tk 4,230 in 2006 prices after allowing for repayment of any loans taken. If the FRUGs use their steadily growing revolving funds in the same way as at present, the incremental income of RUG members is expected to gradually rise from about Tk 16.6 million in 2007 to Tk 22 million in 2022. However, the evidence during MACH project is that RUG member incomes show a substantial increase in the initial years of membership, with modest growth in later years. If the FRUGs implement the policy of graduating members who are raised out of poverty and adding new poor members that is in their constitutions, then the incremental income from the IGA and micro-credit support would be expected to be higher.

The MACH records show the numbers of farmers adopting contour cultivation and the areas converted to this each year. Based on two demonstration plots compared with a control an estimate of the return over 3 years compared with costs for contour and normal cultivation is available, from this the net gain to the farmer from contour cultivation over normal cultivation was Tk 74,990 per acre. The following conservative assumptions are made: no further expansion of contour cultivation after MACH (although the Department of Agriculture Extension has agreed to continue promoting this practice), the net benefits accrue 3 years after establishing a contour garden (in fact they start earlier),

and after the first 3 years the average annual benefit is Tk 25,000 per acre per year. This gives a long term benefit from contour cultivation in this area of Tk 2.3 million per year at 2006 prices.

Overall the driving force in economic impacts from MACH is the estimated gain in fish production from restored wetland ecosystems. On its own this is sufficient to more than justify the project investment. Assuming a 6% real opportunity cost of capital or discount rate, by 2022 the present value of those benefits valued and directly attributable to MACH is predicted to be about Tk 2,970 million or US\$ 44 million. Moreover much of the additional products directly benefit the poor, are not traded by Bangladesh and are regarded as having insufficient domestic supply.

#### D. Benefit cost assessment

The total cost of MACH I, MACH II, and ISMP up to June 2007 is the equivalent of about US\$ 12.76 million, converting the Taka costs of ISMP to US\$ at the prevailing exchange rate in the middle of each year (Table 32). For the purpose of this analysis no further costs were assumed, although it is expected that the equivalent of an additional US\$ 1.16 (Tk 80 million) will be spent from the ISMP after June 2007. However, over US\$ 0.44 million of this would be spent on outreach and other supports that will benefit other areas not those covered by the main MACH projects (for example, habitat restoration and sanctuaries in other locations and support for alternative incomes for fishers affected by the government ban on catching juvenile hilsha known as “jatka”). In addition the equivalent of US\$ 0.2 million has already been spent on similar outreach activities but while these costs have been included in the assessment, no benefits have been estimated. This gives a present value for costs of MACH up to June 2007 of US\$ 9.57 million.

**Table 32: Expenditure of MACH projects and benefit- cost analysis**

Year	Exchange rate (Tk per US\$)	MACH related costs (total, including costs for activities outside MACH areas)					Total benefits		Net benefit (US\$)
		MACH-I (US\$)	MACH-II (US\$)	ISMP (Tk)	ISMP (US\$)	Total (US\$)	Tk	US\$	
1999	48.00	937,790				937,790	0	0	-937,790
2000	50.80	918,361				918,361	49,824,602	980,799	62,439
2001	56.50	1,524,850				1,524,850	36,357,582	643,497	-881,353
2002	57.40	1,627,122		3,232,858	56,322	1,683,444	123,877,216	2,158,140	474,696
2003	57.90	1,158,494	124,908	33,339,899	575,819	1,859,220	133,631,803	2,307,976	448,756
2004	58.00		932,307	56,561,588	975,200	1,907,507	340,027,455	5,862,542	3,955,036
2005	63.00		826,000	64,353,646	1,021,486	1,847,486	283,444,748	4,499,123	2,651,637
2006	68.95		838,523	56,497,015	819,391	1,657,914	285,132,383	4,135,350	2,477,436
2007	68.75		154,736	18,597,915	270,515	425,251	317,274,391	4,614,900	4,189,649
2008						0	316,832,000	4,608,465	4,608,465
2009						0	317,157,131	4,613,195	4,613,195
2010						0	317,488,505	4,618,015	4,618,015
2011						0	317,826,242	4,622,927	4,622,927
2012						0	318,170,463	4,627,934	4,627,934
2013						0	318,521,293	4,633,037	4,633,037
2014						0	318,878,859	4,638,238	4,638,238
2015						0	332,519,498	4,836,647	4,836,647
2016						0	340,361,963	4,950,719	4,950,719
2017						0	358,224,010	5,210,531	5,210,531
2018						0	380,655,281	5,536,804	5,536,804
2019						0	384,206,107	5,588,452	5,588,452
2020						0	347,516,099	5,054,780	5,054,780
2021						0	325,947,424	4,741,053	4,741,053
2022						0	321,997,935	4,683,606	4,683,606
<b>Total</b>		<b>6,166,616</b>	<b>2,876,474</b>	<b>232,582,919</b>	<b>3,718,733</b>	<b>12,761,823</b>	<b>6,585,872,990</b>	<b>98,166,732</b>	<b>85,404,909</b>
<b>PV</b>		<b>5,136,865</b>	<b>2,420,930</b>	<b>186,515,223</b>	<b>2,996,519</b>	<b>9,570,403</b>	<b>2,971,826,239</b>	<b>44,994,074</b>	<b>35,423,671</b>

PV = Present value at 6% discount rate

Consequently considering the benefits discussed above against the costs to June 2007 (Table 33), using a 6% discount rate and considering the period 1999-2022, the net present value of the MACH program is expected to be just over US\$ 35 million, the benefit-cost ratio is 4.7, while the internal rate of return is 56%. This indicates a strong financial and economic return from the investment.

**Table 33: Summary of Benefit-cost assessment**

Benefits		Costs	
Fish catches	25,074 ha	MACH-I	US\$ 6.17 mill
	Yield in last 2-3 years 182.9 kg/ha above baseline	MACH-II	US\$ 2.88 mill
	Long term additional production: 4,587 t/yr fish	ISMP	Tk 232 mill US\$ 3.72 mill
	Tk 297 mill pa benefit	<b>Total</b>	<b>US\$ 12.76 mill</b>
	PV US\$ 40 mill		
IGAs	Long term increment in income Tk 3,265 household/yr	<b>Total costs</b>	<b>US\$ 9.57 mill (PV)</b>
	4,000-5,000 borrowers pa	<b>Total benefits</b>	<b>US\$ 44 mill (PV)</b>
	PV US\$ 2.3 mill		
Trees	195,850 survive to felling after 15 years (excluding swamp trees)	<b>Net present value</b>	<b>US\$ 35.43 mill</b>
	One cycle net return Tk 70.7 mill	<b>Benefit cost ratio</b>	<b>4.7</b>
	PV US\$ 1 mill		
Pineapple	93 ha contour cultivated		
	PV US\$ 0.4 mill	<b>IRR</b>	<b>56%</b>



## 6. People's Empowerment

### A. Introduction

The word 'empowerment' is defined in many ways by different development projects. However, it is commonly seen as an approach where the understanding of "*Rights* work as the starting point for processes that enable people to take control of their lives and assets through the ability to make informed and free choices" (Thematic Lesson Paper Series 8, RLEP, 2005). The Bangladesh Poverty Reduction Strategy (PRS) paper also identifies empowerment through participatory governance and enhanced voice of the poor as a national priority.

From the very outset empowering communities for improved wetland management has been central to the MACH Project. In fact a major focus of the project has been on empowering the poor to participate in the processes of wetland governance. To begin with, the building block of the project has been enabling 16 Resource Management Organizations (RMOs), representing the user community of the management area to be in control over decisions on management, utilization and benefits of local wetland resources. In parallel with this it has sought to empower poor users of wetlands through RUGs, not only in terms of economic empowerment through improved livelihoods, but also by leaving revolving funds in their ownership with full powers of decision making. Clearly, the project has been striving to achieve the empowerment goals through many strategic approaches:

- **Creating space for participation of the poor and women:** MACH started with an extensive social analysis and tried to understand the power relations and diversity existing in communities. The project consciously made space for the poor resource users in RMOs with a target of 60% of the community representatives coming from poor resource users, so that they are more able to make their voices heard and opinions valued. At the same time the elite are not excluded but strengthen the institutions by working as champions of conservation and the poor. Moreover, it successfully developed strategies and set quotas to include women in all of these organizations, including all the co-management institutions.
- **Enhancing capabilities and knowledge:** in order for local people to engage in meaningful participation the members were given awareness on rights, knowledge about management rules, training on leadership skills, accounts keeping, legal issues and have gradually developed exposure and an accepted role in higher forums like upazila level meetings and co-management committees (UFC: Upazila Fisheries Committee) where the leaders of the CBOs are full members. Through the process of developing management maps and plans they had to carry out their own analysis to decide upon strategies for overcoming problems and implementing activities.
- **Economic security:** The lack of economic security often prevents the poor from more effectively managing the natural resource they depend on. The incentives of the alternative income generation (AIG) in the MACH Project have contributed towards the poor being able to actively participate in the management of the water resource they depend on by giving them enough income that they can reduce and stop fishing for periods to let the resource recover. The project created parallel entities to RMOs called Resource Users Groups (RUGs) which included not just support to take up income earning opportunities, but provided economic empowerment in the form of capacities required for engaging in new enterprises.
- **Promoting sustainability:** The community organizations such as RMOs and the Federations of Resource User Groups or FRUGs have been given formal recognition through registration with Social Welfare Department. This has increased their credibility as organizations within the community, within the local government system and beyond the project at the district and even central level. These groups are empowered with rights within the legal framework of Bangladesh.
- **Building local social capital:** it is an important aspect of empowerment. Social capital has been enhanced by MACH in two ways. Firstly, by developing common understanding and trust among the members of the community organizations, and by *bonding* these together through site networks among RMOs and federations of RUGs. Secondly, by *bridging* the gaps between the community organizations and local government through the co-management committees, and for

example creating links with service providers and with Union Parishads that will continue after the project.

Empowerment is a change in behavior, mindset and ability which is difficult to measure quantitatively. Therefore, this section presents some positive stories and anecdotal evidence that gives a voice to the people's empowerment that has taken place as a result of a conscious effort made by MACH or sometimes as a spin-off. There are instances that show that RMOs are strong enough to withstand local pressure from elites. By virtue of their social cohesion, and through formal registration as social welfare organizations, they are becoming more difficult to ignore. Also, Upazila Nirbahi Officers, Upazila Fisheries Officers and Union Parishad Chairmen have become more responsive to their requests for assistance. Women are in more control over their lives due to economic opportunities and exposure to knowledge; they are better able to express their rights and needs publicly, and receive more respect from the family and community.

In their June 2006 Evaluation of USAID/Bangladesh Environment Programs the independent evaluation team evaluating MACH said the following: "An outstanding achievement of the project has been the empowerment of women. The project has operated in conservative rural areas, where women have traditionally had few rights and little power over their lives or livelihoods".

### **B. Anecdotes on Empowerment**

Below are some examples out of many where empowerment has come into play and where change is likely to remain because of the stakeholders strengthened awareness.

#### ***Together We Stand***

With 30 members from Rustampur, Badealisha and Lawyerkul villages Dumuria RMO was established in Hail Haor in Sreemangal Upazila in 2000. In 2004 the Ministry of Land in consultation with the Ministry of Fisheries and Livestock reserved the leases to five beels (Charadoba-Chataldoba, Dhalidoba, Patradoba, Latua Metra Kankata and Dumer) to Dumuria RMO for sustainable management. The members collected fees and took interest free credit from the MACH Project to pay the lease money. However, although they took possession of four beels, Dumer beel (125 acres) was taken over by its former leaseholder and subleased to the fishers of Lalbagh. When the RMO went to take possession of the beel, they were sent away by the musclemen of the ex-leaseholder who claimed to have won the lease from the Government. Moreover, he tried to bribe and influence the MACH staff and members of the RMO in many ways to give up the management right over the beel. The members of the RMO held meetings and discussions and organized and mobilized the entire community of general fishers on the issue.



*Rights training at Dumuria RMO*

The ex-leaseholder tried to utilize his political influence being a former student leader himself. He got the Sreemangal Pourashava Chairman to pressurize the RMO leaders to hand over the beel to him in return for the lease money already paid by them. The RMO did not give in but argued with the Chairman and in the end were able to convince the Chairman that if the RMO manages the beel, the benefits will reach the poor fishers of the locality. Still, the resistance from the ex-lessee did not end. Under the circumstances, the RMO leaders requested the Upazila Fisheries Officer and Upazila Nirbahi Officer to arbitrate. The UNO asked both the parties to come to his office with the relevant papers on the issue. As the leaseholder could not show proper documents related to the beel, the UNO threatened to take legal action against him on behalf of the RMO and asked him to give up possession of the beel. The following day he removed his people from the beel and Dumuria RMO took over the management.

The struggle was not over as yet as 15 days later two fishers (permitted by the RMO to fish in Dumer Beel) were arrested by the police with their catches from the beel. It so happened that the ex-leaseholder persuaded the RMO Chairman, Shubol Das, to sell the lease title in return for Tk 40,000 in a Tk 150 stamp paper. It made the other RMO leaders furious. They sought help from the UNO, Officer in charge (OC) of the police station and the local UP Chairman to resolve the conflict. The UNO called a meeting in Bhunobeer Union Parishad on request from the RMO. The conflict regarding the beel was analyzed openly at the meeting and both the parties were asked to deliver papers. Obviously the former leaseholder failed to produce valid documents and was proven guilty. Finally, he was made to beg forgiveness in the open meeting and promise that he would never cause any more trouble for the RMOs but instead help them with their work.

### ***Right is Might: Recovery of Khaya Beel***

Khaya Beel (11.98 acre) is one of three beels that form part of Kaiyar Beel (27.22 acre) fishery in Hail Haor in Moulvibazar Sadar. For 15-20 years it has been regarded as forbidden territory by the poor fishers. Even the previous leaseholders who took the entire Kaiyar Beel on lease had to be satisfied only with Ramai (6.24 acre) and Medi (9 acre) and couldn't dare to take possession of the unattainable Khaya. The reason being, Ahmed Khaleq Mian, a powerful resident of Dashkahania, a neighboring village, had been in control of the beel for many years and enjoyed the benefits along with his family.



*Ramedia RMO members in a meeting*

In 2004 with the assistance from MACH, Ramedia Resource Management Organization (RMO) won the management right of Kaiyar Beel. Upon payment of the lease fee the local land office handed over all the related documents to the RMO. The jealous Khaleq filed a suit against the MACH staff and the RMO President at the Sreemangal Upazila Sadar Thana and claimed his private ownership over Khaya Beel. He planned on catching fish by dewatering the beel. The RMO President and Secretary sought help from the local UP Chairman in this regard. The Chairman sent a few village police and a surveyor from the land office to the spot for inquiry. They were chased away by Khaleq's sons and musclemen and the beel was thus cleared of fishes.

Consequently, the RMOs persuaded the land officer to file a case against Khaleq over assault and damage caused to the beel. Further, the President of Ramedia RMO filed another case against Khaleq and his sons for illegally occupying the beel. Most importantly, the RMO leaders won the trust of the officer in charge at the thana police station by explaining about the objective of the organization, lease agreement with the government and their management activities. Therefore, the police officer sent notices to both the parties to produce ownership documents related to the beel. Obviously, Khaleq failed to produce valid documents and was sent to jail for 20 days with his son.

The members of the RMO engaged in discussion with both fishers and farmers of the adjacent area and explained to them about the benefits of excavation and other resource management activities under the RMO. As a result, about 1,000 fishers and farmers joined the RMO members to recover the beel from the capture of Khaleq's family. The group received police protection from the local Thana. Currently, Khaya Beel is under the management of Ramedia RMO although the court cases are still ongoing.

### ***Katha Center: brainchild of the BBRMO women***

In Bailsha Beel Resource Management Organization in Sherpur, women have been involved in resource management activities for some time. Moreover, they are also members of Resource Users Groups (RUGs). As members of the RUGs and RMO they have received training to develop skills for new enterprise development, leadership qualities and some have also worked as leaders of committees. Moreover, in 2006 they received training from the project on establishing linkages with other service providers of both government and non government agencies.



Some of the women members in Bailsha RMO expressed their wishes to create linkages with BRAC activities and establish a BRAC supported 'Katha center' in their community. This would ensure market access for their produce and empower hundreds of women economically. The women representatives along with some male RMO members and project staff negotiated with the local BRAC staff and were successful in establishing a Katha center in their RMO office. About 150 women are now producing different handicraft items for BRAC's chain of handicraft shops - ARONG. This has not only increased their income but also reinforced their confidence in themselves as champions of the interests of poor women in their area and good negotiators.

### ***Ensuring bans on harmful fishing practices are followed***

The members of Ramedia RMO are very vigilant about protecting the fish and wetlands in their area. They are proud that as a result of their management efforts the locals are now enjoying higher fish catches and that once rare species of fish are now more numerous in their area. In many ways they have created awareness among the community particularly the fishers about the management rules for their sanctuaries and for the wetlands in general. One of their local regulations is: *poisoning for harvesting fish at any level is strictly prohibited*. Despite high levels of awareness raising, a local influential person applied poison in a *khal* (canal) about 1 km away from the main beel managed by the RMO, and hired fishers to harvest the fish. The Ramedia RMO members quickly informed to the SUFO who visited the spot and after discussion with the RMO and UNO proposed to open a legal case against the group that poisoned the fish. The UP chairman then intervened and suggested a public meeting be held to decide on how to handle the offender. Finally it was decided to fine the offender Tk 70,000 for poisoning the khal. Most of the fine has already been paid to the RMO which it was agreed would organize re-stocking native fishes into the area with the money from the fine.

### ***Gini fishing: a thing of the past***

In the past a custom of large groups of people catching fish from public water bodies ("fishing festivals") was a common practice in Gazipur Upazila during the dry seasons. Those who fished like this were locally known as *Ginis*. This was a major cause of reduction of brood (egg carrying) mother fish which in turn led to a decrease in total production. With the depletion of fish stocks before the project Gini fishing also ceased.

In 2000 the local communities with the support of the MACH project began to manage the large wetlands by forming Resource Management Organizations (RMO). The four RMOs established sanctuaries in Turag River, Goalia River, Mokosh and Alua Beels as well as restricted dry season take on broodfish and by 2003 the increase in fish production and diversity became quite apparent to everyone in Gazipur Upazila. Consequently, the *Ginis* reappeared after a recess of 10-12 years. On 14 December 2004 about 5,000-6,000 people from the neighboring upazilas pillaged fish worth an estimated Tk 300,000 from the sanctuaries of Mokosh and Kaliadaha beels taking many of the brood female fish. The RMOs were not prepared to resist it this year as it came as a surprise.

Afterwards, the four RMOs got together and engaged in discussions on how to protect their wetlands from such harmful practices. At a networking meeting the RMOs finally came up with strategies to mobilize opinion against Gini fishing. In this meeting Kaliakoir Upazila Fisheries Officer expressed support and guided them to formulate plans. The following activities were taken by the RMOs based on the strategy they agreed:

- A preliminary survey was conducted to identify from which unions and upazilas the *Ginis* came. It was discovered that the *Ginis* mostly came from the



*Ginifishing in Mokosh beel,  
Dec2004*

neighboring areas of Bhawal, Mirzapur, Sripur, Mauna, Salna Bazar, and Barmi and a few local people joined them.

- Awareness against Gini fishing was created among the people of those areas with the help of government officials, elected UP Chairmen and powerful residents of those communities so that people would refuse to become parties to the activities.
- With the help of the Kaliakoir UFO all the UFOs in Gazipur District together took a resolution against Gini fishing at the office of Gazipur UFO and the message was also sent across to other UFOs in different upazilas.
- Letters were sent to the elected UP Chairmen of the identified upazilas and the village police were involved to spread the word about harmful effects of Gini fishing through loud speakers in marketplaces.
- Leaflets were prepared and distributed in schools and marketplaces.
- Awareness meetings were held adjacent to Mokosh and Kaliadaha by the RMOs.

Ever since these interventions, the RMOs have tightened security measures at the sanctuaries to resist a probable attack by gini fishers during the dry season. These initiatives have completely stopped the gini fishing and December 2004 was the last time this destructive activity has occurred.

### *New beginning for the women in Chenguria*

The women of Chenguria Shapla Mohila Samity in Sherpur meet every Wednesday, babies in their laps, on the floor of President Sofia Begum's home. They discuss the loans they've taken, the businesses they're pursuing, and the rules that they are laying down for their husbands, most of whom are fishermen. "We are all mothers here," says Sofia. "If a woman's husband is a fisherman and he brings her a pregnant fish, the woman will refuse to cook it. We tell them, a mother must be allowed to raise her children."

The initially difficult task of reducing the amount of fishing that takes place during the breeding season of April–June, has been accomplished in part because of the women's efforts. Aside from encouraging and informing their husbands, the women take out loans and establish their own businesses. The women say they have gained more respect from their husbands, and are now being consulted on financial matters.

Most importantly the women are able to better provide for their children. Before, many of the women embarrassedly admit, their families subsisted only on fish. Now, with increased family incomes, women are able to buy milk, eggs, and other nutritious foods as well as the fish. "We are no longer beggars and borrowers, we are providers," says member Mosamud Tahura.



*"We are no longer beggars and borrowers, we are providers," says RUG member Mosamud Tahura*

The group has been able to provide not only for their families, but for their community as well. Tahura was recently elected as a Union Parishad (UP) member. She works as a grass roots level government representative, bringing the needs of her community to the attention of officials at the higher levels in the Upazila for example. Recently, she worked to secure 70 new sanitary latrines for her community. "We are extremely proud," says Tahura, both of her work and of that of the other women. "We are empowered." The women of the Chenguria Shapla Mohila Samity formed the group with the support and guidance of the MACH Project.



***Enjoying the early taste of success***

Mohammad Belal Hossein is a successful poultry farm owner at the age of 19. He started in 2001 with 100 chickens by taking a loan of Tk 5,000 from MACH-CARITAS. He received training on poultry rearing and marketing from the MACH project and kept expanding his poultry farm by taking two more loan amounts of Tk 8,000 and Tk 10,000 respectively after paying back the first. So far, Belal has completed 28 cycles of rearing and selling poultry (buying chicks, raising them, and then selling the chickens). At present, he is the proud owner of a poultry farm with 1,000 chickens. Currently, Belal's monthly income fluctuates in the range of Tk 6,000-8,000 and the total profit earned from his poultry business over seven years is Tk 127,000. His family is already enjoying the fruits of his hard labor and good judgment. He built a comfortable



*Belal in his poultry farm*

house for his mother by investing Tk 60,000 and can afford the luxury of having a mobile phone at his age. He is proud of his achievements. In his own words, "If I didn't receive poultry training I would have ended up as a fisherman like most of the people in my area. Fishermen here earn a maximum of taka two hundred a day working ten to twelve hours. This income is not consistent. Now I make ten times more from my poultry farm." His plan is to increase the number of chickens to 2,000 and start up a shop in Sreemangal town in the near future. Belal is an example of

a fishing youth who with fishing resources becoming more limited may have gone into other negative activities in the village had it not been for MACH.

***Lobbying for the right to cleaner water***

"Our fish are dying! Many water resources will be destroyed; general people who live on fishing will be unemployed due to the untreated waste water from the industries. Please help us to live and survive!" these were the words of Moazzem Hussain, Chairman, Turag RMO on 31 July 2006 at a meeting with the Director General of the Department of Environment (DoE) and other officials of the DoE. The meeting was facilitated by the MACH project on request from the Local Government Committee members (now Upazila Fisheries Committee - UFC) recognizing that DoE is responsible for regulating pollution and enforcing effluent discharge laws. The Resource Management Organizations (RMOs) of Kaliakoir have also been lobbying for their right to cleaner water in many ways and at different times.



*Meeting between kaliakoir UFC and DoE on 31 Jul'06*

The study on *Conflict in Areas of Industrial Pollution* by Nishat Chowdhury (2007) points out that the problem of pollution in Turag River and Mokesh Beel from industrial units when first encountered was a silent issue because just about every household had a member working in one of the industries

in the area. In 1999 the RMOs in a MACH workshop first identified it as a serious and growing problem. Later it was found to be destroying their gains achieved under MACH in term of higher fish production. In 2005 due to a major fish kill in the sanctuaries the RMOs became desperate for a permanent solution to the problem.

MACH has taken three steps to help support the RMO efforts. Firstly, it provided the RMOs with equipment to monitor water quality (DO: Dissolved Oxygen meters), and trained local volunteers. Five teams now regularly monitor water quality in the beel and river, and this is expected to be sustained after MACH support ends through the endowment provided by the project. Secondly, the RMO and UFC members and DO monitors have also received training provided by BELA on rights and on how to get involved in advocacy and move forward with petitions and if necessary court cases. Thirdly, on request from the community organizations MACH created access at the higher policy level for the UFC members to present their grievances based on evidences collected through DO monitoring. The main examples of how the local community and co-management bodies have lobbied for cleaner water are:

- In 2005 the RMOs invited an environmental activist, Prof. Abdullah Abu Sayed, to the area to give a first hand account of their suffering and to draw a commitment from him. This was widely circulated in the news both print and TV.
- On 6 August 2006 the RMOs organized an open meeting at Mouchak union to formulate a petition. The invitees included local journalists, Kaliakoir Upazila Nirbahi Officer, Upazila Fisheries Officer, Upazila Agricultural Officer, Social Welfare Officer and most importantly the local community. Copies of the invitation letter were also sent to the DC and factory owners for their information. At the meeting the RMOs collected signatures from the community members for the petition and sent a copy of the petition to the office of DoE through BELA and other concerned upazila officials and the DC.
- As the previous complaint to the DoE and the industries had fallen on deaf ears, on request from the RMOs MACH arranged a meeting on 31 July 2006 at DoE where members of the UFC and DO monitors narrated the history of their sufferings and presented evidence to the DG, DoE of the significance of the problem. As a solution, the DG proposed to sign a Memorandum of Understanding (MOU) with the UFC. Under the agreement, the UFC including its RMO members will act as watchdogs with the Department of Environment and be consulted during the granting or renewal of Environmental Clearance Certificates for industries. They will also work jointly to assess the violations industry by industry affecting their area.
- On 19 March 2007 a second meeting took place at DoE. Among the participants were representatives from the DoE, Department of Fisheries and Bangladesh Textile Manufacturers Association. Members from the UFC (two RMO leaders, three Union Parishad Chairmen and the Upazila Fisheries Officer) gave a strong account of the significance of the water pollution at Turag River, Mokesh Beel and Ratanpur Khal. ATN Bangla covered the event on their main news with a story on the issue of pollution which also included powerful interviews with the RMO representatives and two elected Chairmen.
- As a follow up to the workshop, on 28 March 2007 the Honorable Advisor (equivalent to a Minister) Dr C.S. Karim, Ministries of Environment and Forest; Agriculture; and Fisheries and Livestock met the UFC and MACH team in order to discuss the pollution problem at Kaliakoir. Consequently, a decision has come out from Dr Karim's office according to which all industries have to submit plans on establishing Effluent Treatment Plants and open a Letter of Credit for purchasing equipment by 21 April 2007 and finally set up their ETPs by October 2007.



*DO monitors recording the pollution level*

## 7. Financial Summary

This section summarizes the financial management of the MACH projects with an emphasis on MACH II which closes on 30 June 2007, and on ISMP which is due to close on 30 June 2008.

### A. Duration and fund allocation

Sl	Project Name	Short name	Donor	Fund	Start date	End date	Duration and remarks
1.	Management of Aquatic Ecosystem through Community Husbandry	MACH I	US AID	\$6.0 M	October 1998	October 2003	61 months
2.	Management of Aquatic Ecosystem through Community Husbandry	MACH II	US AID	\$3.1 M	November 2003	June 2007	Extended as MACH II for 44 months from Nov'03
3.	Investment Support to MACH Project	ISMP	GOB	Taka 34.56 Crore = \$6.0 M	July 2002	June 2008	ISM was extend 1 <sup>st</sup> time for Jul 05-Jun 06 and 2 <sup>nd</sup> extension from Jul 06-Jun 08. Total duration is 72 months.

### B. Implementing Partner Organizations

Sl	Organizations	Classification	Responsibilities in brief	Staffing	Status
1.	Winrock International, USA	Prime Sub-Contractor	Program planning, overall supervision of program implementation & financial management, physical interventions, sanctuary establishment, habitat restoration, & construction	1. Chief of Party 2. Natural Resource Advisor 3. Manager Admn. Finance 4. Secretary 5. Admin & accounts (3 pers) 6. Sr. Engineer (2 pers) 7. Field engineers and supports (17 pers)	Long-term Part-time Long-term Long-term Long-term Long-term Long-term
2.	BCAS	Local Partner	Liaison with GoB authorities, Coordination of policy influence and GIS	1. Policy Expert (2 pers) 2. Coordination & program management (2 pers) 3. GIS & Supports (4 pers)	Sort-term Long-term Long-term
3.	CARITAS	Local Partner	Micro credit, AIGA, Training & development of Resource user Groups and their federations.	1. Project Coordinator 2. Field Coordinators (3 pers) 3. Field Officer- Inst. Dev. 3 pers 4. Agro extension – 3 pers 5. Field Officer 5 pers 6. AFO & Supports – 23 pers	Long-term
4.	CNRS	Local Partner	Motivation at grass root level, formation of Resource Management Organization, habitat restoration & institutional development at program Site level.	1. Floodplain Ecologist 2. Project Coordinator/Monitoring 3. Institutional Expert 4. N. R. Planner – 3 pers 5. FO – Institution Dev 3 pers 6. FO – NRM & Supports-18 pers	Short-term Short-term Short-term Long-term Long-term Long-term

**C. Budget and Expenditure****Table 34: MACH II budget and Expenditure as on 30 April 2007**

Sl	Line Item	Budget (USD)	Expenses as on 30 April 2007 (USD)	Balance of Budget (USD)
1	Salaries and Fringe Benefits	792,296	732,193	60,103
2	Short-Term Specialist	7,004	-	7,004
3	Travel Per Diem	54,389	28,321	26,068
4	Allowances	208,384	194,393	13,991
5	Procurement	41,850	26,956	14,894
6	Program Activities	44,000	39,865	4,135
7	Other Direct Cost	440,252	496,779	(56,527)
	<b>SUB-TOTAL</b>	<b>1,588,175</b>	<b>1,518,507</b>	<b>69,668</b>
8	Sub- Contracts	922,052	822,093	99,959
9	Indirect Costs	589,206	545,428	43,778
	<b>TOTAL DIRECT COSTS</b>	<b>3,099,433</b>	<b>2,886,028</b>	<b>213,405</b>
10	Cost Sharing Match	601,108	556,269	44,839
	<b>Maximum amount that is likely to be spent May 2007 - June 2007</b>			<b>258,244</b>
	<b>Unspent balance likely to remain</b>			<b>-</b>

**Table 35: ISMP budget and Expenditure as on 30 April 2007**

Sl	Line Item	Budget (Taka) (Revised on December'06)	Expenses as on 30 April 2007 (Taka)	Balance of Budget (Taka)
1	Staff Salaries and Allowance	24,300,000	18,199,279	6,100,721
2	Procurement	5,920,000	5,496,160	423,840
	<b>Project activities:</b>			
4	Re-excavation – Khal	23,350,000	2,023,677	1,326,323
5	Re-excavation – Beel	23,450,000	8,957,749	4,492,251
6	Re-vegetation/re-forestation	19,200,000	18,599,857	600,143
7	Physical infrastructure	12,300,000	9,641,669	2,658,331
8	Sanctuary establishment	20,300,000	19,428,165	871,835
9	Credit Program	10,000,000	9,589,849	410,151
10	Jatka Fishing	20,000,000	152,416	19,847,584
11	Endowment	40,000,000	23,600,000	16,400,000
12	Water pollution control	13,600,000	10,106,635	3,493,365
13	Community sustainable activities cost/Training workshop/awareness	30,900,000	20,451,080	10,448,920
14	Outreach	17,720,000	9,268,707	8,451,293
15	Communication/Documentation	3,200,000	2,556,321	643,679
16	Follow-up activities	7,000,000		7,000,000
17	Other Direct Cost	23,660,000	17,369,436	6,290,564
	<b>SUB-TOTAL</b>	<b>294,900,000</b>	<b>205,441,000</b>	<b>89,459,000</b>
18	Consultants	29,700,000	21,203,032	8,496,968
19	Indirect Costs	21,000,000	14,672,934	6,327,066
	<b>TOTAL DIRECT COSTS</b>	<b>345,600,000</b>	<b>241,316,966</b>	<b>104,283,034</b>

**Maximum amount that is likely to be spent during May'07– June'08:**

Category	Amount (Tk)
Endowment	16,400,000
AIGA -Jatka	19,847,584
Follow-up*	7,000,000
Other activity in fourteen months	60,000,000
<b>Total Exp. Jan - Oct '06</b>	<b>103,247,584</b>
<b>Balance that may remain</b>	<b>1,035,450</b>

*\*Follow up amount will remain in hand after June'08 and will spent for 2 years from July'08-June'10*



## **D. Financial Reporting and Audit**

### ***MACH I and II***

USAID placed funds with Winrock International (WI) USA under USAID's funding obligation. MACH Bangladesh received funds from WI USA based on monthly expense reporting for the previous month and the funding requirement for the current month.

MACH Dhaka paid local NGO Partners based on their monthly expense reporting with supports for the previous month reviewed by MACH HQ, Dhaka and funding requirement for the current month.

The audit point of MACH I and II is in WI headquarters and MACH I and II expenses through local partner NGOs were audited by the local independent Auditors of Hoda Vasi Chowdhury & Co. (an associated audit firm of auditors Deloitte Touch Tomatsu of the USA). All expenses through partners will have been audited by the end of July 2007 for the entire period of the MACH I and II project period. MACH II partner expenses ending in the last completed year in June 2006 were already audited by the same audit firm.

### ***Investment Support to MACH (ISMP)***

**Funding:** The Investment Support to MACH Project (ISMP) is derived from GoB funds generated through sale proceeds of PL-480, Section 416B of food-aid provided by USDA/USAID. This fund is allocated through a Project Implementation Letter (PIL) signed by both USAID and the External Resource Division, Government of Bangladesh (ERD), and liquidation certificate is obtained from the Ministry of Finance.

The purpose of the ISMP has been to support the MACH program activities particularly those activities associated with excavation and re- excavation of public (Government if Bangladesh owned) wetlands (beels and channels), to establish sanctuaries and plantations, to restore wetland habitats, to support AIGAs, support the co-management institution established by MACH and to establish endowment funds for continued support to develop and sustain improved wetland resources and management institutions. It also supports extension and implementation of best practices outside the three MACH sites through an outreach component working with other Government of Bangladesh projects.

**Results Package Team (RPT) /Project Management Unit (PMU)** held meetings where USAID, the Department of Fisheries (DoF), Ministry of Fisheries and Livestock (MOFL) and MACH partners sat each month to review the progress of the planned activities and address implementation issues.

Initially the ISMP duration was up to 30 June 2005 but it has been extended up to 30 June 2008, in order to ensure implementation of planned ISM activities and to ensure the sustainability of the field level resource management activities. It was also extended to provide further support to the government, particularly DoF in the development of the inland capture fisheries strategy and program.

**Ministry of Finance** places funds with Winrock International Dhaka in a corporate bank account with Standard Chartered Bank in Dhaka as ADP funding allocation system for each financial year. Release of funds by GOB is subject to submission of an expense report certified by USAID and countersigned by a GOB official of the line ministry (MOFL) appointed as Project Director- ISM.

ISMP Bangladesh received funds from the corporate bank account through an authorization from WI HQ based on monthly expense reporting for the previous month and funding requirements for the current month.

MACH Dhaka paid local NGO Partners based on their monthly expense reporting with supports for the previous month duly reviewed by MACH HQ, Dhaka and funding requirement for the current month.

The audit point of ISMP is at MACH headquarters in Dhaka.. ISMP expenses of both Winrock and local partners from April 2003 – 30 June 2006 were audited by local independent auditors Hoda Vasi Chowdhury & Co. (an Associated Audit Firm of auditors Deloitte Touch of the USA)



## 8. MACH II Revised Exit Plan Milestone Log (Major Events/Activities November 2006- June 2007)

MACH-II was extended at no cost from its original scheduled end on October 28, 2006 through to the end of June 2007. This section summarizes the progress in achieving the milestones set in the workplan for this extension period, since it is not covered by the previous MACH annual reports. The focus of the extension period was to further strengthen the local institutions and organizations established by MACH so that they would be able to function long term after the project ends. The extension was also intended to enable some ongoing physical works to be completed, to support Department of Fisheries with the aim of seeing greater uptake of best practices developed through MACH, and to complete reporting and dissemination of findings from the project.

At the time of writing all of the milestones have been achieved, with the following qualifications:

1. Registration of Goalia RMO with Social Welfare Department is ongoing and will be secured during the ISM extension period (but registration has already been obtained for three FRUGs in this district within the extension period).
2. Placement of the endowment fund for Sreemangal Upazila was delayed until 2007-08 financial year as there were insufficient funds in the 2006-07 GoB ADP allocation.
3. Dredging in Baikka Beel sanctuary, Hail Haor progressed well in this period, but will continue in 2007-08 and for which funds remain available.
4. Funds were not placed with Department of Fisheries for its jatka livelihood support program, but the Government of Bangladesh has agreed upon the mechanism to be followed for implementing this program, and DOF is now ready to receive funds once they are available in the 2007-08 ADP.

Notable achievements in this period included: the formation of five Upazila Fisheries Committees to replace the previous four project based Local Government Committees; the completion and official opening by the head of USAID mission and Deputy Commissioner Moulvi Bazar of the visitor tower in Baikka Beel, Hail Haor; the completion of other buildings and physical works; the preparation of a detailed program design for implementing the Inland Capture Fisheries Strategy of DOF; and the completion and dissemination of a series of policy briefs and technical reports.

**Table 36: Details of progress against milestones set for the no-cost extension of MACH-II**

Description	Planned Completion Date	Actual Completion Date	Comments	Responsible Organization
<b>Support to RMOs/FRUGs and UFCs</b>			All items dependent on ISM local currency funding	
• Registration of three FRUGs and one RMO of Kaliakor completed	December 2006	May 2007	DD of Social Welfare in Gazipur delayed the process but through constant support from the DGs office in Dhaka it was finally accomplished.	BCAS
• UFC Formed	January 2007	January 2007	Government order issued for the 5 project upazilas along with their ToR	BCAS
• Development of additional UFC in Moulvi Bazaar	February 2007	April 2007	Successfully established with a positive response from all GoB agencies	BCAS
• Simplified monitoring system for stakeholders	April 2007	May 2007		CNRS
• Assessment Process and report card system in place for UFC and RMO	March 2007	June 2007		CNRS
• Endowment fund established and operation guideline in place	December 2006	Kaliakor endowment established in June 2006, Sherpur in July	For Sreemongal Upazila the endowment will be established as soon as	BCAS/ Winrock

Description	Planned Completion Date	Actual Completion Date	Comments	Responsible Organization
		2006, and Jhenigati in January 2007. Moulvi Bazaar Upazila June 2007.	new ADP funds are available for 2007-2008. This will likely be August-September 2007	
• Endowment monitoring system in place	December 2006	June 2007	System in place and supervision will continue into 2008 under ISM funding.	CNRS
• Links established through workshops between stakeholders and local service providers	November 2006	December 2006	Completed, this has been done at all sites and was useful and effective	CNRS
• Final assessment of RMO	February 2007	March 2007		CNRS
<b>Wetland Resource Enhancement/Completion of civil works/Pollution (ISM)</b>			All items below dependent on ISM local currency funding	
• Completion of visitors facility in Baikka Beel	February 2007	February 2007 (official opening and hand over)		ISM Team
• Remaining 13 RMO/FRUG meeting facilities completed	April 2007	June 2007	This included the Outreach sites.	ISM Team
• Remaining excavation of 5 beel and canal sites completed	May 2007	May 2007 (2006-07 scheduled schemes)	Additional dredging in Baikka Beel sanctuary will continue after June of 2007 under the ISM fund which continues up to June 2008	ISM Team
<b>Support to Department of Fisheries</b>			All items below dependent on ISM local currency funding	
• Jatka support program of the DoF	June 2007	Not done yet	Support to this is dependent on an official request from DoF for the program. June 2007 Steering Committee agreed that DoF would request funds and then transfer to PKSf for implementation. When fund is available for new ADP (2007-08) this can be funded.	DoF
• Limited outreach to FFP sites MACH has supported in the past	May 2007	May 2007	Some further support to new sites is planned in 2007-08	ISM
• Identification of priority areas for possible expansion phase key wetland areas	December 2006	December 2006	List completed and recommendations made to DoF ICF section. DoF proposes to work to refine this in 2007-08	MACH Team (all partners)
• Support to DoF in development of proposals to implement ICF action plan (including designation of critical wetlands)	May 2007	February 2007 (program concept paper)	Programmatic approach for ICF drafted and provided to DoF	MACH Team (all partners)
<b>Reporting and Monitoring</b>				
• Annual Reports	December 2006	December 2006		Winrock and MACH Team (all partners)
• Completion Report including all monitoring results	June 2007	June 2007		Winrock and MACH Team (all partners)
• Steering Committee Meeting	May 2007	June 2007		

Description	Planned Completion Date	Actual Completion Date	Comments	Responsible Organization
• LGC/UFC Meetings	Quarterly	Ongoing and on schedule	Continuing into the future	BCAS/CNRS
• Assessment of training impacts on fishers and RUG members	December 2006	November 2006		Winrock
• Policy Briefing notes (7)	December 2006	March 2007		Winrock and MACH team
• Technical Reports (7) to be completed	March 2007	June 2007		Winrock and MACH team (all partners)
<b>Dissemination</b>				
• Dissemination of reports completed	May 2007	June 2007	Report preparation ongoing for limited remaining documents. All to be provided on website, DoF, USAID.	Winrock and MACH Team (all partners)

## **Annex 1: Summary List of MACH-I & MACH-II Reports**

## Summary List of MACH-I & MACH-II Reports

SL#	Title	Date
<b>A. Semi Annual, Annual &amp; Completion Reports</b>		
1	Semi annual report 1999	Sep'99
2	1st Annual report	Apr'00
3	2nd Annual Report	Feb'01
4	Semi Annual Report 2001	Aug'01
5	3rd Annual Report	Apr'02
6	Semi annual report 2002	Oct'02
7	4th Annual Report	Feb'03
8	Completion Report Vol-1 Main Document	Oct'03
9	Completion Report Vol-2 Appendices	Oct'03
10	Completion Report Vol-3 Fish Catch and Consumption	Oct'03
11	Completion Report Vol-4 Performance Monitoring	Oct'03
12	Completion Report Vol-5 Geospatial Data Portfolio	Oct'03
13	MACH-II Semiannual report	June'04
14	MACH-II 1st Annual report	Dec'04
15	MACH-II Semiannual report	June'05
16	MACH-II 2nd Annual report	Dec'05
17	MACH-II Semiannual report	Jun'06
18	MACH-II 3rd Annual report	Dec'06
19	Completion Report Vol :1 Mach Achievement	Jun'07
20	Completion Report Vol :2 Mach Performance Monitoring	Jun'07
21	Completion Report Vol :3 Mach Key Documents	Jun'07
22	Completion Report Vol :4 Mach Publications	Jun'07
<b>B. MACH-I Reports</b>		
1.	Special Information Database & Analysis System	Dec'98
2.	Interim Inception Report	Jan'99
3.	Overview of Baseline and Monitoring Programs	Apr'99
4.	Monitoring Protocols	May'99
5.	Fish Biodiversity of the Gopla River and Kamakali Khal system during the early monsoon period	Jul'99
6.	Report on RRA, Census & Socio Economic Baseline Survey	Feb'00
7.	Rapid Rural Appraisal for Malijhee Upper Kangsa River basin	June'00
8.	Baseline Report on Sherpur	Aug'00
9.	Development of Geospatial and Non-geospatial database	Jan'01
10.	Baseline Report on Fisheries, Vegetation, Wildlife & Household Fish Consumption	Feb'01
11.	Report on RRA	Feb'01
12.	Restoration of Vegetation and Sustainable Management of the wetlands and watersheds of Hail Haor and Turag Bangshi floodplain	Feb'01
13.	Feasibility Report on MACH Outreach Program	Feb'01
14.	Afforestation Program Implementation (Work plan)	Feb'01
15.	Final Feasibility study on re-establishing connectivity between Kushiya River and Hail Haor	Apr'01
16.	SocioEconomic Baseline report	Sep'01
17.	Draft Report on Hail Haor Watershed Management Plan	Nov'01
18.	Final report on MACH Kaliakoir Pollution Project	Dec'01
19.	Mid Term Review	Dec'01
20.	Conservation Easement – A Plausible Way Of Securing Land For Stream	Dec'01

SL#	Title	Date
	Riparian Corridor And Barren Upland Conservation Program	
21.	Activities Implementation, Monitoring and reporting of MACH-Caritas activities	Jan'02
22.	Hydrology Study Report	Feb'02
23.	Estimation of the importance of non fish aquatic wetland resource use by socio economic status (Hail Haor wetland)	Feb'02
24.	Hail Haor Wetland: Estimation of Economic Value	May'02
25.	The Utilization And Management Of Savings And Micro-Credit Fund Of Mach Project.	Oct'02
26.	Mainstreaming Gender in MACH Project	Aug'03
27.	MACH-II Technical Application of Winrock Partners. Ref No: 38:-03-004	Sep'03
<b>C. MACH-II Miscellaneous Report</b>		
1.	Gender Survey for RMO-RUGs Members and MACH Field Staff	Apr'04
2.	Summary Report on Status Assessment of 16 RMOs, MACH project (1st Report)	June'04
3.	Assessment Of Awareness Level Of Stakeholders Regarding Wetland Resources And Bio-Diversity Conservation	Aug'04
4.	Report of the Mid-Term Evaluation committee on ISMP	Jan'05
5.	Six Monthly assessment of Resource Management Organizations Dec'04-Jan'05	Jan'05
6.	Six Monthly assessment of Resource Management Organizations June-July'05	Aug'05
7.	Assessment of public awareness about wetland resources and bio-diversity conservation, MACH project	Sep'05
8.	Achievements and Learning on MACH Institutions and credit operations	Sept'05
9.	Federation of Resource User Groups (FRUG) assessment Report Aug-Sep'05	Oct'05
10.	Exit Strategy	Feb'06
11.	Baikka Beel Sanctuary Management Plan	Mar'06
12.	Six Monthly assessment of RMOs Jul'05 - Jan'06	Mar'06
13.	FRUG assessment 2nd report April-06	May'06
14.	Six Monthly assessment of RMOs Jan'06- July'06	Aug'06
15.	Synthesis of the Round Table Discussion on "Future Plans for Inland Capture Fisheries"	Sept'06
16.	Second assessment of public awareness about wetland resources and bio-diversity conservation, MACH project	Sept'06
17.	Evaluation of credit and income generating training programs, MACH project	Oct'06
18.	FRUG assessment 3rd report Nov-06	Dec'06
19.	Six Monthly assessment of RMOs Jul'06 - Dec'06	Jan'07
20.	Information Sheet for Ramsar Wetland, Hail Haor, Sreemangal, Moulvibazar	Feb'07
<b>D. MACH-II Technical Notes</b>		
1.	RMO guidelines	Feb'05
2.	Reforestation and maintenance guideline	June'05
3.	Credit management manual for FRUGs	Nov'05
4.	MACH case studies	Dec'05
5.	Nursery practice for swamp forest trees: Hijal, Koroch, Pitoli	Jan'06
6.	Communications strategy	Jan'06
7.	Benefits of contour cultivation of pineapple	Feb'06
<b>E. MACH-II Technical Reports</b>		
1.	TP1 Restoring wetlands through improved governance: community based co-management in Bangladesh	Jan'06
2.	TP2 Industrial pollution and its threat to Mokosh Beel wetland in Kaliakoir	Feb'06
3.	TP3 Wetland Protection and Enhancement through Sanctuaries in Bangladesh	Feb'06
4.	TP4 Extent and Duration of Inundation and its Relation with Fish Production in Hail Haor	Dec'06
5.	TP5 Lessons from piloting community based co-management of large wetlands	Apr'07



SL#	Title	Date
	in Bangladesh	
6.	TP6 Economic value of Bangladesh wetlands and their restoration	In Progress
7.	TP7 Changes in fish biodiversity, wetland restoration, and fish reintroduction	In Progress
8.	TP8 Trends in fish consumption and nutrition in community restored wetlands	In Progress
<b>E. Pollution Study Reports and Booklets*</b>		
1.	Choosing an Effluent Treatment Plant	Mar'05
2.	Alternative Production and Cost Savings in Winch-Dyeing	Mar'05
3.	AZO DYES	Sep'05
4.	Collaboration for Improved Environmental Governance: A Framework to Enable Compliance with National Environmental Quality Standards	Dec'05
5.	Human Health and Industrial Pollution in Bangladesh	Mar'06
6.	Health and Safety in the Textile Dyeing	Mar'06
7.	Environmental Clearance Certificate Process	Mar'06
8.	Management of Textile Dyeing Sludge	Mar'06
9.	Choosing Compatible Dye	Dec'06
10.	Industrial pollution and its threat to Mokosh Beel wetland in Kaliakoir	Jan'07
11.	Managing and Monitoring of Effluent Treatment Plant	In Press
12.	Choosing Reactive Dyes for Optimal Dyeing of cotton	In Press
13.	Manual for Biological Monitoring of Water Pollution	In Progress
14.	Environmental Clearance Certificate for Red category Industry	In Progress
15.	Conflict in areas of Industrial pollution	In Progress

\* These papers have been prepared through projects and activities co-funded by DFID, EU and USAID (MACH).

## **Annex 2: Extracts from the current Bangladesh Poverty Reduction Strategy Paper Relevant to MACH**

## **Extracts from the current Bangladesh Poverty Reduction Strategy Paper Relevant to MACH**

**Pg 91**

### **5.C.1.2 Fisheries**

5.121 The country has experienced significant growth in the fisheries sub-sector. Although fish production from rivers and estuaries has declined, overall fish production has grown at 6-8 percent over the 90s, but it has slowed down since 2000/01. The main spurt came from the rapid growth in aquaculture: pond fishery and shrimp culture. More recently, floodplain fisheries have emerged as a highly potential area with particular significance for poverty reduction goals. The sub-sector contributes over 5 percent to GDP and export earnings and employs about 10 percent of the total labor force. The increased production is reflected in a growth in the share of fishery in the aggregate value of agricultural production. This is also reflected in a modest increase in per capita fish consumption during the nineties. As fish is income elastic, the aggregate demand will continue to rise with a rise in income. A comprehensive effort to increase fish production can thus draw upon this certainty of an expanding domestic market alongside export opportunities.

5.122 For accelerating fish production, the inadequate supply of quality fish seed is the primary constraint. Fish inbreeding has taken and is taking a very serious toll on inland fish production. The fish industry needs to follow the lead of poultry industry and develop a superior genetic hub consisting of parent stock breeding programs and hatcheries to supply increasing demand for fish fingerlings.

5.123 Inland open water capture fisheries have declined substantially and losses in output from this source have adversely affected the poor who used to earn a livelihood from subsistence fishing in the floodplain. Traditional livelihood opportunities of the poor in the shrimp sector have been adversely affected. However, the rapid growth in inland culture fishery at about 14 percent per annum has largely offset the loss in capture fishery. The issue of employment and livelihood opportunities in backward and forward linkage activities - fingerling production, fish catching, processing, marketing etc - has also gained prominence. Especially, home-based pond aquaculture involves women and children. The recent innovation of poly-culture in rice fields has opened up further opportunities for small and marginal farmers to exploit whatever little land they have in growing fish in rice plots concurrently and alternately. However, the sector suffers from shortage of quality fish seeds for which brood fish stock, hatchery and nursery management has to be addressed seriously.

5.124 The Government is committed to accelerate fisheries sector growth. The overall strategy of fishery sector development will envisage intensification of aquaculture by species and ecosystems, addition of export-oriented species, ensuring bio-diversity and preserving natural breeding grounds, product diversification and value addition, and development of appropriate marketing infrastructure. The capacity of the Department of Fishery (DoF) will be redefined and strengthened so that it can consolidate and continue to support inland aquaculture through intensification of culture fisheries with improved knowledge of fish culture, brood fish stock, quality fingerlings and feeds. The underlying strategy will be to promote a dynamic rural aquaculture, involving the key actors among NGOs, private sector entrepreneurs and community-based fishing groups, i.e. fish farmers, hatchery and nursery operators, fingerlings vendors, feed manufacturers and fish processors. DoF will preserve, patronize and make more productive use of inland capture fishery through community based participation of fishermen and fishery related stakeholders. Fisheries research will be upgraded to continue flow of technology generation. Various policies of other ministries impinge upon the fishery sector development because these

policies regulate the availability of, access to and use pattern of the open water bodies. These will be coordinated and a necessary legal framework will be formulated. Specific programs will be undertaken to maintain water bodies and make them available for improved aquaculture. Development of water bodies should be planned by BWDB and LGED in coordination with DOF and DLS. The strategic plan for the implementation of the National Fisheries Policy will be finalized so as to increase productivity of scarce fishery resources and also to ensure access of the poor and community groups to water bodies. The plan of action will address development of inland and coastal fishery management, education, research and extension services, organizational as well as commercial policies (i.e. marketing, processing, quality control, export and transportation). Especially quality assurance in fish harvesting and processing will be emphasized.

5.125 The leasing policy of jalmahals will seek to optimize equity and productivity concerns. Three points merit priority consideration: firstly, the importance of appropriate long-term leases, secondly, the importance of viable production plans against which jalmahal lease rights are to be granted, and thirdly, ensuring adequate opportunities for poor fishermen and community groups to be participant in the process. These steps will not only increase access of the poor to open water resources for fish culture but also increase productivity of inland capture fishery. For all of the above to work effectively, it is also important to consider the vesting of jalmahal ownership in DOF rather than the Land Ministry. In the event of the last, DOF will have to find effective and innovative solutions to the problem of an adequate field presence to deal with the expanded supervisory load.

5.126 Human resource development will be given priority by the Department of Fisheries, while skill development with respect to fish production, processing and marketing at the local level will be accomplished through public sector agencies, NGOs and private sector. Revamping the research infrastructure to support the needs of a dynamic and expanding sector will be given priority.

Pg 178:

5.489 **Biodiversity:** Biodiversity is an asset for a nation. However, population pressure, conversion of forestland and wetland into agricultural land, overexploitation of forest products and excessive withdrawal of water, relentless wetland depletion due to overexploitation of both flora and fauna are causing great harm to our biodiversity. Agro-diversity has been reduced and this limits potential of further growth and development in this sector. At the same time, a large section of terrestrial diversity of plants and animals is being threatened due to deforestation and conversion of forestland. Similarly, aquatic diversity is also under pressure due to the drying up of rivers, reduction of flow of water in major rivers, and accumulation of pesticide residues in lake waters.

5.490 There are 16 protected areas (PAs) in the country. In addition, the Government has declared the Sundarbans, Cox's Bazar, Teknaf Sea Beach, St. Martin's Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marjat Baor, Gulshan, Banani and Baridhara Lake as ecologically critical areas (ECAs) in Bangladesh. In terms of poverty, people living on the resources in these areas are generally poor. Consequently, reduction of opportunities to access resources from these ECAs and sanctuaries will result in conflicts and social unrest. Policies need to be adopted for community-based participatory management (where poor are included) to reduce and/or rationalize their dependence on such resources to ensure their sustainable management and poverty reduction.

5.491 To achieve biodiversity the participation of the poor at the community level is essential particularly given the fact they will be benefiting from conserving biodiversity. Improvement of biodiversity will benefit the poor particularly in terms of fisheries given that a large number of people depend on this activity both as an income generating activity and also as a source of protein. Thus it is essential to protect key-open water fisheries and other habitats.

5.492 **Public Commons:** Public commons includes natural resources such as land, open water resources in wetlands, forests, grasslands, grazing land, reed land, khas land, peat land, rivers, estuaries and the open seas with the characteristic that people in general have customary rights and access to them. These are sources of livelihood for the poor including the hardcore poor. They collect firewood, fodder and construction materials, fruits and vegetables for daily consumption from, graze animals upon, and catch fish in these resources. The dependence on common resources is very high: some 80 percent of the population depends, to some extent, on the utilization of these resources or on processing the resultant products. Thus public commons may be one of the most important safety net available to the poor particularly in the rural areas, provided these are managed in a sustainable manner.

5.493 Increasing access to natural resources for rural poor is an essential element of the process of reducing poverty in the rural areas. Rents from public commons, if captured by the poor, can help them initiate a process of capital accumulation that can help to pull them out of poverty and integrate them into the mainstream economy. However in most cases the poor have been excluded from access to the common property resources. They have access to at most low quality public commons. Thus the resource base for poverty reduction of the poor are either shrinking or degrading. This frequently leads to two kinds of problems. One is overexploitation of the resources to the point of total depletion while the other is the capture and management of quality resources by the Government and/or the local elites with the exclusion of the poor.

Strategic Goal	Key Targets	Actions taken/Under way	PRSP Policy Agenda (FY05-07)	Future Priorities	Responsibilities
(1)	(2)	(3)	(4)	(5)	(6)
<b>Policy Matrix 1: Agricultural Growth towards Poverty Reduction</b>					
19. Increasing productivity in inland capture fishery	<ul style="list-style-type: none"> <li>• Increase fish output from semi-closed and closed water bodies</li> <li>• Reclaim and improve fish habitats and sanctuaries</li> </ul>	<ul style="list-style-type: none"> <li>• National fishery policy is formulated</li> <li>• The strategic plan for implementation of the policy is under finalization</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidate experience and formulate regulatory framework</li> <li>• Continue hand over of water bodies</li> <li>• Promote MACH type interventions</li> </ul>	<ul style="list-style-type: none"> <li>• Enact laws and institute regulatory framework with clearly assigned responsibility. -Reform mandate of BFRI for new type of research</li> <li>• Involve genuine fishers and other stakeholders through community-based approach</li> </ul>	MoFL, MoL, MoYS, MoWR, MoLJPA, MoEF, BFRI, DoF
20. Raising income of the poor fishers	<ul style="list-style-type: none"> <li>• Increase income from cage, pen, seed and fry production</li> </ul>	<ul style="list-style-type: none"> <li>• Training programs on cage and pen culture, seed and fry production are ongoing</li> </ul>	<ul style="list-style-type: none"> <li>• Continue developing low cost and improved fish processing, packaging and transportation systems</li> </ul>	<ul style="list-style-type: none"> <li>• Develop and disseminate low cost improved packaging and transportation systems</li> <li>• Reduce spoilage through improvement of marketing</li> </ul>	BFRI, DOF, fish traders, CBOs, NGOs
21. Promoting rice cum fish culture	<ul style="list-style-type: none"> <li>• Introduce fish production in rice land concurrently and alternately</li> </ul>	<ul style="list-style-type: none"> <li>• This strategy is emphasized in the existing fishery research and extension policy</li> </ul>	<ul style="list-style-type: none"> <li>• This strategy is to be popularized</li> <li>• Rice cum fish culture is to be emphasized in fishery curricula and mainstream training programs</li> </ul>	<ul style="list-style-type: none"> <li>• Increase fish production without permanently converting rice land to fish ponds</li> <li>• Encourage and train resource poor farmers to practice fish culture in rice plots</li> </ul>	DAE, DoF, NGOs, private sector
22. Strengthening fisheries research and extension	<ul style="list-style-type: none"> <li>• Accelerate fish production</li> </ul>	<ul style="list-style-type: none"> <li>• Research outfits exist in BFRI, BAU and other universities</li> </ul>	<ul style="list-style-type: none"> <li>• Further financial support is to be provided for fisheries research</li> </ul>	<ul style="list-style-type: none"> <li>• Target promotion of rural aquaculture as pro-poor growth strategy</li> </ul>	MoFL, MoWR, BFRI, Universities, NGOs, Private Sector
<b>Policy Matrix 2: Water Resources Development &amp; Management</b>					
6. Protect wetland/ Sundarban, saline water intrusion and promote accretion of land from the sea	<ul style="list-style-type: none"> <li>• Environmental protection, habitation for the poor people on the raised platforms and in the char areas</li> </ul>	Actions taken <ul style="list-style-type: none"> <li>• Char development and Settlement Project (CDSP), Sundarban Bio-Diversity Project, Haor Development and wetland Development Board</li> <li>Actions underway               <ul style="list-style-type: none"> <li>• Hatia-Nijhum Dip cross dam</li> <li>• Preparation of Master plan for integrated Haors and Wetlands</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Undertake co-ordinated efforts to make the accreted land habitable and suitable for crop production</li> <li>• Implement Integrated Coastal Zone Management Plan (ICZMP)</li> </ul>	<ul style="list-style-type: none"> <li>• Action to be taken to reclaim land from the seashore as well as in the coastal area, through construction of cross dam and other structural measures</li> </ul>	MoWR (BWDB, WARPO), MoL, MoA (DAE.)
<b>Policy Matrix 3: Environment and Sustainable Development</b>					



Strategic Goal	Key Targets	Actions taken/Under way	PRSP Policy Agenda (FY05-07)	Future Priorities	Responsibilities
(1)	(2)	(3)	(4)	(5)	(6)
1. Ensure Sustainable livelihood of the poor 2. Integrate environmental issues in all policies and plans 3. Strengthen the process of environmental analysis in project design and implementation	<ul style="list-style-type: none"> <li>Participatory forestry has been introduced to allow increased access of the poor in the forestry sector</li> </ul>	<ul style="list-style-type: none"> <li>Enact laws and introduce regulatory frameworks recognizing the rights of indigenous and rural people on common property</li> </ul>		FD, MoEF, MoLJPA, DOE	MoL, MoWR, LGD, MoEF, MoLJPA, MoCHT, MoE, REB, LGED, CBOs, NGOs
	<ul style="list-style-type: none"> <li>Improve access of the poor to natural resources for production, health and nutrition</li> <li>Increased access of the poor to Common Property Resources (CPR) through policy and project intervention</li> </ul>	<ul style="list-style-type: none"> <li>NEMAP raised issues related to Common Property Resources</li> <li>WSSD Country Report addressed sustainable livelihood issues</li> <li>Under SEMP, pilot projects have been undertaken to ensure sustainable livelihood of the poor (Model developed for combating Monga at Kurigram district. Trying to replicate)</li> <li>Important projects are on participatory charland management, haor and flood plain management, eco-village etc. (Pilot projects implemented. Trying for arranging fund to expand the activities)</li> </ul>	<ul style="list-style-type: none"> <li>Replicate success stories of participatory forestry in other parts of the country</li> </ul>		MoEF, FD
	<ul style="list-style-type: none"> <li>Ensure access of the poor in NRM-especially in forestry</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>		

## **Annex 3: Trends in Fish Catch**

## Trends in Fish Catch

### Overview

There was no previous historical data set of sufficient quality and temporal magnitude to track trends in fish production in the MACH Project sites. It is therefore very difficult to accurately measure open water fish production impacts against a backdrop of non-existent historical trend data. The project having a short lifetime could not develop sufficient background trend data to understand the natural variations and complexities of the existing fishery fully. The catch data taken by the project is regarded as very reliable (in itself) but the variables that determine the catch naturally vary every year. The periodicity of and area of water coverage (extent) for example vary from year to year. These hydrologic and climatological changes cause variation in the catch normally. It is these “normal” fluctuations for which historical trend data is insufficient in Bangladesh. For the specific MACH sites there is also no historical record of area and extent of inundation from year to year. Therefore the results shown by the project data may not all be attributable to USAID’s assistance. The project has attempted to use the 6-7 years of data that has been gathered to try to understand the gross trend in production for each of the areas taking into account the hydrology recorded by the project. One significant trend has been noted though through MACH I and MACH II. This has been that the catch/yield at all sites has been trending upwards and the evidence for this has been further strengthened by the fact that fish consumption around the sites has also increased.

One possible solution to understanding the background trend that the project looked at was to use another basin (other than the ones MACH works in) as a control. For this approach to be viable the other basin must be similar in nature to the one to be tested. The project looked for possible controls but was unable to find ones that did not have significantly different conditions. There were so many differences that the controls were unworkable and would have been misleading.

With the high degree of hydrological variability in the floodplain, this indicator should be used to look at gross trends only. The actual catch data has been in the ranges that would be expected and the differences found between sites in the Catch per Unit of Area seem very plausible. In general regional averages for yields per hectare in high quality active floodplains are in the range of 300 to 400 kg/ha. The Turag-Bangshi site being a highly degraded system had a low catch (58 kg/ha during the baseline year) and increased to 105-140 kg/ha in the first three project impact years. Yet yield in the Turag Bangshi site in the last three project years has averaged about 290 kg/ha which is comparable to the other sites even though it has the least dry season water followed by the Kangsha-Malijee site. Hail Haor has the greatest dry season water area of the three sites and had the highest baseline yield. However, the baseline yields of all three sites were well below that expected in reasonably healthy connected floodplains of the region.

The project throughout its life monitored catches intensively every 10 days. The yields have been evaluated and are discussed briefly below. As one can see from the data contained in the attached tables the fisheries of the three areas had declined and production was far reduced from what should have existed in a healthy floodplain. Just maintaining yields over the past five years from the baseline figures would have been an achievement. As can be seen in the following tables, with improved management including dry season sanctuary establishment, habitat restoration, and the adoption of sustainable fishing norms by the RMOs, MACH has seen not only maintenance of the baseline yields but substantial increases which appear to be maintainable. In TB site yields in 2003-06 were five times the baseline, while in KM site yields in 2002-06 were double the yields of the initial two years, and in Hail Haor yields in 2004-06 were 88% higher than in the baseline. This is data is the product of recording many hundreds of actual fishing events over the past seven years in all types of habitat and with all types of gears. MACH also has anecdotal evidence from the many interviews which have reflected the patterns seen in the data.

### *The monitoring methodology for fish catch*

The baseline data collection year in Hail Haor was from April 1999 through March 2000, in Turag-Bangshi it was May 1999 through April 2000, and in Kangsha-Malijhee (Sherpur) site it was August

2000 to July 2001. Thereafter impact monitoring continued in all three sites. The following methodology and analysis procedure were followed.

### **Habitat Stratification**

Biological productivity is a function of the ecological condition of the habitat, which is governed by the landscape, and hydrological regime of the area. The spatial and temporal variation in the project area is high, as it is over most of the floodplains of Bangladesh. Fishing method and gear techniques vary considerably by different habitat locations. In order to portray a fish catch that represents the project area, the habitats were stratified into rivers, canals, beels, and floodplains. The selection criteria also included the geographical distribution over the project site, water flow, inundation regime and biological zones of the area. Baseline conditions are used to measure parameter changes after appropriate interventions and implementation of fisheries management. The aim was to capture changes that were expected to be both local (in a specific habitat) and global (throughout the project site). Accordingly a number of locations and habitats were selected and have been monitored in the same way ever since.

### **Monitoring Site Selection**

The monitoring sites (Table 1) selected during the baseline study (following the wetland inventory and resource mapping exercise conducted by MACH) have continued to be monitored for the impact assessment. The same criterion as in the baseline has been followed. The sites monitored were not selected to focus on locations where impacts from management improvements introduced through MACH might be concentrated, but to represent the whole of the wetland system – for example in Hail Haor some of the areas monitored are in areas that have continued to be controlled by traditional leaseholders and are not directly managed by RMOs, but would be expected to be impacted to the extent that the whole haor is benefited by changes in management in a substantial part of it.

### **Sampling Protocol**

Floodplain fisheries, with their spatial and temporal variations in fish and water abundance, are as complex and dynamic as the fishing practices. The type of fishing gear used affects a fisher's catch within a specific habitat. A sample unit was considered to be one set of gear used for a catch attempt. The effectiveness of the fishers and their motivations are also significant in setting parameters for recording sample units. The selection of sample fishing units while recording catch data is crucial and it requires the judgment of the fisheries biologist. Accordingly, attempts have been made to be consistent so that the most reliable estimates can be made from the collected data.

To offset any bias from the spatial distribution of fishing gear used, the field biologist collected data from different locations at the monitoring locations. For each gear type at least three fishing units were monitored. If there were more than 30 fishing units of one particular gear type operating in a day data was collected from not less than 10 percent of the operating fishing units. Irrespective of catch data from individual fishing, gear use by all types of fishing units in operation were counted during the catch monitoring day. This is the effort for that day. At the end of the day a list of fishing units by gear type was prepared. In order to accommodate for possible temporal variations in a single month the sampling intensity was set at a 10 days interval and accordingly data was collected three times a month from the selected locations. Gear of the same type with differing dimensions were standardized for some purposes in the analysis to 100 feet (30.8 m) (see MACH Baseline report on fisheries, vegetation, wildlife and protein consumption).

### **Monitoring Parameters**

Fish catch assessment monitoring collects data on fishing intensity, species diversity, catch composition, fishers by category and fishing gear through a questionnaire. The data gathered on these parameters acts as a benchmark during the baseline and was then used to measure impacts. The terminology is defined as follows:

**Fish catch:**

- species by number and weight

**Fishing gear and fishers:**

- fishing gear type and number, net area and mesh size
- fishers type, sex, age, village and distance from fishing ground

**Time and duration of fishing:**

- fishing starting and ending times
- probable fishing duration

**Fishing rights:**

- the fisher's access to the fishing ground

**Data Analysis**

The fish catch can vary spatially, temporally, and on the basis of the ecological condition of the habitat. In order to incorporate these variations and to monitor parameters the collected data has been analyzed on the basis of the monitoring locations, monitoring habitats, types of gear, types of fishers and seasonal variation. Fishing intensity, duration of fishing, total catch, catch by species, and the number of species with their abundance have been analyzed. Catch per Unit of Effort (CPUE) has been analyzed along with above mentioned parameters and has been used to determine the Catch per Unit Area (CPUA) which has been considered as the indicator of fish yield. Formulas and definitions are provided below.

**Seasonal variation:** For the study the year was divided into four seasons. These are Pre-Monsoon (April-June), Monsoon (July-September), Post-Monsoon (October-December) and Dry (January-March).

**Fishing gear:** The types of fishing gear found in operation during monitoring were recorded with their dimensions. For current *jal* (nylon monofilament gill nets) and *ber jal* (seine nets) gear units of the same type but with differing dimensions were standardized to 100 feet (30.8 m) for use in some of the analysis for Catch per Unit of Effort (CPUE). An alternative standardization was also used - catch per person day - since this can be used to compare across fishing gear types.

**Fishing intensity and duration of fishing:** Fishing intensity describes the amount of gear used during the monitored day. This has been calculated from an average of three sampling days per month. Gear numbers of all types were counted and then extrapolated for that month. Fishing duration was recorded for all the operated gear and the average duration of fishing was calculated for each specific gear type.

**Catch per Unit of Effort (CPUE):** The average catch in kilograms (kg) per unit of gear per hour of operation, or alternatively the average catch in kg per fisher per day of fishing.

**Special considerations**

In this report there is some deviation between data already reported in earlier reports and the impacts shown in this report. This report is the final analysis of the data and incorporates:

**Table 1: Monitoring locations, habitats and areas**

Monitoring locations	Monitoring area (ha)	Habitat
<i>Hail Haor Site</i>		
Jethua Beel	67.95	Beel, canal, floodplain
Gopla River	41.23	River
Boulashir floodplain	234.38	Floodplain
Cheruadubi Beel	30.40	Beel
62-Beel Complex	419.48	Beel, floodplain
Rustompur Beel Complex	221.73	Beel, canal, floodplain
Balla Beel	159.09	Beel, floodplain
<b>Total</b>	<b>1174.26</b>	
<i>Turag Bangshi Site</i>		
Mokash Beel South	100	Beel
Mokash Beel North	100	Floodplain
Kalidaha Beel	50	Beel
Mokash Khal	0.70	Canal
Turag River	14	River
Aowla Khal	1.02	Canal
Aowla Beel	100	Beel
Bangshi River	17	River
<b>Total</b>	<b>382.72</b>	
<i>KM site</i>		
Baila Beel	44.10	Beel, floodplain
Takimari Beel	34.75	Beel, floodplain
Kewta Beel	33.07	Beel
Nijla Beel	63.92	Beel, floodplain
Bagadubi Khal	4.20	Khal
Malijhi River (Baharalia kur)	5.00	River
Aowra Bowra Beel*	69.33	Beel
Bailasha Beel	13.35	Beel, floodplain
<b>Total</b>	<b>267.72</b>	

\* Not under an RMO, treated as a control and excluded from main analysis

1. A comparative analysis of baseline versus impact years using the common monitoring locations.
2. An estimation made based on the area fixed at the baseline period.
3. Output tables/data were further reviewed at the site and as well as at the RMO level. Outputs were finalized after considering the feedback from the sites.

### **MIS unit**

The MIS unit analyses data and monitors fish production, bio-diversity, fish and other protein consumption and hydrology. The MIS unit provides monthly output tables for management and RMOs.

### **Fish catch and effort trends**

The indicator reported above is assumed to represent a sustainable restoration of wetland productivity in the form of fish catches standardized per unit area of wetland (using the maximum normal annual extent of connected inundation in a site). Either a continually rising trend or a shift in catch that is then sustained during the project is expected to confirm this. Unfortunately confidence intervals on catch per ha estimates cannot be calculated since the number of sampling spots is limited. Water level and other environmental factors also influence catches, for example impact year 5 in HH and TB included the 2004 monsoon which was a higher than average flood year. However, it is also important to understand the changes in fishing effort and how these interact with catch estimates. The project aimed to reduce fishing pressure, on the other hand when a fishery is restored more people may be attracted to fishing since more fish are available. Provided the CPUE and CUPA have increased it is likely that the fishery is both sustainable and more productive, even if effort has also increased.

The trends in total fishing effort have differed between the three sites, as represented in the monitoring data, probably in response to the availability of fish (Fig. 1). Thus in Hail Haor effort was declining, possibly in response to the livelihood program and fishing norms from the baseline up to 2003-04, with apparently some success in reducing current net use. In 2004-05 effort returned to the baseline level but the catch per unit effort that year was significantly higher than the baseline in this year of high water levels (as it had been in 2002-03)<sup>3</sup>. This means that effort increased in response to the increased population of fish due to high water levels. In 2005-06 effort fell back and was almost identical to 2003-04, hence overall in this site there appears to be some success in limiting fishing effort to sustainable levels.

---

<sup>3</sup> CPUE as shown in the figures and significance tests here differs from the overall CPUE quoted elsewhere which are based on total sample catch divided by total sample effort. Here, in order to test for significant differences, each fishing unit is treated as an equivalent sample unit and is not weighted by its total catch.



In Turag Bangshi fishing effort in the monitored locations increased in each year after the baseline up to 2004-05. This might be thought a cause for concern, but this was a heavily degraded fishery up to the baseline, catch per unit effort has increased significantly in the same period (although the CPUE is much lower and the effort level much higher than in Hail Haor). Moreover, the greatest increase in effort was in 2004-05, again when water levels were high and CPUE reached its peak (Fig 3). In 2005-06 effort fell to just over the 2000-01 level, but a relatively high proportion of effort was through current nets in 2004-05, this is some cause for concern as the RMOs were supposed to encourage fishers to stop using this gear type.

There is no clear trend in Kangsha-Malijee site regarding effort yet. Even though catches (CPUA) have increased – effort increased up to 2002-03, and then fell in each year to 2005-06. Moreover there have not been significant changes in CPUE in aggregate in this site – although CPUE was higher in impact years 2, 3 and 4, it did not differ significantly from the baseline, and in impact year 5 (2005-06) returned to the baseline level. This contrasts

with the other sites – in Turag-Bangshi CPUE remained at a higher level in the last three impact years, and although it fluctuates in Hail Haor in the last two impact years it remained significantly higher than in the baseline.

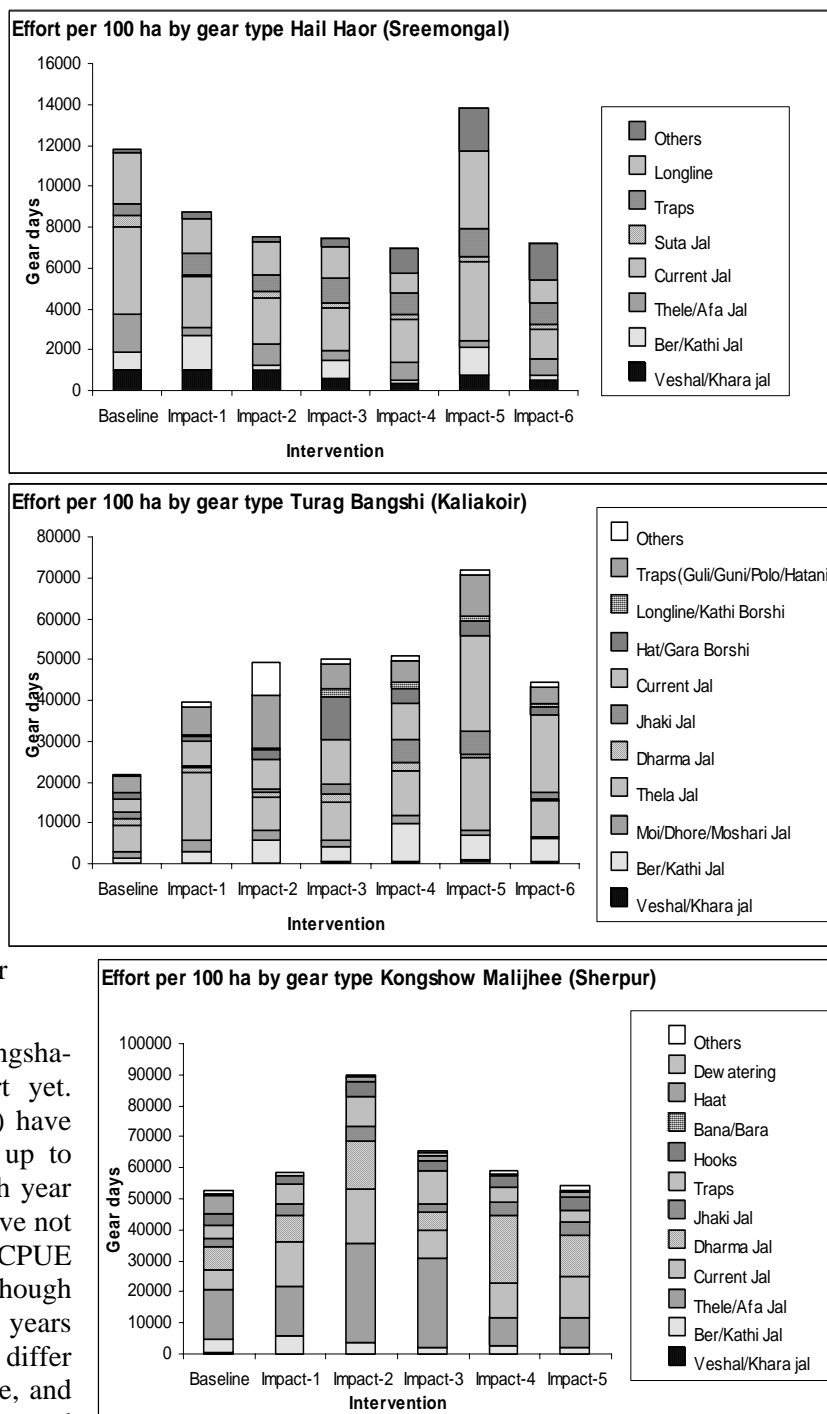
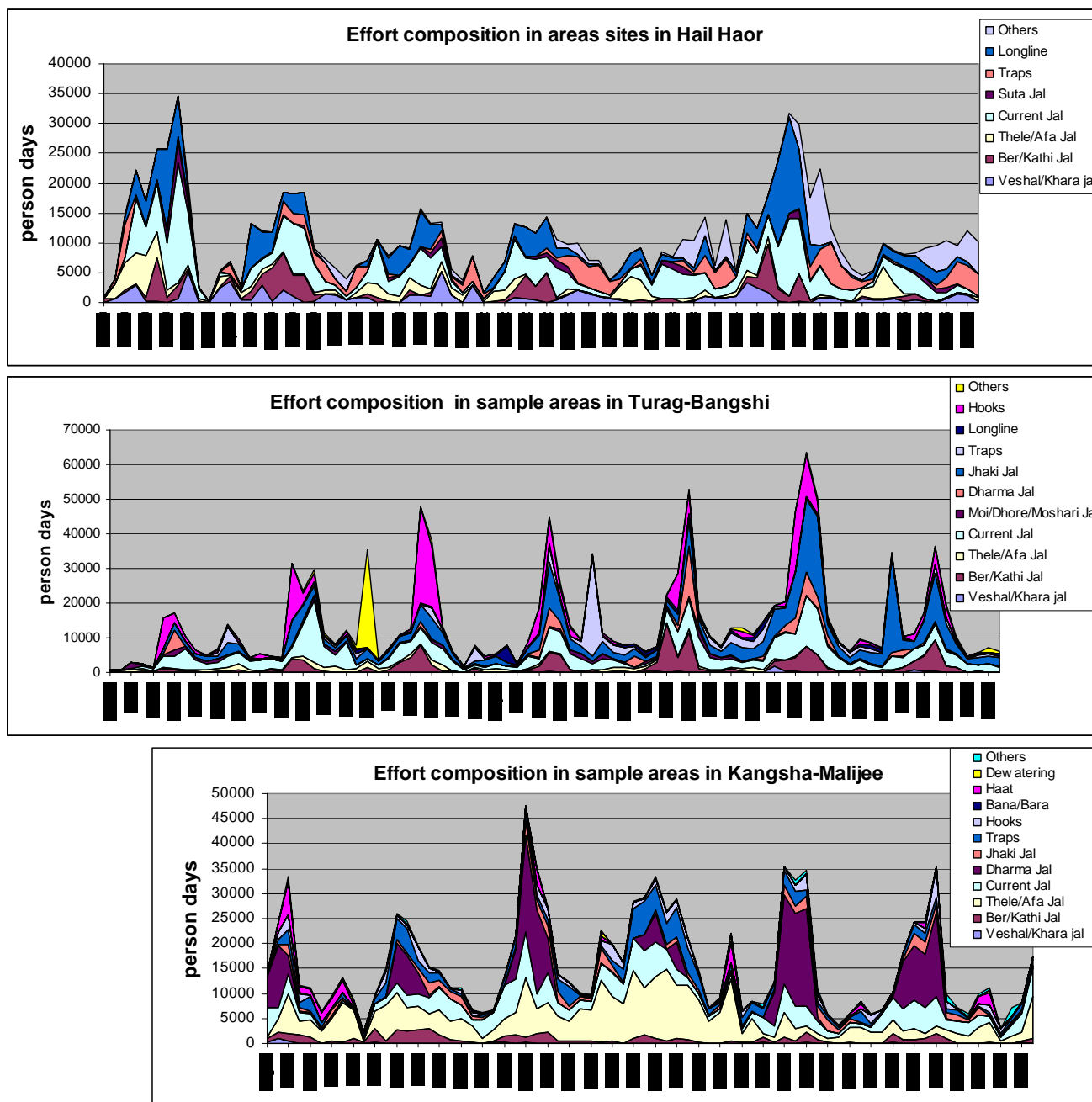
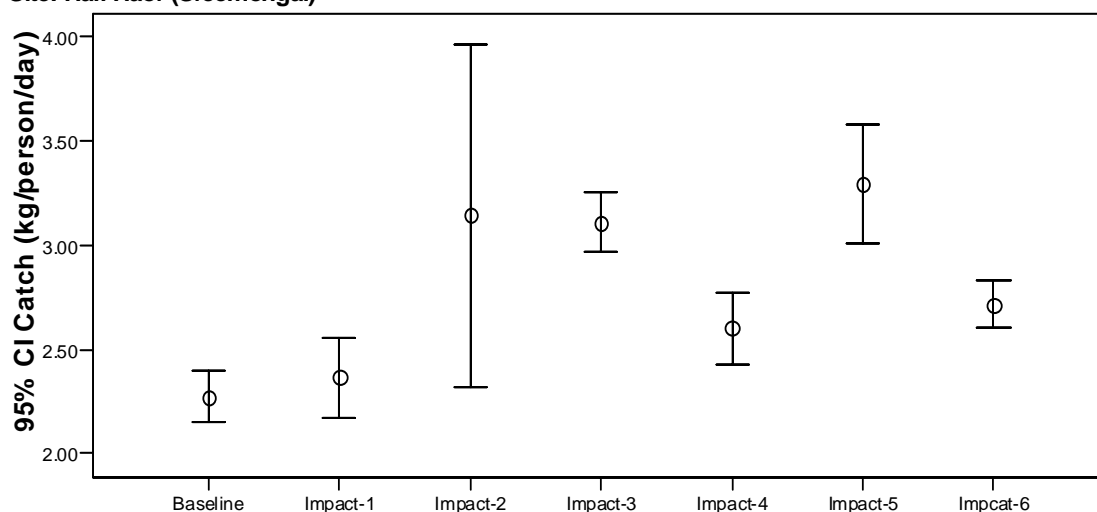
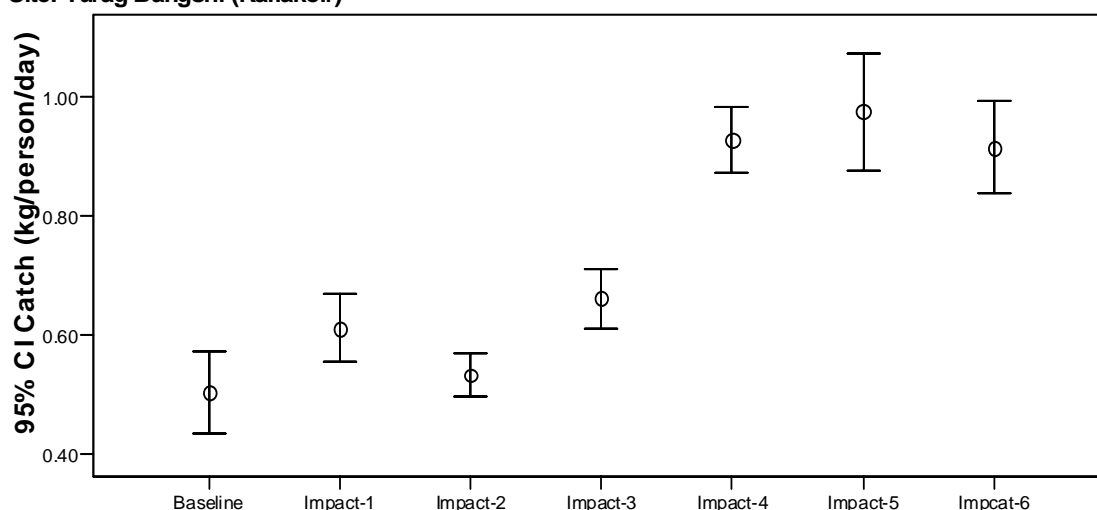
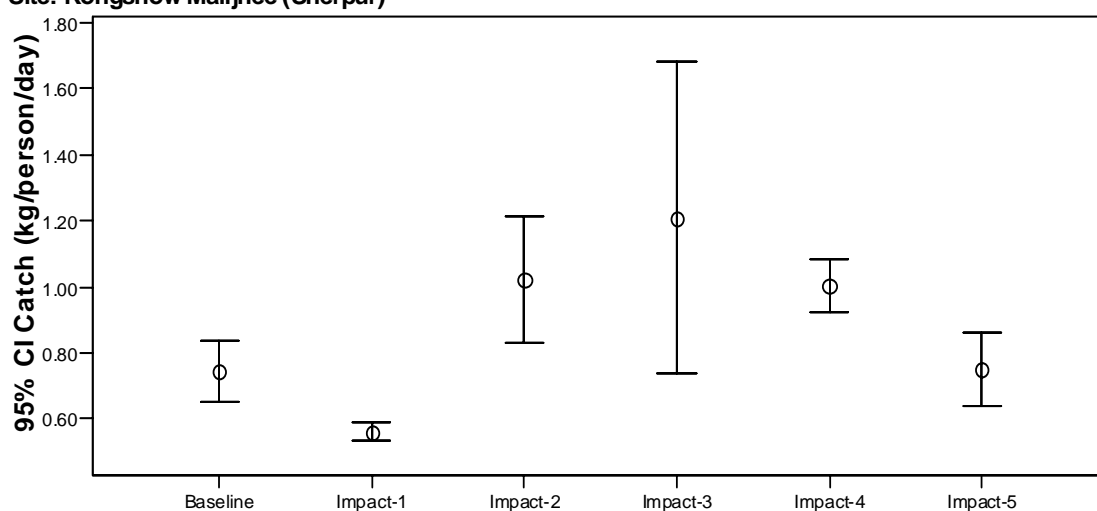


Fig. 1 Fishing effort by site



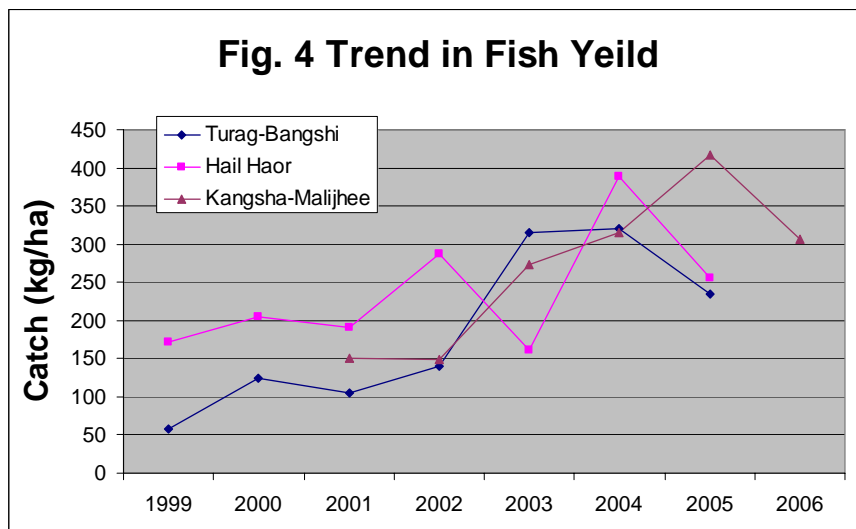
**Fig. 2 Seasonal pattern of fishing effort by gear type in MACH fishing monitoring sample areas**

Fishing effort shows a strong seasonality generally peaking in the late monsoon and post monsoon periods (Fig. 2). However, in Hail Haor there is a relatively high level of fishing effort throughout the year, with current nets and long lines used in the monsoon and traps increasingly used in the post-monsoon to winter period. Fishing peaks are more pronounced in Turag-Bangshi site coinciding with the draw down of water from seasonally flooded areas, but secondary peaks of fishing in the dry season or pre-monsoon are likely to coincide with catching of fish moving into the area to breed with the rising water, or of fish trapped in depressions which are pumped out and for example caught by hand.

**Fig. 3 Catch Per Unit Effort (kg/person/day) by site 1999-2006****Site: Hail Haor (Sreemongal)****Site: Turag Bangshi (Kaliakoir)****Site: Kongshow Mali jhee (Sherpur)**

Since on average catch per person day has risen, the increases in catch per hectare that were found from the surveys are believed to reflect a healthier and more productive wetland system, and should

be sustainable. Fluctuations in catch per hectare are associated with environmental variability. In Fig. 4 the difference in actual dates of the “impact years” of monitoring between the sites mean that the highest peaks for all three sites coincide with production associated with high water levels in 2004. Variations are associated with lower water levels, with high growth of aquatic plants such as water hyacinth which make fishing difficult, and in Turag-Bangshi possibly from water pollution, although a longer series of data would be needed there to determine if that is the case.



To understand better the fishing trends in these complex systems requires analysis by gear type. For example, in the Kangsha-Malijee site out of the main gears used the CPUE has increased significantly (t-tests  $p < 0.05$  comparing impact years 3-5 (2003-04 to 2005-06) with the first two years (2000-01 and 2001-02) for ber jal (seine nets), jhaki jal (cast nets), thela jal (push nets), hooks and traps, but did not change significantly for current jal and dharma jal (small lift/dip nets). Similarly in Hail Haor the CPUE for gears operated by individual poorer people – push nets and long lines – has been significantly higher in most of the impact years compared with the baseline. In Turag-Bangshi site there is a less clear cut pattern in the CPUE trend for separate gear types than for all fishing as a whole, but CPUE for cast nets has increased significantly. The supporting tables include data on the mean CPUE (kg/person day) for the main gears in each site along with statistical tests for significant differences between years.

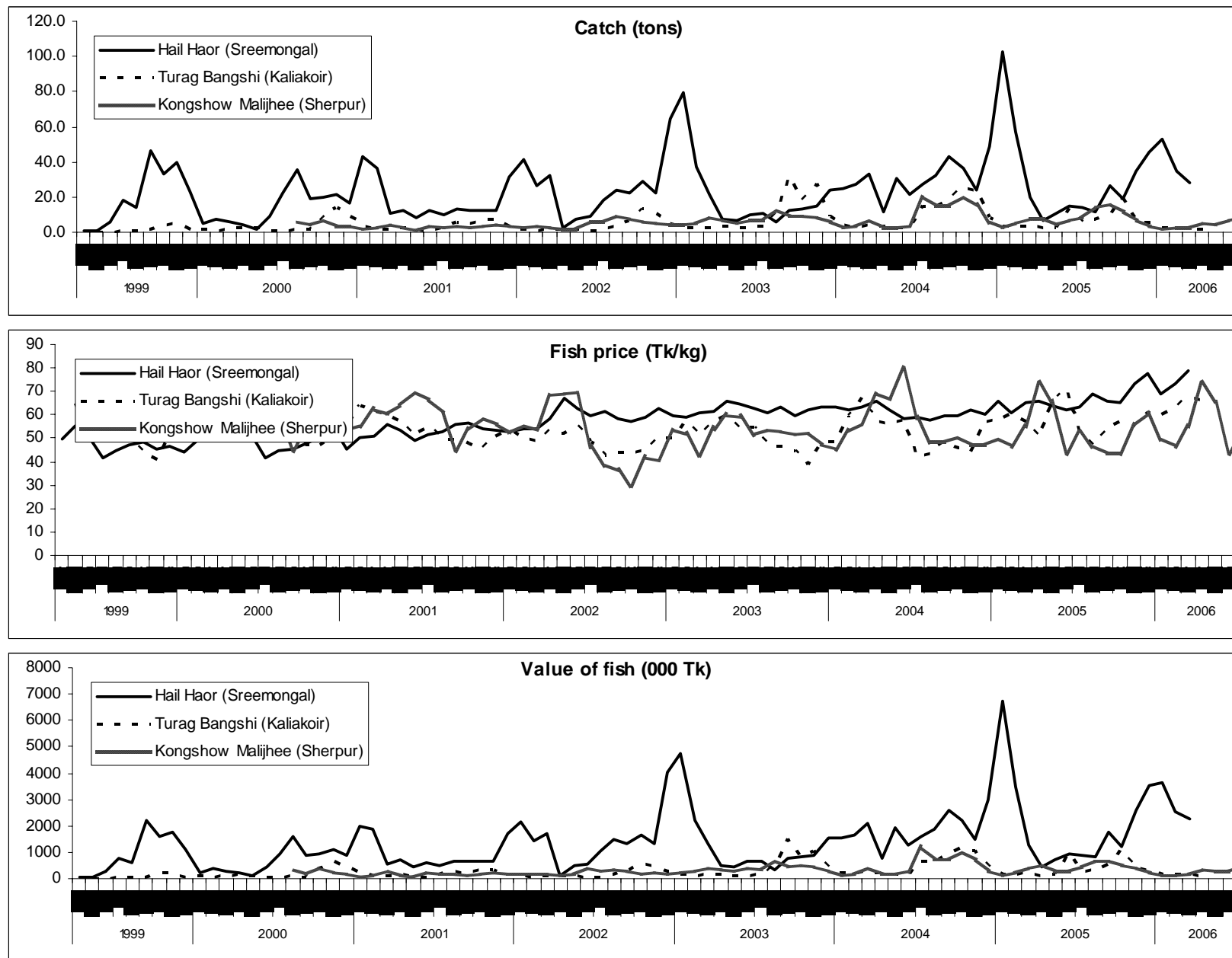
However, even this is not the whole story since the gear characteristics for each type can also change over time, and the RMOs through project support have tried to influence fishers to end use of fine mesh nets (the supporting tables detail the characteristics of the gears sampled each year during the surveys). In Hail Haor large lift nets (veshal jal) appear to have become larger and have significantly smaller mesh size in later years compared with the baseline, and time operated per day for several gear types has fallen. In Turag-Bangshi there were few notable changes in gears although seine nets have become larger. In Kangsha-Malijee site seine nets have increased in length (not significant) over the six years and their mesh size increased significantly (from under 2 mm to about 5 mm) although it is still smaller than in Hail Haor. In the case of current jal both length and mesh size increased significantly (mesh size more than doubling from 17 to 40 mm), and for thela jal (push nets) mesh size has increased significantly (from under 2 mm to over 7 mm, see supporting tables).

Table 2 gives a breakdown of changes in CPUE (kg/ha) for each of the monitoring locations, revealing the differences between habitat types and the existence of “hot-spots” for fishing such as khals where fish are concentrated after the monsoon. However, for these smaller areas there is a lack of obvious links between presence of sanctuaries or RMOs and greater increases in productivity and fish catches. The impacts of improved management have been at the wetland scale rather than restricted to particular RMOs or water bodies within each site.

**Table 2 Summary of CUPA (kg/ha) by monitoring locations**

Site/location	Area (ha)	Management status	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
<b>Hail Haor (Sreemongal)</b>			<b>171.1</b>	<b>205.0</b>	<b>190.8</b>	<b>287.3</b>	<b>161.8</b>	<b>388.6</b>	<b>256.0</b>
Jhethua Beel	67.95	RMO, includes 0.21 ha sanctuary	121.6	190.6	160.1	154.9	102.5	230.7	197.1
Gopla River (Inside Hail Haor)	41.23	RMOs but no fishing norms	393.7	465.7	490.0	732.7	523.5	1203.2	718.3
Boulashir Floodplain	234.38	Paddy fields near 2 RMO areas	69.8	78.0	62.0	57.3	70.0	164.0	103.6
Chirudubi Beel	30.40	In between 2 RMOs	278.3	323.0	619.5	482.9	900.8	2174.8	1336.5
62-Beel Complex	419.48	Outside RMOs, near permanent sanctuary	263.7	315.8	256.9	448.3	156.0	306.0	229.7
Rustampur Beel Complex	221.73	RMO, includes 0.06 ha sanctuary	159.1	154.4	144.9	254.0	116.7	475.3	254.8
Balla Beel	159.09	RMO, includes 1.53 ha of sanctuaries	35.6	86.8	123.6	151.8	165.8	331.7	250.6
<b>Turag Bangshi (Kaliakoir)</b>			<b>57.8</b>	<b>124.7</b>	<b>104.8</b>	<b>140.1</b>	<b>315.2</b>	<b>320.7</b>	<b>204.0</b>
Mokash Beel (South)	100.00	Includes 2 ha sanctuary	42.0	98.3	79.8	103.9	199.9	246.8	171.4
Mokash Beel (North)	100.00	RMO no sanctuary	33.5	104.7	104.5	149.4	547.3	288.8	339.1
Kalidaha Beel	50.00	RMO no sanctuary	62.4	141.0	69.3	169.2	243.9	292.9	
Mokash Khal/Solhati Khal	0.70	RMO no sanctuary	790.9	2381.0	1404.9	3696.4	3439.6	10816.0	4636.2
Turag River (River section)	14.00	Includes 3.64 ha sanctuary	144.5	217.2	251.5	253.1	386.8	500.5	313.0
Aowla Khal (Canal)	1.02	RMO no sanctuary	627.7	1485.3	858.1	1091.7	712.9	1412.4	2071.1
Aowla Beel	100.00	RMO, several nearby sanctuaries	65.8	77.8	105.0	76.1	174.9	180.1	107.3
Bangshi River (River section)	17.00		97.3	376.1	137.0	292.3	451.5	1205.8	385.1
<b>Kongshow Malijhee (Sherpur)</b>			<b>150.2</b>	<b>149.2</b>	<b>273.4</b>	<b>315.6</b>	<b>416.1</b>	<b>307.1</b>	
Baila Beel	44.10	Includes 1.87 ha sanctuary	134.3	144.2	333.7	248.4	303.3	224.5	
Takimari Beel	34.75	RMO, near to sanctuary	180.0	147.0	422.4	482.1	565.4	322.3	
Kewta Beel	33.07	Includes 0.89 ha sanctuary	250.8	186.6	369.7	185.9	488.4	188.1	
Nijla Beel	63.92	No sanctuary	104.3	174.8	156.0	308.7	237.9	230.2	
Bagadubi Khal (Canal)	4.20	No sanctuary	1305.5	847.3	2128.4	4785.6	2841.4	1620.3	
Bahar Ali Kur (Malijhi River)	5.00	RMO and 2.16 ha sanctuary	271.2	441.9	973.7	914.4	1999.3	766.5	
Aowra Bowra Beel	69.33	No RMO or management (control)	39.6	28.8	38.0	30.2	229.6	286.3	
Bailsha Beel	13.35	Includes 1.95 ha sanctuary	260.9	251.7	386.1	310.7	686.8	725.7	

Lastly Fig. 5 gives an overview of the monthly pattern of estimated fish production, prices and value of catches over the period monitored. It is estimated that in this period 15,000 mt of additional fish were caught in the three sites, with a value of about Tk 1,000 million.



**Fig. 5 Summary of estimated fish catch, prices and values by month in the three sites**



## Supporting Tables

CPUE (kg/gear/day) - Hail Haor (Sreemongal)

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/Khara jal	5.3	7.4	5.5	7.0	7.6	7.9	6.0
Ber/Kathi Jal	6.9	11.8	7.5	9.5	12.1	21.0	11.0
Thele/Afa Jal	2.2	2.7	3.3	2.9	2.9	3.3	2.9
Current Jal	0.2	0.2	0.4	0.2	0.2	0.2	0.1
Suta Jal	0.2	0.2	0.3	0.3	0.3	0.4	0.2
Traps	0.1	0.1	0.1	0.2	0.1	0.3	0.3
Longline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Others	2.1	1.5	2.3	7.8	6.4	5.9	5.3
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Veshal/Khara jal						A	
Ber/Kathi Jal						ABDG	
Thele/Afa Jal			A			A	
Current Jal			EG				
Suta Jal						AEG	
Traps						ABCDE	ABE
Longline							
Others				ABC			

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

CPUE (kg/gear/day) - Turag Bangshi (Kaliakoir)

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/Khara jal	0.8	2.2	0.5	1.2	3.2	14.9	2.3
Ber/Kathi Jal	1.8	3.9	2.4	3.9	5.4	6.4	4.1
Thele/Afa Jal	0.5	0.8	0.7	0.8	1.0	0.8	0.5
Current Jal	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Moi/Dhore/Moshari Jal	1.2	1.9	0.9	1.0	1.0	1.3	1.0
Dharma Jal	1.4	0.8	0.6	0.7	1.1	1.4	1.8
Jhaki Jal	0.5	0.7	0.5	0.7	0.9	1.2	1.2
Traps	0.2	0.3	0.2	0.2	0.5	0.6	0.3
Longline	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Hooks	0.4	0.3	0.3	0.4	0.3	0.5	0.3
Others	1.2	7.6	3.8	2.6	2.5	2.9	2.7
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Veshal/Khara jal						ABCDEG	
Ber/Kathi Jal					AC	ABCDG	
Thele/Afa Jal				A	ABCG		
Current Jal					ABC	ABCD	ABCDEF
Moi/Dhore/Moshari Jal		CDE					
Dharma Jal						D	BCDE
Jhaki Jal					C	ABCDE	ABCDE
Traps							
Longline	BCDEFG						
Hooks						G	
Others		ADEFG					

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

**CPUE (kg/gear/day) - Kongshow Malijhee (Sherpur)**

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5
Veshal/Khara jal	2.0	2.0	2.4	8.6	8.2	1.9
Ber/Kathi Jal	2.0	2.3	2.8	3.9	4.7	4.3
Thele/Afa Jal	0.7	0.5	0.9	0.9	0.9	0.9
Current Jal	0.0	0.0	0.3	0.0	0.0	0.0
Dharma Jal	1.5	0.6	1.8	8.3	2.1	1.3
Jhaki Jal	1.3	1.2	2.0	2.3	2.6	1.8
Traps	0.1	0.1	0.0	0.0	0.1	0.0
Hooks	0.3	0.2	0.3	0.3	0.3	0.2
Bana/Bara	1.8	0.3	1.7	0.6	0.7	0.7
Haat	0.4	0.4	1.0	0.5	0.6	0.6
Dewatering	13.3	21.4	3.7	10.0	2.8	4.3
Others	2.1	1.1	2.0	5.1	4.5	1.9
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)
Veshal/Khara jal						
Ber/Kathi Jal				AB	ABC	AB
Thele/Afa Jal			B	B	B	B
Current Jal						
Dharma Jal				B		
Jhaki Jal			AB	AB	ABCF	AB
Traps	CDF					
Hooks			B			
Bana/Bara						
Haat			ABDF			
Dewatering						
Others				ABCF	BF	

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

**CPUE (kg/person/day) - Hail Haor (Sreemongal)**

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/Khara jal	3.5	4.7	3.1	3.6	3.5	3.9	3.1
Ber/Kathi Jal	1.3	2.1	1.7	1.8	2.3	4.2	1.7
Thele/Afa Jal	1.3	1.7	2.1	2.2	2.0	2.2	2.0
Current Jal	2.4	2.1	3.8	3.0	2.0	2.6	1.6
Suta Jal	4.0	2.5	5.7	4.4	2.7	3.2	2.6
Traps	3.3	3.4	3.4	3.7	3.2	7.2	4.9
Longline	1.8	1.7	2.3	2.9	2.8	2.7	3.0
Others	1.2	1.5	2.7	4.3	3.7	2.8	2.9
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Veshal/Khara jal		CG					
Ber/Kathi Jal						ABDG	
Thele/Afa Jal			A	A	A	A	A
Current Jal			EG				
Suta Jal							
Traps						ABCDEG	E
Longline			AB	ABC	AB	AB	ABC
Others				ABFG	AB		A

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

**CPUE (kg/person/day) - Turag Bangshi (Kaliakoir)**

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/Khara jal	0.6	1.7	0.5	1.0	3.1	12.0	2.1
Ber/Kathi Jal	0.4	0.6	0.4	0.6	0.8	0.9	0.5
Thele/Afa Jal	0.5	0.7	0.7	0.8	1.0	0.8	0.5
Current Jal	0.2	0.1	0.1	0.1	0.3	0.2	0.4
Moi/Dhore/Moshari Jal	0.8	1.8	1.0	1.2	1.2	1.1	1.0
Dharma Jal	2.1	0.8	0.6	0.7	1.1	1.3	1.8
Jhaki Jal	0.4	0.6	0.5	0.6	0.8	1.1	1.2
Traps	1.3	0.8	0.9	0.9	1.8	1.1	0.8
Longline	1.2	1.2	1.1	1.6	1.4	1.3	1.7
Hooks	0.4	0.3	0.4	0.4	0.4	0.5	0.3
Others	0.6	2.2	1.4	1.6	1.7	1.7	1.9
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Veshal/Khara jal						ABCDEG	
Ber/Kathi Jal					ACG	ACG	
Thele/Afa Jal				A	ABCG		
Current Jal					BCD	B	ABCDEF
Moi/Dhore/Moshari Jal		ACDEFG					
Dharma Jal	BCD					D	BCD
Jhaki Jal					AC	ABCDE	ABCDE
Traps					BCDFG		
Longline							C
Hooks						G	
Others		A					

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

**CPUE (kg/person/day) - Kongshow Malijhee (Sherpur)**

Gear	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5
Veshal/Khara jal	0.9	1.6	1.8	6.3	5.8	1.9
Ber/Kathi Jal	0.4	0.5	0.6	0.8	1.0	0.8
Thele/Afa Jal	0.7	0.5	0.8	0.9	0.9	0.9
Current Jal	0.2	0.1	0.9	0.1	0.1	0.1
Dharma Jal	1.4	0.5	1.6	8.1	1.8	1.2
Jhaki Jal	1.0	0.9	1.5	1.7	1.6	1.2
Traps	0.9	1.1	1.1	1.0	1.2	1.0
Hooks	0.6	0.6	1.0	0.9	1.0	0.8
Bana/Bara	0.9	1.4	2.7	0.8	6.7	5.4
Haat	0.4	0.4	1.0	0.5	0.6	0.6
Dewatering	5.9	5.6	0.9	1.9	1.1	2.3
Others	0.9	0.5	0.9	1.7	1.9	1.0
<b>Comparisons of Column Means</b>	(A)	(B)	(C)	(D)	(E)	(F)
Veshal/Khara jal				AB	AB	
Ber/Kathi Jal				A	ABC	A
Thele/Afa Jal			B	B	B	B
Current Jal						
Dharma Jal				B		
Jhaki Jal			AB	ABF	ABF	B
Traps		AF	A		ADF	
Hooks			AB	AB	AB	B
Bana/Bara						
Haat			ABDF			
Dewatering						
Others				AB	ABCF	

Results are based on two-sided t-tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

Tests are adjusted for all pair-wise comparisons within a row of each innermost sub-table using the Bonferroni correction.

**Gear Characteristics in Hail Haor**

Gear type		Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/Khara jal	No.	100	67	62	73	54	57	76
	Length (m)	8.66	9.15	10.52	12.59	11.86	11.11	13.94
	Width (m)	8.47	10.07	10.91	10.63	10.75	11.03	11.02
	Mesh size (mm)	14.37	13.46	10.32	8.05	7.72	7.30	8.28
	No. of fisher	1.63	1.94	4.57	2.59	1.94	.	2.04
	Total fishing time (hrs/day)	16.20	16.28	13.27	14.29	12.49	11.76	13.00
Ber/Kathi Jal	No.	69	110	17	77	28	84	38
	Length (m)	51.31	68.87	63.20	72.94	92.66	75.85	61.18
	Width (m)	5.53	6.54	6.37	6.61	6.71	6.20	6.18
	Mesh size (mm)	9.30	9.69	9.00	8.78	8.64	6.42	7.87
	No. of fisher	5.35	10.36	12.16	11.42	5.30	.	6.58
	Total fishing time (hrs/day)	9.61	5.16	6.16	9.31	6.68	5.74	7.45
Thele/Afa Jal	No.	244	104	144	114	153	108	160
	Length (m)	1.69	5.65	5.06	4.48	2.12	2.06	3.23
	Width (m)	1.30	1.59	3.97	1.79	2.54	1.61	1.65
	Mesh size (mm)	7.02	8.42	7.58	8.31	6.85	5.85	6.20
	No. of fisher	1.66	2.27	3.04	2.00	1.81	.	1.52
	Total fishing time (hrs/day)	6.60	5.36	5.78	5.77	4.97	4.07	4.89
Current Jal	No.	376	293	315	471	511	651	503
	Length (m)	33.14	39.62	39.87	38.47	50.51	47.60	43.11
	Width (m)	1.13	1.36	1.60	1.40	1.41	1.75	1.75
	Mesh size (mm)	32.71	33.69	33.69	29.87	33.83	49.83	46.65
	No. of fisher	1.30	2.14	3.08	2.06	1.32	.	1.17
	Total fishing time (hrs/day)	10.79	11.54	10.84	11.33	10.82	11.44	12.46
Suta Jal	No.	94	17	65	85	102	69	124
	Length (m)	42.27	42.36	31.61	35.42	37.77	38.23	38.66
	Width (m)	1.36	1.59	1.21	3.35	1.10	1.64	1.42
	Mesh size (mm)	41.18	46.18	28.17	52.38	30.74	63.38	47.41
	No. of fisher	1.98	2.69	4.23	2.13	1.26	.	1.53
	Total fishing time (hrs/day)	13.44	17.95	11.10	14.00	11.80	13.73	14.86

**Gear Characteristics in Turag-Bangshi**

Gear type		Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Veshal/ Khara jal	No.	10	17	6	19	28	31	36
	Length (m)	13.21	21.11	11.20	14.00	26.08	14.79	14.55
	Width (m)	10.70	10.06	8.50	11.02	11.17	11.56	11.57
	Mesh size (mm)	12.80	33.84	11.00	29.20	15.89	23.11	29.47
	No. of fisher	1.20	1.29	1.00	1.32	1.00	.	1.14
	Total fishing time (hrs/day)	4.80	5.28	3.00	5.86	4.16	5.36	4.49
Ber/Kathi Jal	No.	51	84	92	81	116	106	89
	Length (m)	126.93	184.73	186.71	194.59	207.24	208.20	213.70
	Width (m)	6.19	7.79	7.68	8.10	7.97	8.07	8.11
	Mesh size (mm)	6.75	5.14	6.57	5.23	5.94	5.54	5.25
	No. of fisher	5.04	6.25	6.52	6.64	8.08	.	7.84
	Total fishing time (hrs/day)	5.67	4.18	3.70	3.32	4.44	4.05	4.03
Thele/Afa Jal	No.	150	234	181	143	200	110	57
	Length (m)	1.83	2.00	2.04	2.13	2.10	2.14	2.57
	Width (m)	1.44	1.60	1.63	1.70	1.63	1.53	1.38
	Mesh size (mm)	4.47	5.50	5.65	5.42	5.07	5.02	5.02
	No. of fisher	1.19	1.17	1.08	1.08	1.22	.	1.09
	Total fishing time (hrs/day)	2.60	2.18	2.41	2.47	2.31	2.16	1.35
Current Jal	No.	341	614	400	490	487	660	501
	Length (m)	285.59	368.44	437.67	324.16	279.26	258.30	249.62
	Width (m)	1.06	1.13	1.42	1.23	1.15	1.18	1.20
	Mesh size (mm)	34.09	41.47	34.91	43.53	43.83	51.81	41.81
	No. of fisher	1.09	1.05	1.03	1.03	1.01	.	1.05
	Total fishing time (hrs/day)	5.48	4.55	6.93	6.11	6.47	5.52	4.95
Moi/Dhore/Mosh ari Jal	No.	108	105	83	79	90	70	53
	Length (m)	8.53	7.30	4.60	8.25	4.77	3.87	3.92
	Width (m)	1.82	2.56	1.79	3.30	2.29	1.89	1.95
	Mesh size (mm)	9.97	10.84	10.22	12.87	11.68	10.56	9.38
	No. of fisher	1.83	1.57	1.63	1.65	1.59	.	1.34
	Total fishing time (hrs/day)	4.55	3.97	4.08	5.14	4.88	3.88	3.38
Dharma Jal	No.	23	49	37	95	98	155	66
	Length (m)	5.46	6.89	6.60	7.11	6.38	6.58	6.76
	Width (m)	5.44	6.99	6.54	7.12	6.38	6.61	6.76
	Mesh size (mm)	15.65	18.63	17.89	21.16	19.07	19.20	18.23
	No. of fisher	1.70	1.00	1.00	1.01	1.00	.	1.00
	Total fishing time (hrs/day)	5.43	3.54	3.85	3.86	4.02	3.62	3.89
Jhaki Jal	No.	197	370	396	445	452	641	592
	Length (m)	3.72	3.83	4.00	4.02	4.01	3.97	3.98
	Diameter (m)	5.98	6.50	7.26	6.05	5.98	5.81	5.94
	Mesh size (mm)	11.59	12.30	12.57	12.70	12.16	12.62	14.08
	No. of fisher	1.22	1.08	1.03	1.04	1.01	.	1.03
	Total fishing time (hrs/day)	3.23	2.41	2.08	2.30	2.32	2.18	2.25

**Gear Characteristics in Kangsha-Malijhee**

Gear types		Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5
Veshal/ Khara jal	No.	23	25	16	21	23	12
	Length (m)	42.82	8.85	12.09	9.67	10.14	24.38
	Width (m)	7.02	7.91	8.29	8.32	8.21	7.56
	Mesh size (mm)	3.35	1.72	3.13	6.19	7.39	6.75
	No. of fisher	2.09	1.44	1.38	1.00	1.13	1.00
	Total fishing time (hrs/day)	10.67	9.30	9.34	13.50	11.52	8.54
Ber/Kathi Jal	No.	94	153	103	50	63	53
	Length (m)	75.22	94.37	132.94	126.83	101.31	127.13
	Width (m)	5.57	5.32	5.14	4.87	4.69	4.46
	Mesh size (mm)	1.75	1.81	3.26	6.27	5.48	5.00
	No. of fisher	5.34	5.17	5.63	6.00	5.02	5.34
	Total fishing time (hrs/day)	5.66	4.44	5.84	5.81	4.92	4.88
Thele/Afa Jal	No.	435	681	837	651	434	373
	Length (m)	1.62	2.12	1.85	1.85	1.76	1.75
	Width (m)	1.44	1.59	1.60	1.58	1.43	1.41
	Mesh size (mm)	1.86	1.93	4.14	6.78	7.03	7.91
	No. of fisher	1.03	1.02	1.02	1.00	1.01	1.03
	Total fishing time (hrs/day)	3.90	2.94	3.02	3.31	3.28	2.92
Current Jal	No.	249	653	632	382	556	522
	Length (m)	307.90	412.07	484.42	572.51	574.81	590.64
	Width (m)	0.94	1.13	0.88	0.90	1.45	0.89
	Mesh size (mm)	17.53	21.88	35.56	42.09	39.99	40.99
	No. of fisher	1.14	1.21	1.22	1.30	1.09	1.13
	Total fishing time (hrs/day)	8.95	9.16	10.65	11.85	11.31	10.64
Dharma Jal	No.	73	189	181	84	177	115
	Length (m)	8.65	9.29	9.51	7.85	8.39	7.20
	Width (m)	8.60	9.31	9.24	7.84	8.39	7.23
	Mesh size (mm)	12.66	4.54	6.35	13.70	20.10	26.33
	No. of fisher	1.14	1.13	1.25	1.04	1.10	1.17
	Total fishing time (hrs/day)	9.29	10.14	10.66	12.72	11.71	11.92

## **Annex 4: Impacts of fish production trends on fish consumption and household livelihoods**



## Impacts of fish production trends on fish consumption and household livelihoods

### Introduction

It was expected that due to MACH interventions, there would be qualitative and quantitative changes in wetland productivity and biodiversity. These changes were expected to consequently impact on the fish consumption amounts and pattern of households living around the wetlands. To assess if this was the case selected households from selected villages located within the impact area of the project intervention were monitored for their fish consumption on a regular basis in all the three sites throughout the project period.

### Methods

#### *Sample Households*

Fish consumption data have been collected each year from between 455 and 490 households from 14 villages in the Hail Haor site, from 280 households from 8 villages in Turag-Bangshi site every year, and from 280 households from 7 villages in Kangsha-Malijhee site except in the baseline year when 289 households were covered. From each sample village, 35 sample households were selected in Hail Haor and Turag-Bangshi sites, and 40 households were selected in Sherpur site. The design was intended to cover the social classes present, this was on the basis of landholding size (landless, marginal farmers, small, medium and large farmers) and they were sampled in proportion to their presence in the villages so most of the households are functionally landless or marginal farmers.

Household fish consumption monitoring started at Hail Haor site from September 1999, in Turag-Bangshi from October 1999 and from January 2001 in Kangsha-Malijhee site (Table 1).

**Table 1 Sample sizes and year definition for consumption survey**

Site	Land-holding	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6
Hail Haor (Sreemongal)	Period	(Sep 99 - Apr 00)	(May 00 - Apr 01)	(May 01 - Apr 02)	(May 02 - Apr 03)	(May 03 - Apr 04)	(May 04 - Apr 05)	(May 05 - Apr 06)
	Landless	295	300	295	291	291	291	295
	Marginal	92	94	92	84	84	84	84
	Small	48	49	48	42	42	42	42
	Medium	36	36	36	28	28	28	28
	Large	19	19	19	10	10	10	10
	Total	490	498	490	455	455	455	459
Turag Bangshi (Kaliakoir)	Period	(Oct 99 - Apr 00)	(May 00 - Apr 01)	(May 01 - Apr 02)	(May 02 - Apr 03)	(May 03 - Apr 04)	(May 04 - Apr 05)	(May 05 - Apr 06)
	Landless	159	160	159	159	159	159	159
	Marginal	68	69	68	68	68	68	68
	Small	22	22	22	22	22	22	22
	Medium	23	23	23	23	23	23	23
	Large	8	8	8	8	8	8	8
	Total	280	282	280	280	280	280	280
Kangsha-Malijhee (Sherpur)	Period	(Jan 01 - Dec 01)	(Jan 02 - Dec 02)	(Jan 03 - Dec 03)	(Jan 04 - Dec 04)	(Jan 05 - Dec 05)	(Jan 06 - Dec 06)	
	Landless	174	169	169	169	169		
	Marginal	65	62	62	62	62		
	Small	20	20	20	20	20		
	Medium	19	18	18	18	18		
	Large	11	11	11	11	11		
	Total	289	280	280	280	280		

### ***Sampling protocol***

Data was collected at three-day intervals from the sample households using fixed recording formats. The fish that each household planned to eat that day were weighed before cooking by species as far as possible. The households were also asked about their own fishing activities in the previous day and this along with the reported catch were recorded based on recall. In Hail Haor any collection of non-fish aquatic resources was also reported based on the respondents recall and was recorded.

Local trained women were recruited and assigned as Resident Monitors (RMs) to collect the data from the sample households. The field staff of CNRS-MACH supervised and assisted the RMs in data collection, they also checked the data forms and resolved problems and inconsistencies. Later at the site level office, RM activities were discussed and data forms are reviewed, coded and edited by the concerned Field Officers. The forms were then sent to MACH head office for computer processing.

### ***Monitoring Parameters***

To compare the changes of fish consumption in terms of quantity and species diversity in the baseline period with the impact years, following parameters were considered:

- Per capita fish consumption by months,
- Per capita fish consumption by land classes,
- Sources of fish consumed
- Species composition of fish consumed,
- Ranking of species by quantity consumed, and
- Other aquatic resources used by the households

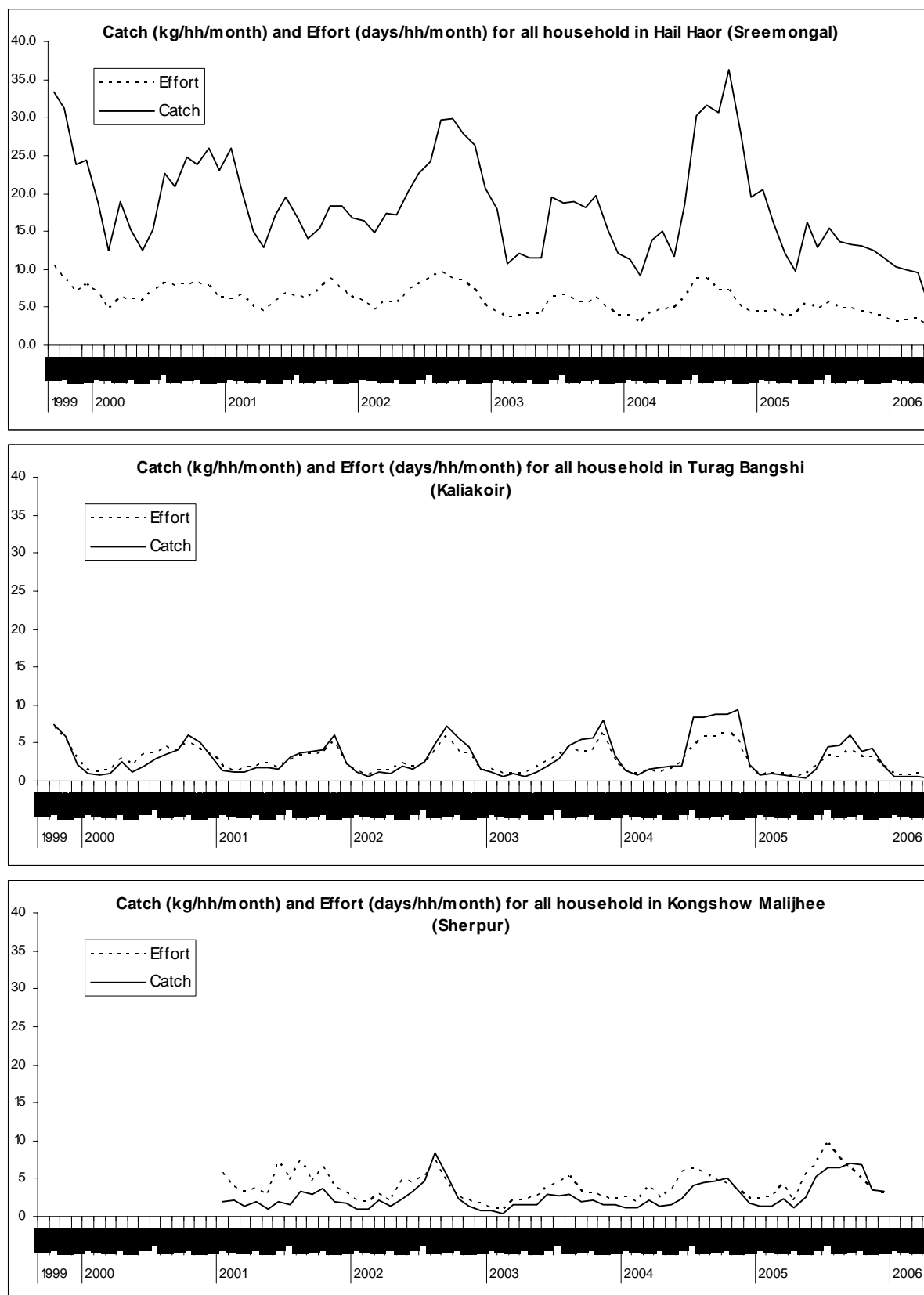
## **Results**

### ***Fishing***

The household monitoring confirms for this sample of households similar seasonality in fishing effort and catches to those found in the catch monitoring in specific parts of the wetlands, there is also a close correlation between effort and catches at the household level (Fig. 1). In the Turag Bangshi site typically households catch about one kilogram of fish per day of fishing, increasing slightly over the project period, while their effort in the peak late monsoon months was higher and for longer in 2004 when inundation was more extensive and prolonged. By comparison in Hail Haor effort levels have changed little between years for this panel of households and are slightly higher than in Kaliakoir, but catches are much higher – in the order of 2-4 kg/household/day depending on the season and year. Given that catch per hectare has risen in Turag-Bangshi during the same period to close to the Hail Haor level, the implication is that households who were not in the villages covered by the monitoring program have started to fish in the floodplain system since MACH started and productivity was restored. By comparison effort levels in the Kangsha-Malijhee site are lower, and catches are low regularly being under a kilogram per household per day.

### ***Fish consumption***

Seasonality in fish consumption is closely associated with the availability of fish and with the household's own catches, peaking in the monsoon and post-monsoon period. In all three sites the highest quantity of fish was consumed in the post monsoon months (October to December), that is the period when fish catch and availability are at their highest (Fig 2). The lowest per capita consumption was in April, the driest month of the year. The monthly variation of fish consumption largely depends on the availability of fish and the purchasing capacity of the people.



**Fig. 1** Seasonal patterns of fishing effort and catch reported in household monitoring in three sites.

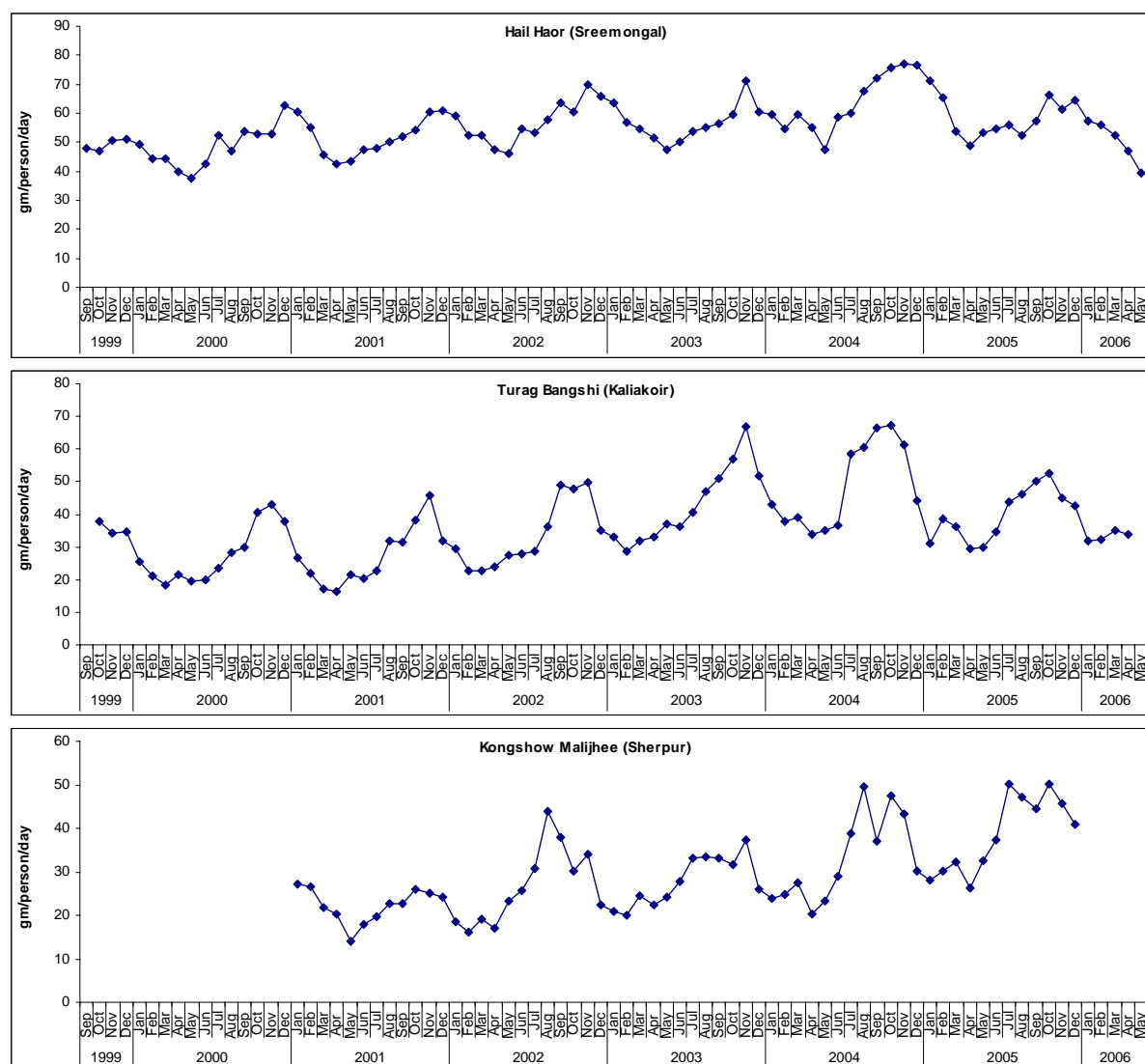


Fig. 2 Monthly pattern of fish consumption (g/person/day) by site

As shown in the figures, overall fish consumption increased significantly in all sites compared with the baseline data. Major findings indicate that small beel and wetland resident fish and prawns constitute the main fish consumed for all households and particularly for poorer households. The vast majority (55-75%) of fish consumed in these sites and throughout the country is purchased in local markets. This is consistent with studies by Helen Keller International which indicate that over 50% of all fish consumed in rural Bangladesh are purchased.

**Hail Haor:** Per capita fish consumption for all social classes increased significantly from 47 g/day in the baseline period to an average of 58 g/day in impact years 3-6. The highest increase, 36%, in fish consumption occurred among marginal farmers followed by 25% and 22% for medium farmers and landless households respectively. Per capita fish consumption of large farmers did not differ significantly: 52 g/day in impact years 3-6 compared to 56 g/day in the baseline year (Fig. 3a). Fish consumption has fluctuated with fish catches, but on average the improved habitats and management practices are expected to sustain higher supplies of fish, and greater access of poor fishers to fishing grounds through the RMOs and the increasing incomes of the poor through alternative income generating activities such as those provided through the FRUGs are expected to continue to raise

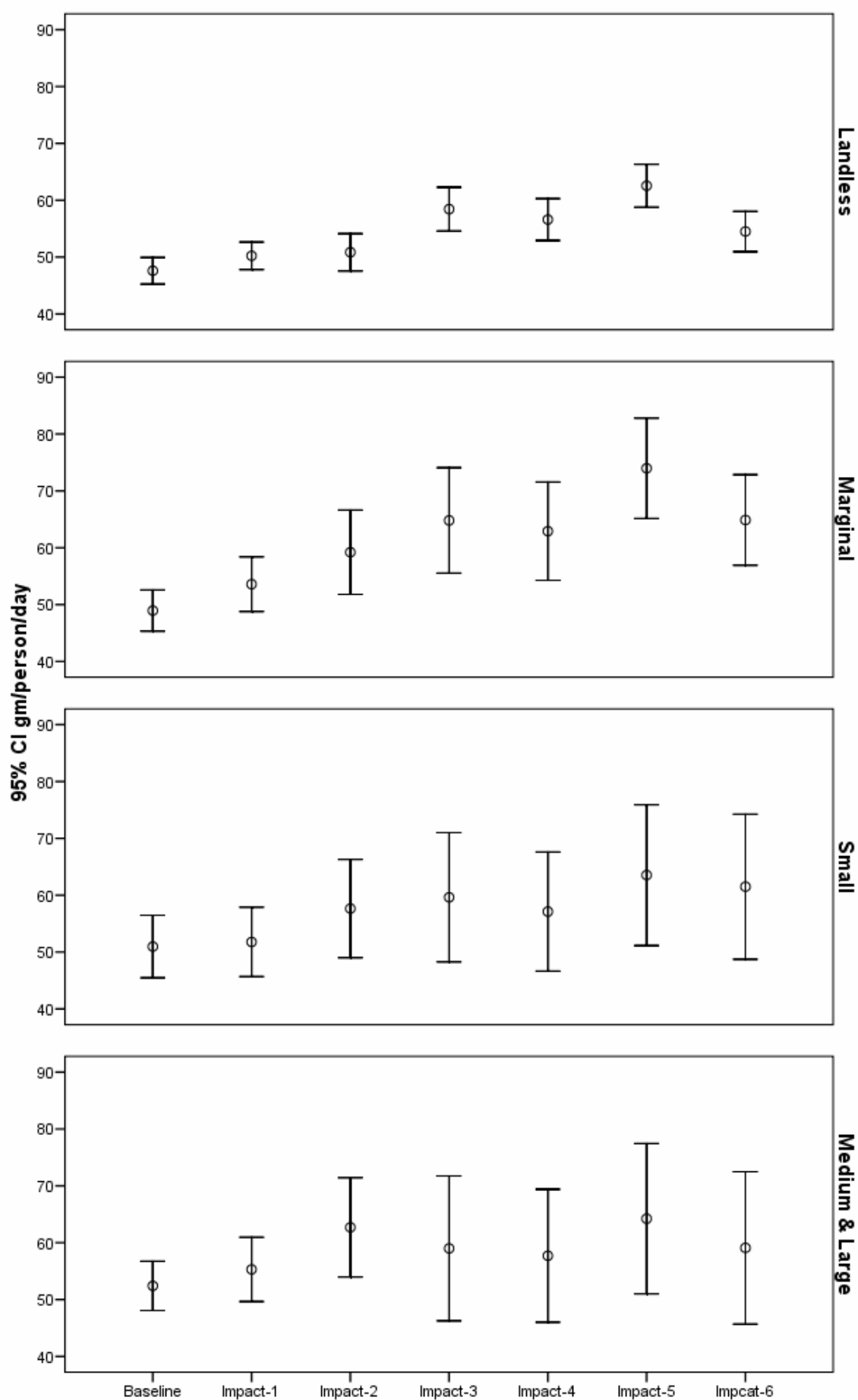
household incomes thus maintaining and increasing demand for fish among the poorer households, so these trends are expected to continue.

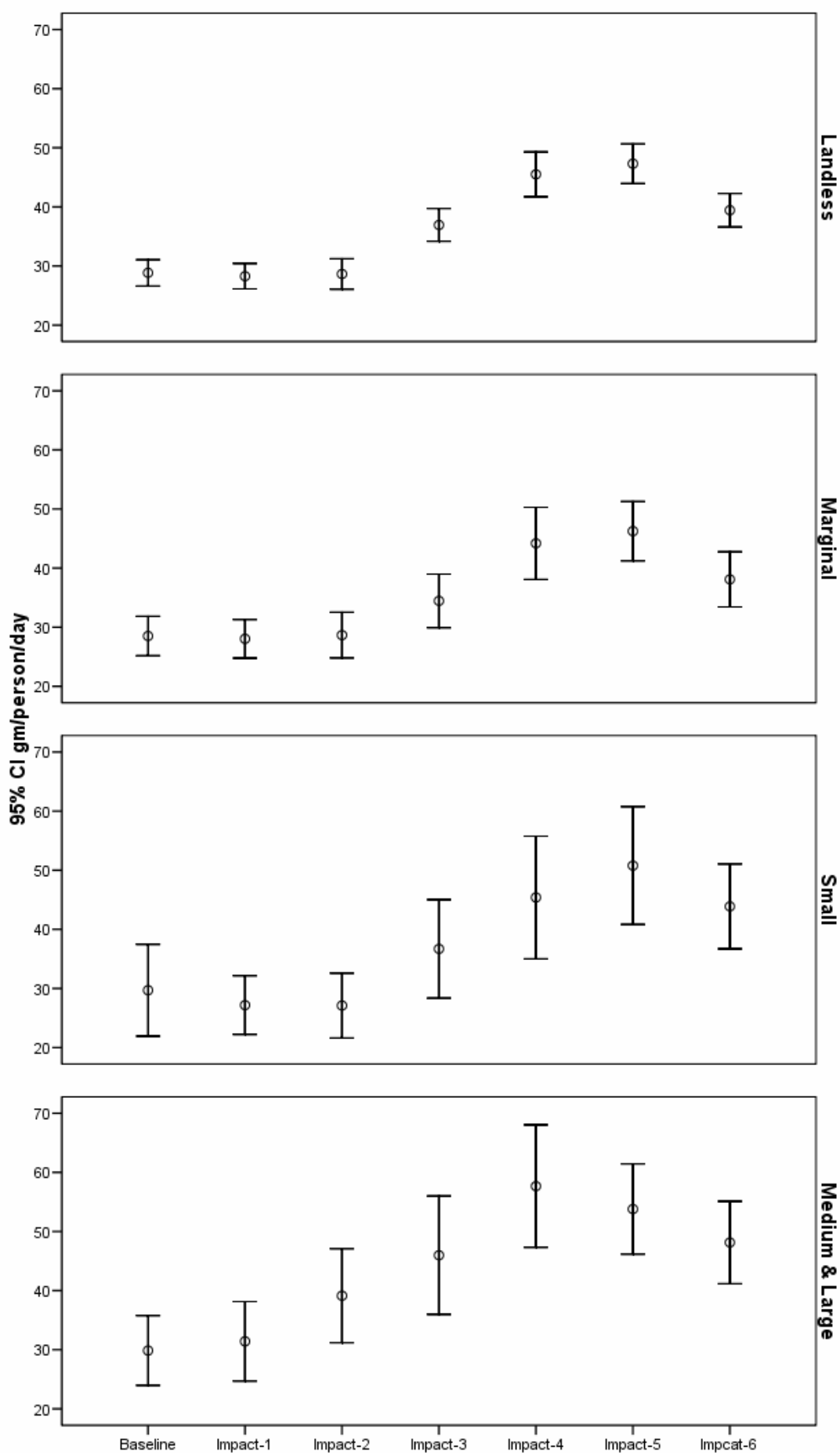
**Turag Bangshi:** In Turag-Bangshi all landholding categories had similar levels of fish consumption before the project and all now eat more fish, all have experienced statistically significant increases (except that the sample of large farmers is small). Combining all social classes, per capita fish consumption significantly increased from 29 g/day at baseline to 43 g/day in impact years 3-6, and increase of 49%. Here all landholding classes gained between 43% and 75% more fish consumption and large farmers more than doubled their fish consumption, followed by 76% and 67% for small and medium farmers respectively (Fig 3b).

**Kangsha-Malijhee:** Households in Kangsha-Malijhee had the lowest fish consumption levels of the three sites initially averaging only 23 g/person/day, and this remains the case, but by just the fourth impact year average fish consumption had increased by 50% to 36 g/person/day, and most landholding categories have made similar gains. Even after one year of project activities consumption increased significantly compared with 2-3 years in the other sites. Per capita fish consumption of landless households increased by 44% and for medium and large farm households by 73% and 59% respectively. Only small farmers failed to show significant increases in their fish consumption (Fig 3b).

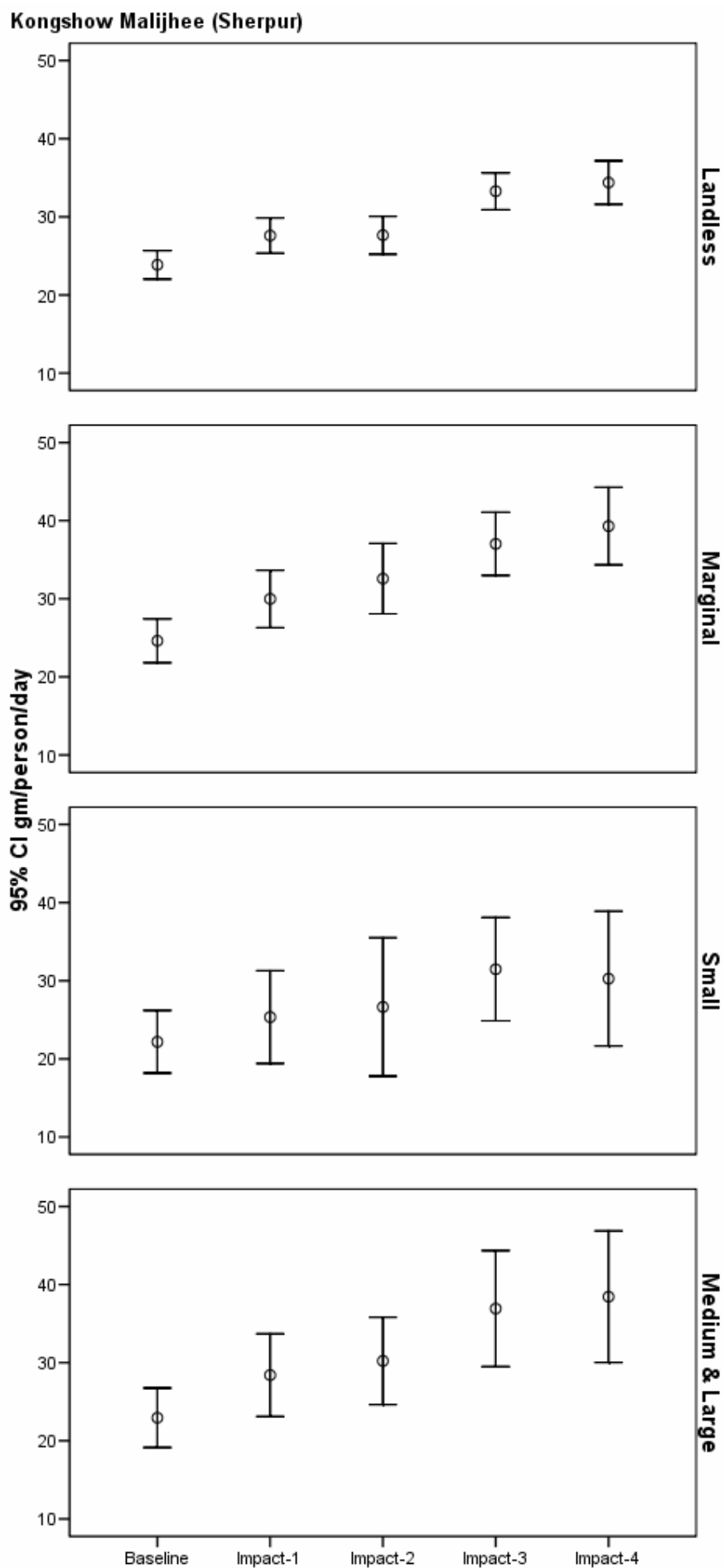
Thus the nutritional benefits from improvements in wetland management and restored productivity have been well distributed across poorer and better off households. Considering the numerical dominance of poorer households in all of these areas, this means that the majority of the increased volume of fish consumed has fed poorer households. However, as will be seen the extra fish eaten are not necessarily the fish caught in these wetlands.

**Fig. 3a Fish consumption (g/person/day) in Hail Haor**  
**Hail Haor (Sreemongal)**



**Fig. 3b Fish consumption (g/person/day) in Turag Bangshi****Turag Bangshi (Kaliakoir)**



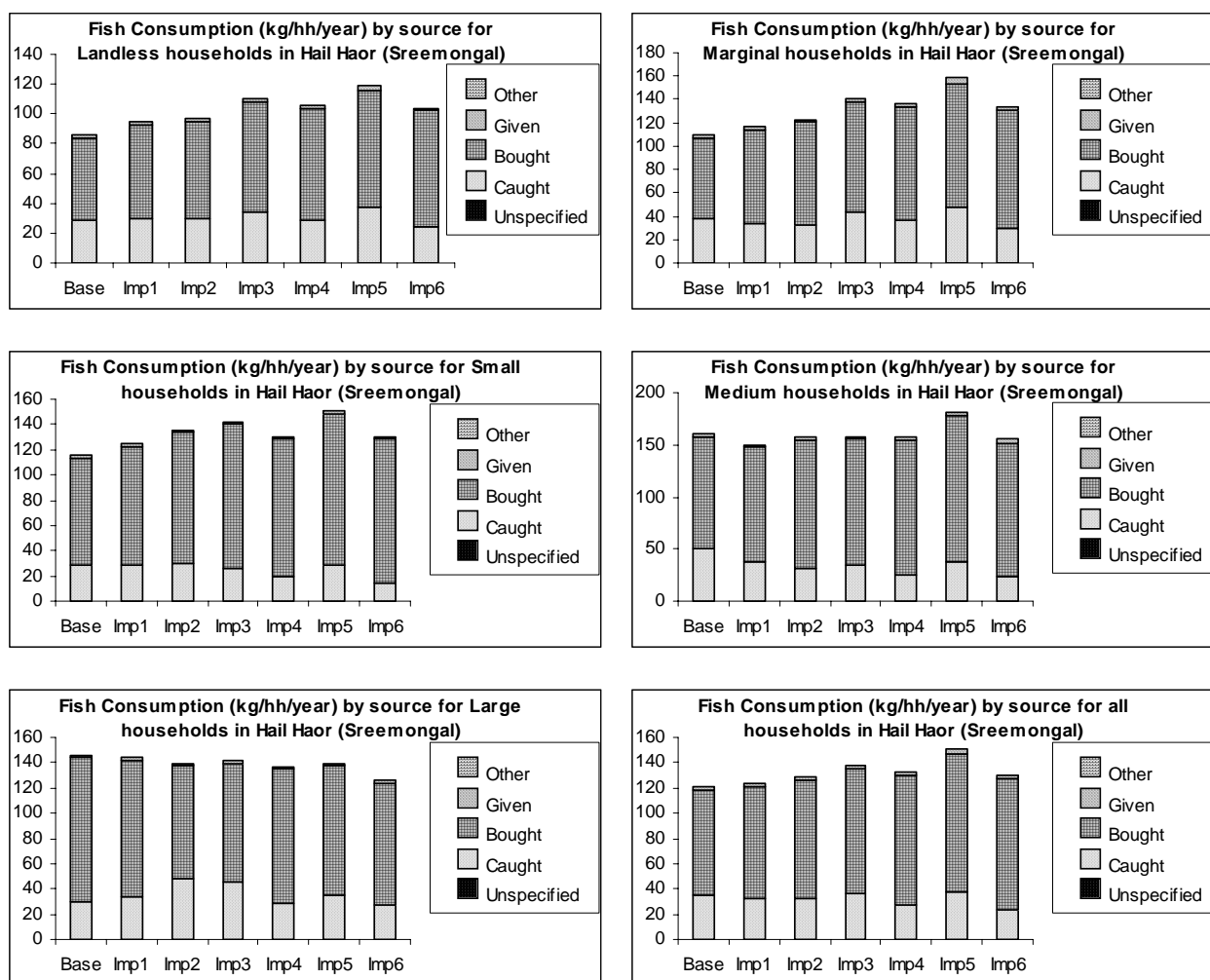
**Fig. 3c Fish consumption (g/person/day) in Kongshow Malijhee**

### Sources of fish

In all three sites a majority of households from all landholding categories bought the majority of the fish they consumed, even though many of these households also catch fish for own consumption. In none of the sites were increases in fish consumption associated with a greater share coming from own catches. In Hail Haor households on average became more dependent on purchased fish – the quantity per household consumed from own catch fell in impact years 5 and 6 to 86% of the baseline level, while the quantity purchased for consumption rose by 29%. In Turag Bangshi in the same period the average quantity caught and consumed per household rose by 81%, against an increase of 68% in the quantity bought for consumption. In Kangsha-Malihee in a shorter period to impact years 3 and 4, the average quantity caught and consumed per household rose by 21% when the amount bought and consumed increased by 86%. When disaggregated the data indicate to some extent that more of the direct consumption benefits from restored fisheries and higher fish catches went to poorer households.

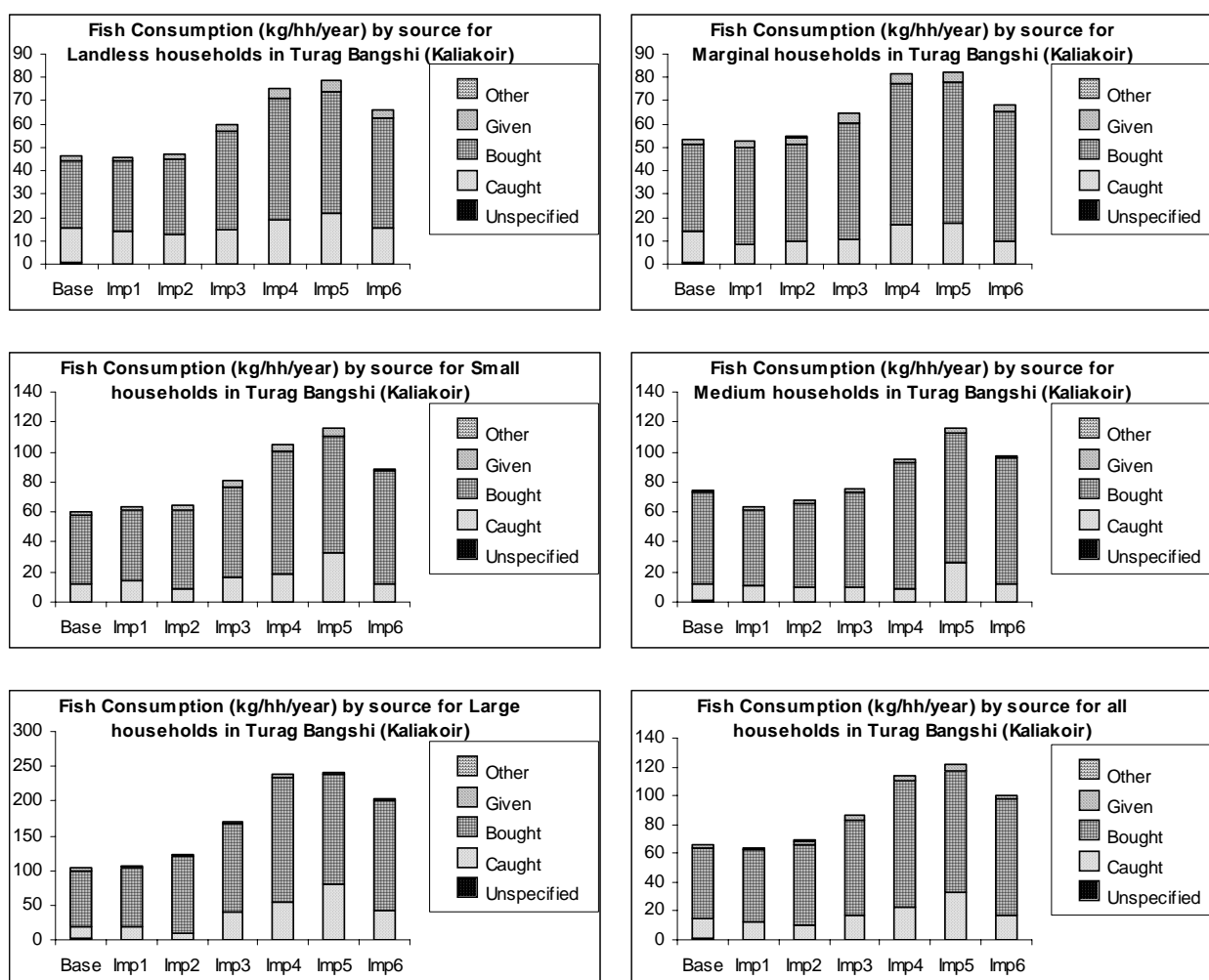
In Hail Haor landless and marginal households increased the quantity of fish consumed from own catches, while small to large landowners tended not to change the quantity coming from own catch although their total consumption of fish increased (Fig 4a). This indicates that landowners bought relatively and in absolute terms more fish, providing an income to the mainly landless and marginal households that fish for an income.

**Fig. 4a Sources of fish consumed by different classes of household in Hail Haor**



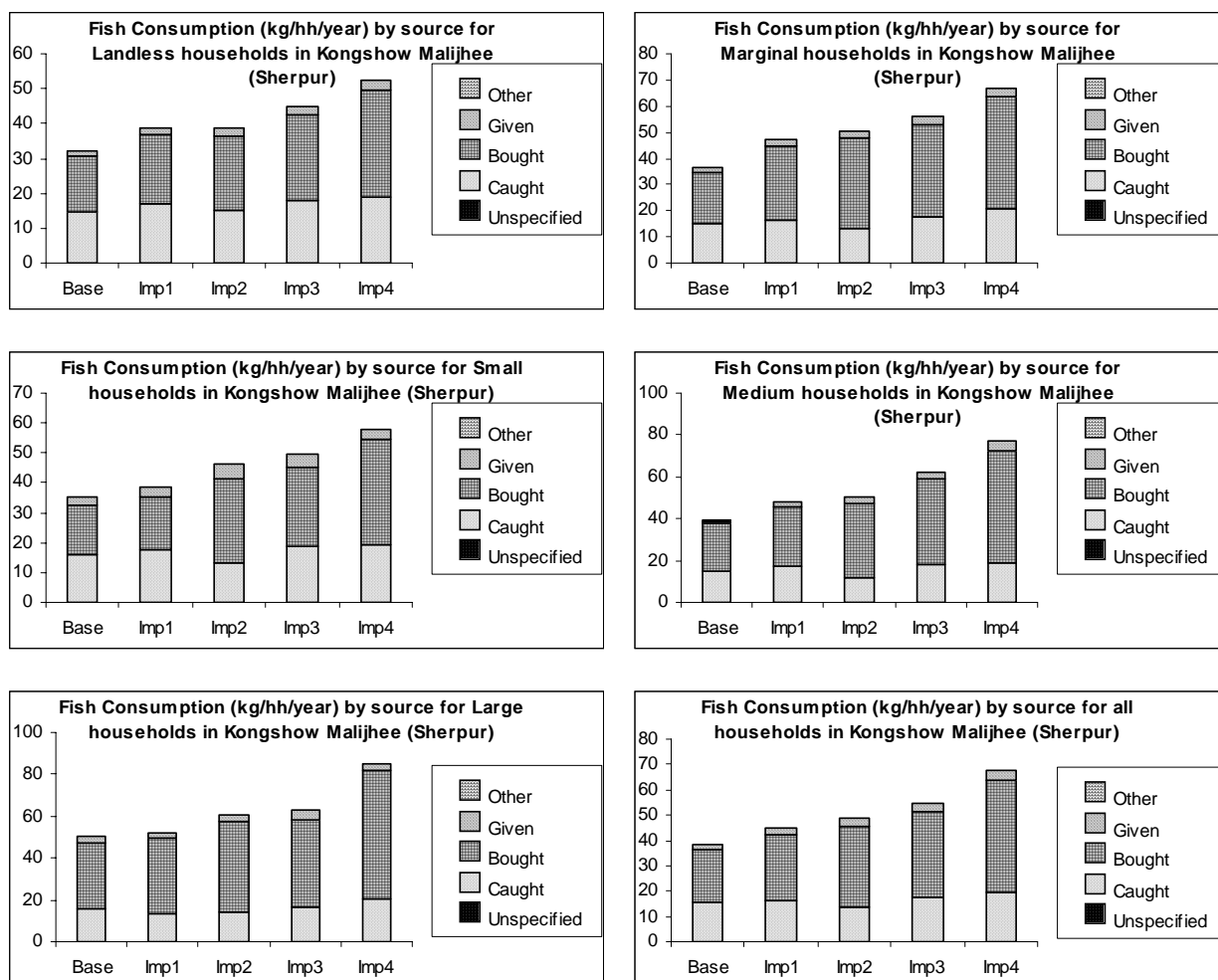
In Turag Bangshi although most landowners catch very little of the fish they consume, the trends in terms of sources of fish consumed are similar for all classes of household – even large farmers increased the amount they themselves catch, particularly in the years of highest fish production (Fig 4b). This presumably reflects the increased availability of fish in the floodplain lands that landowners cultivate and where they can fish when water levels recede at the end of the monsoon. The amounts of fish purchased have also increased substantially for all classes of household.

**Fig. 4b Sources of fish consumed by different classes of household in Turag-Bangshi**



In Kangsha-Malijee in the baseline year own catches of fish were relatively more important as a source of food for poorer households (landless, marginal and small farmers) than in the other sites (Fig. 4c). Although households on average caught more fish in later years, the increases in consumption are mainly derived from fish purchased in local markets. This suggests that subsistence fishing has changed little, but with increased total fish catches professional and part time fishers have more to sell and all categories of household have been able to buy this increased production.

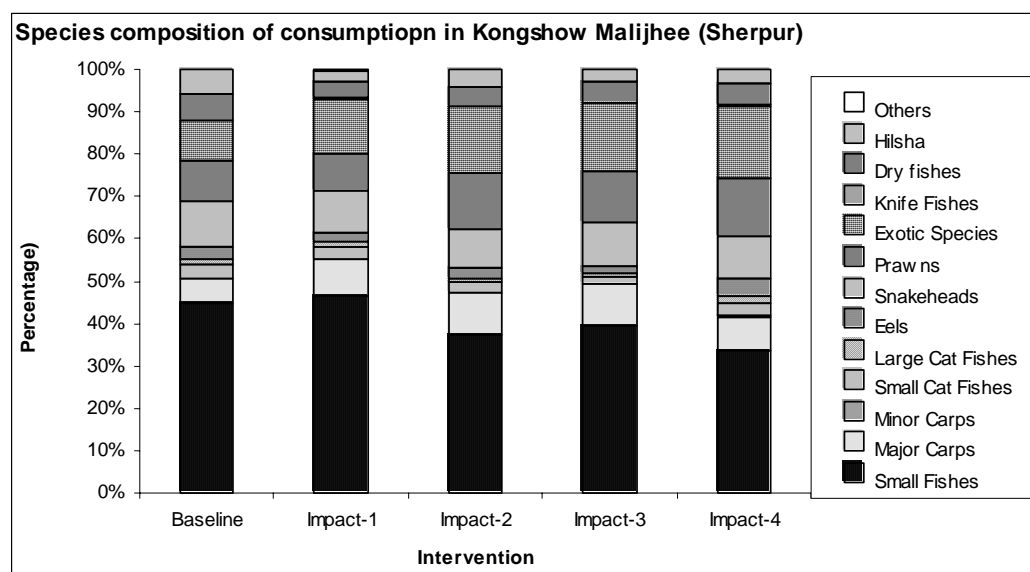
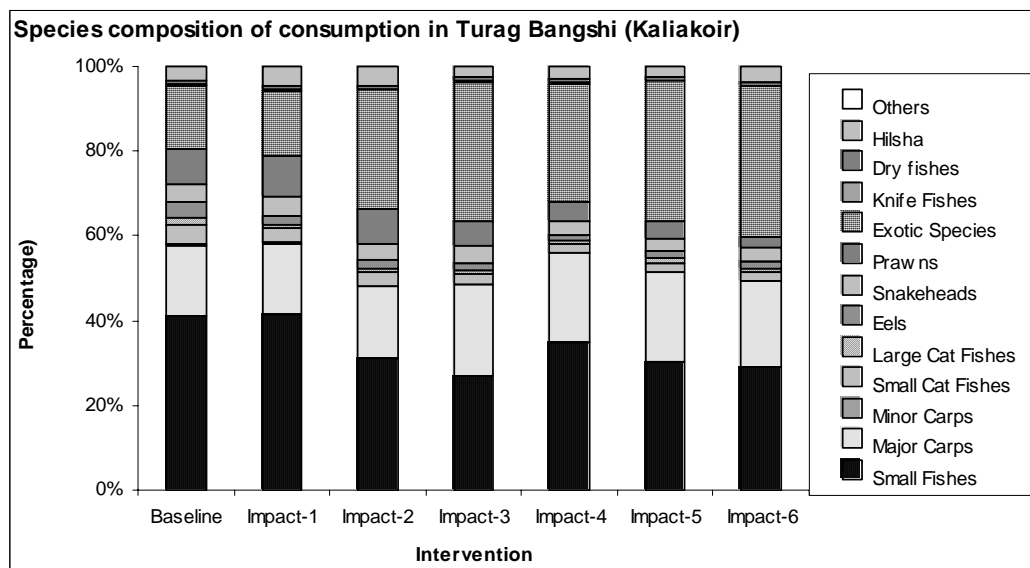
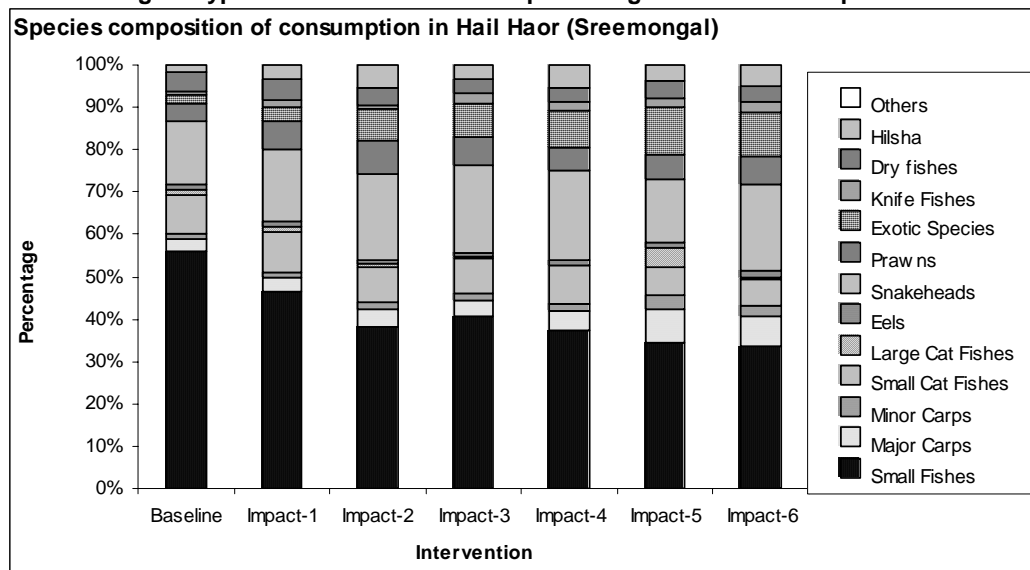
If the availability of fish in the wetlands has increased, and a majority of households are landless and marginal farmers, why has such a large part of their increased fish consumption been bought? One factor is increasing specialization which the training and credit provided through MACH has also contributed to – some households have dropped out of fishing, while others continue. But another factor is the relative prices of different types of fish and their availability.

**Fig. 4c Sources of fish consumed by different classes of household in Kangsha-Malijee**

### *Species composition of fish consumption*

A wide range of species were recorded in the household consumption monitoring, just as in the catch surveys. The tables of the top 20 species consumed confirm the overall importance of small native species such as puti and taki (note that in Table 2 “gura mach” are mixed small fishes, while gura icha are various small shrimps). However, some larger (and high value) beel resident carnivorous fishes such as snakeheads (shol) which have benefited from conservation and restoration measures have risen in the league table of species consumed in Hail Haor.

A second trend that is not project related is apparent. In Hail Haor some of the growth in fish consumed is for cultured exotic species notably Thai Pangas and Silver Carp, although exotic fish are still a small proportion of total fish consumed here, where there is a large supply of wild caught fish from the haor, exotic cultured species still rose from 2% to 11% of fish consumed, with the quantity increasing by 10 times over 6 years (Fig. 5).

**Fig. 5 Types of fish consumed as a percentage of total consumption**

This trend is more dramatic in Turag Bangshi. Despite the dramatic growth in fish catches in the floodplain there, fish consumption is now dominated by cultured species. For example, Thai Pangas was not in the top 20 most frequently eaten species of fish in the baseline year, but rose to be in the top three places in impact years 3-6 (2002-03 onwards). Exotics and major carp, almost all of which are cultured, contributed just over half of the fish consumed in that site by 2004-05. This growth in fish consumption from aquaculture sources is independent of MACH activities. While the growth in aquaculture is one factor behind this trend, another factor is the demand for larger and more highly prized native fishes, with ready access to Dhaka and high prices there for those native species it is likely that a good proportion of increased catches from the wetlands here are traded out of the locality.

**Table 2a Top 20 species in terms of frequency of consumption in Hail Haor (Sreemongal)**

Baseline	Impact 1	Impact 2	Impact 3	Impact 4	Impact 5	Impact 6
Dry fish	Dry fish	Dry fish	Dry fish	Dry fish	Dry fish	Dry fish
Jat Puti	Jat Puti	Taki	Taki	Taki	Jat Puti	Taki
Khalisha	Taki	Jat Puti	Jat Puti	Jat Puti	Taki	Jat Puti
Taki	Mola	Gura Echa	Gura Echa	Gura Echa	Gura Echa	Gura Echa
Koi	Gura Echa	Gura mach	Khalisha	Khalisha	Gura mach	Gura mach
Shing	Shing	Mola	Meni/Bheda	Meni/Bheda	Khalisha	Khalisha
Gura mach	Gura mach	Shing	Gura mach	Shing	Meni/Bheda	Meni/Bheda
Gura Echa	Khalisha	Meni/Bheda	Mola	Shol	Mola	Shol
Mola	Meni/Bheda	Khalisha	Shing	Gura mach	Shing	Shing
Meni/Bheda	Tengra	Shol	Shol	Koi	Shol	Mola
Chuna Khalisha	Shol	Hilsha	Koi	Hilsha	Tengra	Hilsha
Okol/Cheng	Hilsha	Tengra	Tengra	Mola	Goinna	Koi
Lal Khalisha	Koi	Chuna Khalisha	Foli	Foli	Koi	Tengra
Shol	Gol Chanda	Koi	Lal Khalisha	Tengra	Thengua Echa	Thengua Echa
Magur	Chuna Khalisha	Lal Khalisha	Hilsha	Chuna Khalisha	Mrigel	<b>Thai Pangas</b>
Tengra	Magur	Gol Chanda	Magur	Magur	Boal	Goinna
Kanchan Puti	Kaikla	<b>Thai Pangas</b>	Gol Chanda	Mrigel	Hilsha	Mrigel
Hilsha	Foli	Goinna	Goinna	<b>Silver Carp</b>	Rui	Foli
Gutum	Thengua Echa	Magur	Chuna Khalisha	Gol Chanda	Foli	<b>Silver Carp</b>
Rui	Goinna	Kaikla	<b>Thai Pangas</b>	Goinna	<b>Thai Pangas</b>	Rui

Exotic species in bold

**Table 2b Top 20 species in terms of frequency of consumption in Turag-Bangshi (Kaliakoir)**

Baseline	Impact 1	Impact 2	Impact 3	Impact 4	Impact 5	Impact 6
Gura mach	Jat Puti	Gura mach	Gura mach	Gura mach	Gura mach	<b>Thai Pangas</b>
Jat Puti	Gura mach	Gura Echa	<b>Thai Pangas</b>	Jat Puti	<b>Thai Pangas</b>	Gura mach
Gura Echa	Gura Echa	Jat Puti	Jat Puti	<b>Thai Pangas</b>	Jat Puti	Jat Puti
Rui	Rui	<b>Thai Pangas</b>	Rui	Rui	Rui	Rui
Tengra	Lamba Chanda	Rui	Gura Echa	Gura Echa	Gura Echa	<b>Silver Carp</b>
Taki	Taki	Taki	<b>Silver Carp</b>	Mrigel	Chapila	Gura Echa
Lamba Chanda	Chapila	<b>Silver Carp</b>	Mrigel	Chapila	<b>Silver Carp</b>	Mrigel
Boro Baim	Tengra	Dry fish	Taki	Dry fish	Dry fish	Chapila
Chapila	Mrigel	Hilsha	Dry fish	<b>Silver Carp</b>	Mrigel	Taki
<b>Thai Sharputi</b>	Dry fish	Mrigel	<b>Thai Sharputi</b>	Taki	<b>Comon Carp</b>	Dry fish
Dry fish	Hilsha	Tengra	Chapila	Hilsha	<b>Thai Sharputi</b>	Hilsha
Mrigel	Boro Baim	<b>Thai Sharputi</b>	Tengra	<b>Thai Sharputi</b>	Taki	<b>Comon Carp</b>
<b>Silver Carp</b>	<b>Silver Carp</b>	Chapila	<b>Comon Carp</b>	<b>Comon Carp</b>	Catla	Catla
<b>Comon Carp</b>	<b>Thai Pangas</b>	<b>Comon Carp</b>	Hilsha	Tengra	Tengra	<b>Thai Sharputi</b>
Bele	<b>Comon Carp</b>	Lamba Chanda	<b>Tilapia</b>	Catla	Hilsha	Tengra
Hilsha	<b>Thai Sharputi</b>	Boro Baim	Boro Baim	Boro Baim	Boro Baim	<b>Bighead Carp</b>
Shing	Mola	Catla	Lamba Chanda	<b>Tilapia</b>	<b>Tilapia</b>	Boro Baim
Mola	Bele	Bele	Catla	Lamba Chanda	Lamba Chanda	<b>Tilapia</b>
Catla	Catla	<b>Tilapia</b>	Guchi Baim	Shol	Guchi Baim	Guchi Baim
Air	Shing	Guchi Baim	Shol	Guchi Baim	<b>Bighead Carp</b>	Shar Puti

Exotic species in bold

**Table 2c Top 20 species in terms of frequency of consumption in Kangsha-Malijee (Sherpur)**

Baseline	Impact 1	Impact 2	Impact 3	Impact 4
Dry fish	Dry fish	Dry fish	Dry fish	Dry fish
Gura mach	Jat Puti	Gura mach	Gura mach	Jat Puti
Jat Puti	Gura mach	Gura Echa	Gura Echa	Gura Echa
Taki	Taki	Jat Puti	Jat Puti	Taki
Gura Echa	Gura Echa	Taki	Taki	<b>Silver Carp</b>
Hilsha	<b>Silver Carp</b>	<b>Silver Carp</b>	<b>Silver Carp</b>	Tengra
<b>Silver Carp</b>	Hilsha	Mrigel	Mrigel	Mrigel
Tara Baim	Mrigel	Hilsha	Hilsha	Tara Baim
Tengra	Tengra	Tengra	<b>Thai Sarputi</b>	Bele
Mrigel	<b>Common Carp</b>	<b>Common Carp</b>	Tengra	Gura mach
Rui	Gutum	Dankina	<b>Common Carp</b>	Dankina
Gutum	Dankina	Gutum	Dankina	Hilsha
Dankina	Rui	Koi	Tara Baim	Guchi Baim
Koi	Tara Baim	Rui	Bele	Gol Chanda
<b>Thai Pangas</b>	Chuna Khalisha	Chuna Khalisha	Gutum	Ranga Chanda
Chuna Khalisha	Shar Puti	Tara Baim	Rui	Gutum
Bele	<b>Thai Sarputi</b>	<b>Thai Sarputi</b>	Ranga Chanda	Mola
<b>Thai Sarputi</b>	Koi	Boro Baim	Koi	<b>Thai Sarputi</b>
Gol Chanda	Gol Chanda	Khalisha	<b>Thai Pangas</b>	<b>Common Carp</b>
<b>Common Carp</b>	Boro Baim	Catla	Catla	Meni/Bheda

*Exotic species in bold*

There is no clear trend in changing composition of fish consumed in Kangsha-Malijee – already some cultured exotic species were in the diet in the baseline year, and have retained their position. The increases in production are mostly small species and as the area is relatively remote it would appear that growth in consumption has been even, with little change in the proportions of species and types of fish consumed.

### *Use of other aquatic resources*

Although fish are the single most important aquatic resource exploited from the wetlands in these three sites, a range of other resources are also used. Therefore the household monitoring program included recording involvement in and use of a wide range of other aquatic resources –plants and animals.

Around two-thirds of households living around Hail Haor collect non-fish aquatic resources of at least one type each year (Table 3). The main resources used are plants – grasses and straw for fodder and Dhol kolmi (*Ipomea*) which has various local names and is used as fuel; while around 14% of households collect snails for poultry and fish feed, and several plant species for human consumption. Households on average (across all monitored households) spend 30 or more days a year collecting non-fish aquatic resources from the haor. Here poorer and better off households appear to be just as much involved. There is no clear trend in use, indicating that in general there have been no changes in either access to these resources or their productivity.

In the Turag Bangshi site about 80% of households have collected some non-fish aquatic resources in each year after the baseline (there the baseline year data may not have been representative of use of some species since it is unlikely that some of the plants suddenly became much more abundant in 2000-2001 (impact year 1). This greater involvement in using aquatic resources may reflect households living closer to parts of the wetland, and it is also associated with a wider range of resources being commonly used: over a quarter of all households collect grass, frogs (as fishing bait), shaluk and fokol (edible water plants). Moreover poorer households tend to spend more days per year collecting these resources, indicating that they are relatively more important for their livelihoods. However, the growing incidence of bird hunting there, involving up to a quarter of all households, is a



concern as the project has been advocating a complete end to hunting birds, with some success in Hail Haor, but apparently the reverse trend is occurring in Turag-Bangshi.

**Table 3 Percentage of households involved in collection of natural resources from the project wetlands**

Natural resource	Baseline	Impact-1	Impact-2	Impact-3	Impact-4	Impact-5	Impact-6	Average
<b>Hail Haor (Sreemongal)</b>								
Any item	66.1	76.2	62.4	65.7	60.9	71.0	69.7	67.4
Grass	41.8	40.7	26.7	28.1	21.3	29.7	28.4	31.0
Straw	0	29.3	29.2	36.0	29.9	35.4	33.8	27.7
Dholkolum/Daokolum	19.8	32.0	24.1	29.0	31.0	24.2	24.0	26.3
Snail/Oyster	14.7	20.2	13.1	18.5	10.3	12.5	8.4	13.9
Kolmi/Barisa Leaf	6.3	12.4	10.6	11.9	9.0	9.5	12.5	10.3
Earthworm	3.5	15.1	11.8	9.7	9.2	6.6	8.4	9.2
Fokol	1.4	6.3	10.2	12.3	11.0	9.5	8.4	8.4
Aram Tubercle	0.8	11.4	6.7	7.0	6.6	7.5	4.8	6.4
Shaluk	2.2	8.1	8.8	9.5	6.2	2.0	7.3	6.3
Bird	3.3	7.5	4.5	5.9	4.4	2.9	2.0	4.4
Frog	2.0	3.9	2.9	2.0	1.5	3.5	2.9	2.7
Hyacinth	0	6.1	1.0	3.1	1.1	3.3	0.2	2.1
Turtle	4.3	3.7	1.2	2.2	0.9	1.5	0.9	2.1
<b>Turag Bangshi (Kaliakoir)</b>								
Any item	58.9	85.7	87.5	86.8	89.3	81.4	78.6	81.2
Grass	40.0	47.9	50.7	53.2	55.7	53.9	43.6	49.3
Shaluk	1.1	52.5	55.4	63.6	52.5	50.7	45.4	45.9
Frog	17.9	39.6	42.5	33.6	49.3	17.1	27.1	32.4
Fokol	0.4	21.4	32.9	37.9	35.0	26.1	28.9	26.1
Snail/Oyster	15.4	13.6	17.1	20.4	25.7	20.0	17.1	18.5
Bird	1.4	9.6	12.1	21.8	31.8	21.8	11.1	15.7
Panikola	0	16.4	18.9	26.8	22.5	10.4	7.1	14.6
Wild animal	0	5.7	6.1	10.7	10.7	2.1	1.4	5.3
Dholkolum/Daokolum	2.1	5.7	8.2	2.5	10.4	2.1	0.0	4.4
<b>Kangsha-Malijhee (Sherpur)</b>								
Any item	35.4	11.1	11.8	29.6	36.9			24.9
Grass	24.3	7.9	10.0	24.3	30.6			19.4
Snail/Oyster	16.8	1.1	5.0	8.6	9			8.0
Bird	2.5	2.9	0.4	1.1	3.1			2.0

Only resource types collected by 2% or more of households are included in the table

Surprisingly, since on average household incomes are lower there, the incidence of collecting non-fish aquatic resources is was reported to be much lower involving only a quarter of households in Kongsha-Malijhee site, and better off households are more involved. Also very few types of aquatic resources were reported to be used there. These unexpected patterns deserve further investigation at this site.

Lastly for Hail Haor the use of non-fish aquatic resources was monitored and analyzed in more detail for the baseline year and impact years 1-3, this reveals very major levels of exploitation. For example, each monitored household on average collected about 20 kg of snails and 70 bundles of grass in a year (Table 4). With perhaps 30,000 households in total using the haor this would imply 600 t of snails and 2.1 million bundles of grass collected each year. Most of the non-fish natural resources were used for family maintenance and consumption, but some were sold notably some aquatic fruits – fokol and shingra – and turtles. Although very few turtles were reported caught the ready market for these is a concern as most of the species recorded in Hail Haor are nationally threatened and have suffered a serious population decline. Demand for some of these resources appears to be high – the prices of several products that are regularly sold in local markets have either remained the same or increased during the project period (Table 5).

**Table 4 Effort (days/household/year) and amount collected (unit/household/year) by use of natural resources in Hail Haor.**

Resource	Baseline		Impact-1		Impact-2		Impact-3	
	Effort (d/hh/y)	Amount (/hh/y)	Effort (d/hh/y)	Amount (/hh/y)	Effort (d/hh/y)	Amount (/hh/y)	Effort (d/hh/y)	Amount (/hh/y)
<b>Grass (bundle)</b>	<b>23.9</b>	<b>154.3</b>	<b>14.0</b>	<b>73.8</b>	<b>17.2</b>	<b>70.1</b>	<b>11.8</b>	<b>40.8</b>
To Sell		13		10		7		4
Fodder		87		90		93		96
<b>Snail/Oyster (kg)</b>	<b>5.4</b>	<b>23.3</b>	<b>5.1</b>	<b>20.7</b>	<b>5.7</b>	<b>15.0</b>	<b>7.3</b>	<b>23.8</b>
To Sell		3		1		0		0
Poultry feed		23		14		16		7
For Fishing		74		85		84		89
Fish feed		0		0		0		4
<b>Earthworm (Nos.)</b>	<b>2.2</b>	<b>1033.4</b>	<b>3.3</b>	<b>1783.5</b>	<b>4.4</b>	<b>1818.4</b>	<b>2.8</b>	<b>1572.4</b>
To Sell		7		13		1		0
For Fishing		93		87		99		98
Fish feed		0		0		0		2
<b>Dhol kolum/Kolum (bundle)</b>	<b>4.9</b>	<b>38.9</b>	<b>8.7</b>	<b>30.3</b>	<b>9.4</b>	<b>25.5</b>	<b>7.7</b>	<b>19.7</b>
To Sell		13		7		3		4
Use for Roof/Fence		0		0		0		0
Use as Fuel		87		93		97		96
<b>Frog (Nos.)</b>	<b>0.7</b>	<b>102.1</b>	<b>0.4</b>	<b>43.3</b>	<b>0.4</b>	<b>48.9</b>	<b>0.2</b>	<b>39.8</b>
To Sell		0		2		0		0
For Fishing		100		98		100		100
<b>Turtle (g)</b>	<b>0.4</b>	<b>706.4</b>	<b>0.3</b>	<b>621.4</b>	<b>0.3</b>	<b>460.4</b>	<b>0.7</b>	<b>1744.9</b>
To Eat		29		8		0		0
To Sell		71		92		100		100
<b>Bird (Nos.)</b>	<b>0.6</b>	<b>1.1</b>	<b>1.2</b>	<b>5.5</b>	<b>0.6</b>	<b>2.0</b>	<b>0.8</b>	<b>3.0</b>
To Eat		53		100		100		100
To Sell		2		0		0		0
To Rear		45		0		0		0
<b>Shaluk (bundle)</b>	<b>0.4</b>	<b>1031.9</b>	<b>0.6</b>	<b>2183.5</b>	<b>0.6</b>	<b>1289.8</b>	<b>0.7</b>	<b>2111.7</b>
To Eat		24		59		100		96
To Sell		77		41		0		4
<b>Kolmi/Barisa Leaf (bundle)</b>	<b>0.9</b>	<b>5.5</b>	<b>0.7</b>	<b>1.8</b>	<b>1.2</b>	<b>2.7</b>	<b>0.6</b>	<b>1.7</b>
To Eat		37		77		78		87
To Sell		62		11		22		13
Fodder		2		13		0		0
<b>Fokol (g)</b>	<b>0.2</b>	<b>2.6</b>	<b>0.7</b>	<b>23.3</b>	<b>1.9</b>	<b>75.5</b>	<b>3.2</b>	<b>170.3</b>
To Eat		7		1		0		0
To Sell		93		99		100		100
<b>Panikola (g)</b>	<b>0.1</b>	<b>137.6</b>	<b>0.1</b>	<b>63.7</b>	<b>0.1</b>	<b>107.2</b>	<b>0.0</b>	<b>57.2</b>
To Eat		100		100		100		100
<b>Aram Tubercle (Nos.)</b>	<b>0.7</b>	<b>1.8</b>	<b>0.8</b>	<b>2.0</b>	<b>1.1</b>	<b>4.4</b>	<b>1.4</b>	<b>1.9</b>
To Eat		64		54		24		75
To Sell		36		46		76		25
<b>Shingrai (kg)</b>	<b>0.1</b>	<b>0.2</b>	<b>0.9</b>	<b>2.0</b>	<b>0.7</b>	<b>1.5</b>	<b>0.7</b>	<b>1.4</b>
To Eat		15		2		1		3
To Sell		85		98		99		97
<b>Straw (bundle)</b>	<b>0.1</b>	<b>0.3</b>	<b>8.4</b>	<b>27.4</b>	<b>7.6</b>	<b>21.7</b>	<b>6.6</b>	<b>15.3</b>
To Sell		0		1		0		0
Fodder		81		29		27		37
Roof/Fence		0		1		5		0
Fuel		19		69		68		62

Figures are averaged across all households covered by regular monitoring for fish consumption

**Table 5 Prices of non-fish aquatic resources reported by households collecting and selling them in Hail Haor**

Price (Tk/unit)	Baseline	Impact-1	Impact-2	Impact-3
<b>Grass (bundle)</b>	<b>5.87</b>	<b>5.67</b>	<b>5.37</b>	<b>12.81</b>
Snail/Oyster (kg)	13.87	18.06		
Earthworm (per hundred)	1.00	2.00	1.00	
<b>Dhol kolmi (bundle)</b>	<b>3.51</b>	<b>6.45</b>	<b>11.16</b>	<b>10.87</b>
Frog (Nos.)		0.30		
<b>Turtle (kg)</b>	<b>90.49</b>	<b>78.15</b>	<b>77.57</b>	<b>90.79</b>
Bird (Nos.)	83.33			
Shaluk (bundle)	0.03	0.02		0.01
<b>Kolmi/Barisa Leaf (bundle)</b>	<b>4.61</b>	<b>2.91</b>	<b>3.96</b>	<b>2.54</b>
Shapla (bundle)	5.00			
<b>Fokol (kg)</b>	<b>4.95</b>	<b>4.80</b>	<b>5.77</b>	<b>5.30</b>
<b>Aram Tubercle (Nos.)</b>	<b>2.89</b>	<b>2.50</b>	<b>5.08</b>	<b>3.60</b>
<b>Shingrai (kg)</b>	<b>36.29</b>	<b>32.34</b>	<b>32.75</b>	<b>39.14</b>
Straw (bundle)		5.00	20.00	

Bold = resources that were sold by at least some households in each year

## **Annex 5: Project Maps**



**A project of the Government of Bangladesh**

**Supported by USAID**

**Project Partners:**

**Winrock International  
Bangladesh Centre for Advanced Studies (BCAS)  
Center for Natural Resource Studies (CNRS)  
CARITAS Bangladesh**



**WINROCK**  
INTERNATIONAL



**WEB: [www.machban.org](http://www.machban.org)**

**MACH Headquarters:  
House No: 2, Road 23A  
Gulshan 1, Dhaka 1212  
Bangladesh**